

COMPENDIUM



80 IP - Driven Solutions Addressing SDG Needs



Intellectual Property Office, India



Intellectual
Property
Office, India

COMPENDIUM



80 IP - Driven Solutions Addressing
SDG Needs



**INTELLECTUAL
PROPERTY INDIA**
PATENTS | DESIGNS | TRADE MARKS
GEOGRAPHICAL INDICATIONS

FOREWORD



“The balance between Intellectual Property and knowledge economy is not just about legal frameworks, but nurturing creativity and innovation that serves society for ensuring a sustainable future built on shared knowledge.”

Sustainable Development Goals (SDGs) are a set of 17 global objectives framed by the United Nations to tackle some of the world’s most pressing challenges. In 2015, 195 nations agreed at the UN that they can change the world for the better. This will be accomplished by bringing together their respective governments, businesses, media, institutions of higher education, and local NGOs to improve quality of life for the people and the planet by the year 2030. These goals represent a shared vision for a better world and act as a comprehensive roadmap for ensuring a better and more sustainable future for everyone. Intellectual Property Rights play a crucial role in supporting and accelerating progress towards these goals by incentivizing innovation, protecting knowledge, and encouraging technology transfer. Within these pages, you'll discover a collection of 80 exemplary IP-driven solutions, curated to address the pressing challenges outlined by the United Nations in their SDGs framework.

The O/o CGPDTM launched this project as a testament to the remarkable intersection of Intellectual Property (IP) and Sustainable Development Goals (SDGs). In pursuit of this endeavour, a public notice was issued, inviting submissions for consideration into the compendium from patent holders. The submissions received were reviewed by an expert committee to find the top 80 inventions addressing the SDG goals. Among these, 10 standout inventions shall feature in the official BRICS compendium, underscoring India’s exemplary contribution in achievement of SDG through IP.

This compendium is prepared on the basis of information provided by the participants. The Patent office has not independently verified the claims made by the participants in their submissions.

As you peruse these pages, I invite you to be inspired by the remarkable ingenuity on display and to consider the profound implications of Intellectual Property in shaping a more equitable, sustainable world. I extend my heartfelt gratitude to the experts whose diligence and expertise contributed to the selection process, as well as to the visionary individuals and organizations whose pioneering efforts are driving us toward a brighter tomorrow.

May this compendium serve as a beacon of hope and a call to action for all stakeholders in the realm of IP, urging us to unite in our pursuit of sustainable development and embrace the transformative power of innovation in ushering a new world characterized by peace and prosperity, for both the people and the planet we inhabit.



Prof. (Dr.) Unnat P. Pandit
CGPDTM and RoC & GI

Disclaimer

The information contained in this compendium is intended for general informational purposes only and is based on submissions from patentees. The inclusion of any intellectual property (IP) asset or invention does not constitute endorsement or validation by the Office of the Controller General of Patents, Designs, and Trademarks. The office has not independently verified the accuracy of the content provided by the patentees. This compendium aims to highlight the interplay between IP rights and Sustainable Development Goals (SDGs), with the objective of inspiring stakeholders to promote sustainable development efforts.

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Intellectual Property of India

ABOUT

the Office of Controller General of Patents, Designs and Trademarks (O/o CGDPTM)

The Office of the Controller General of Patents, Designs & Trade Marks (CGPDTM) works under the Department for Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce and Industry. Its primary responsibility is the granting of Patents, registration of Designs, Trade Marks, Copyright, and Geographical Indications (GIs) and SICLD in India. These functions are executed in accordance with the respective Acts and Rules governing each aspect of Intellectual Property (IP).

CGPDTM administers several key statutes, including the Patents Act, 1970; the Trade Marks Act, 1999; the Designs Act, 2000; the Copyright Act, 1957; the SICLD Act, 2000 and the Geographical Indications of Goods Registration and Protection Act, 1999. While the headquarters of CGPDTM is located in Mumbai, it operates branch offices in Kolkata, Delhi, Ahmedabad and Chennai. The Patent Office, serves as an International Searching Authority (ISA) under the Patent Cooperation Treaty (PCT).

Recent amendments, such as the Patents (Amendment) Rules, 2024, aim to streamline prosecution procedures, boost patent filings, and improve the efficiency of IP services. The journey of India, the 5th largest economy has been remarkable in this context. India is now the 6th largest in terms of number of patents filed, and 3rd largest in terms of number of Trade Marks filed (World Intellectual Property Indicators 2023).

The office has successfully undergone a modernization initiative, encompassing both infrastructure upgrades and enhancements in human resources, aligning with international standards and evolving requirements within the IP domain. The evolution of India's IP system over the past two decades has involved significant legislative amendments to align with global standards while prioritizing socio-economic objectives and public health interests.

**IP-Driven
Innovations
for
Addressing
SDG Needs**

1. An Ultra Light Weight Nanofiber Polymer Carrier

Summary:

The product, Fertilizer carrying membrane (FCM), is a nanofiber-based material and is the first of its kind carrier to host agriculturally important microbes. The very high surface area of nanofibers accounts for a high payload of cells of about 10^{12} cfu/mg, which is 10^7 times higher than the conventional solid biofertilizers (10^8 cfu/g). This, in turn, could reduce the bulkiness of fertilizer application, and a small roll of the FCMs (5 g) could cater to an acre of land and improve logistics to a great extent. FCM's would

behave like a lyophilized culture with no contamination, but the cost of production would be much cheaper. The other novelty of the product is that it can be solubilized in water and applied to the fields/crops through normal application procedures and demands no sophisticated method of application. Unlike other biofertilizers, the present product does not leave any residue in the soil and can be degraded by normal soil flora, thus making it eco-friendly.

Salient Features:

The invention is a nanofiber membrane hosting around 10^{12} cfu/mg of agriculturally important microbes such as Nitrogen fixers. The load is very high compared to conventional bacterial carriers. The stability of the bacteria in these membranes is 2-fold (24 months) compared to conventional carriers such as lignite, peat, and talc. The product is lightweight and is 1000 times less bulky. 5 grams is needed for an acre. The product is soluble in water and can be applied easily through any irrigation portal available at the farmer's field. The product can thus reduce the use of chemical fertilizers and improve crop yield and soil quality.

Problems Addressed:

The invention addresses the problem of indiscriminate use of chemical fertilizers and is an alternative to bulkier biofertilizers available. The biofertilizers available are either solid or liquid formulations. Due to the inefficient carrier material, the microbes in these formulations tend to lose their viability and their efficiency. Large amounts of solid biofertilizers need to be applied to observe beneficial effects. Therefore, the transition from inorganic to organic farming is limited by the low efficiency of carrier material. Trained personnel are required to produce and pack the soil inoculants in sterile conditions, failing which the formulations may be overgrown with contaminants. Considering the climatic conditions and the inappropriate storage, further loss of activity is expected. The invention thus aims to offer a solution by harboring soil inoculants in electrospun nanofibers.

Impact of the Invention:

- Societal: As lightweight products, they are very easy to transport. The product for an acre can be carried by the farmer in his shirt pocket instead of big bags. Fertilizers of such low volume will definitely bring a social revolution in the way Agri inputs are showcased and marketed.

Patent No: 428596

Date of Grant: 10/04/2023

Applicant: IIT Madras, DBT

Inventor(s): T.S.Chandra,
Kavitha Sairam, T.S.

Natarajan, Anant Raheja,
Arvind Karunakaran



Photographs:

- **Economic:** logistics account for 30% of expenses in the fertilizer industry, which in turn burdens the farmer and the nation. The technology reduces the bulkiness of the carriers used, and hence, only 10 to 15 grams is needed for an acre, which means the cost of logistics can be brought down by 1000 times. The technology also reduces the use of chemical fertilizers, and hence, the farmer can save 20% on the input cost. With an increase in the yield by 20%-30%, the farmer achieves an output benefit as well. Hence, the farmer can obtain a cost-benefit of 30%-50% by using the present invention
- **Environmental:** The manufacturing of 1 ton of chemical fertilizers releases 1.5 tons of CO₂. Since the present invention reduces chemical fertilizer usage, it will reduce CO₂ emissions. A single truck can carry fertilizers for thousands of hectares of land, which again helps reduce fuel usage and greenhouse gas emissions. The microbes used improve the soil quality by improving the water retention capacity and retaining the soil structure, thereby rejuvenating the soil.



Commercialization Details:

The invention is licensed to FIB-SOL Life Technologies. FIB-SOL is innovating and commercializing technologies in the agri input space. FIB-SOL currently holds the largest manufacturing capacity for water-soluble nanofibers (60 kg/annum).

2. A Process for Synthesis of Ferric Derisomaltose Complex

Summary:

The present invention provides a simple, solvent-free, and economical process for the synthesis of ferric isomaltose complex with high iron content, good stability, and reduced toxicity. In an aspect, the present invention provides a solvent-free process for the synthesis of ferric derisomaltose complex comprising the steps:

- preparation of modified dextran comprising in-situ reduction of dextran ;
- oxidizing electrolytic iron with 10.0% hydrogen peroxide to make nascent ferric iron, which is

highly feasible for coupling with reduced dextran of step (i) to obtain a ferric iron-dextran;

- heating the nascent ferric iron of step (ii) with reduced dextran of step (i) in the presence of an alkali, followed by cooling;
- Adjust the pH in the range of 5.50-6.50 using mineral acid and
- filtering, and drying the filtrate in a spray dryer to obtain the product.

In a second aspect, the present invention provides a ferric derisomaltose complex that is so obtainable that it has improved stability, yield, and reduced toxicity.

Salient Features:

Ferric Derisomaltose is one of the latest injectable irons accepted worldwide due to its much lesser hypersensitivity reactions and anaphylactic shock.

Application of Ferric Derisomaltose

- Iron deficiency anemia in adults with Inflammatory Bowel Disease (IBD)
- Heart Failure Patients
- Dialysis Patients

The present invention relates to a process for synthesizing stable, reduced-toxicity water-soluble Ferric Derisomaltose, which is useful in the treatment of iron deficiency anemia. In particular, the present invention relates to a solvent-free and eco-friendly improved process for the synthesis of water-soluble Ferric Derisomaltose.

Ferric Derisomaltose is an iron replacement product for intravenous infusion. Ferric isomaltose is an iron carbohydrate complex with a matrix structure composed of interchanging ferric hydroxide and carbohydrate isomaltose layers. Derisomaltose consists of linear, 30 hydrogenated isomaltooligosaccharides with an average molecular weight of 1000 Da and a narrow molecular weight distribution almost devoid of mono- and disaccharides. Ferric der isomaltose has an average molecular weight of 155,000 Da and has the following empirical formula: $\{FeO(1-3X)(OH)(1+3X)(C_6H_5O_7^{3-})_X\}$, $(H_2O)_T$, $(C_6H_{10}O_6)_R(-C_6H_{10}O_5-)Z(C_6H_{13}O_5)_R$, $(NaCl)_Y$ $X = 0.0311$; $T = 0.25$; $R = 0.14$; $Z = 0.49$; $Y = 0.14$.

Patent No: 388898

Date of Grant: 10/02/2022

Applicant: West Bengal
Chemical Industries

Inventor(s): Sunil Kumar
Agarwal, Sujit Das Adhikari, S.
Prabhu, Avijit Sehanobish,
Saunak Sarbajna



Problems Addressed:

Our Patent 388898 is targeting Goal 3 of Sustainable Development Goals 2030.

GOAL 3: GOOD HEALTH AND WELL-BEING

Ensure healthy lives and promote well-being for all at all ages

- For Target 3.1 (By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births)

Our Invention targets iron deficiency in the human body, especially in women. Iron is one of the essential elements for women during pregnancy after childbirth.

- For Target 3.2, (By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births)

Our invention is helping to reduce the mortality of children below 5 years and neonatal through iron sufficiency in the mother's body and baby's body.

- For Target 3.4 (By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being)

Our invention cures Anemia, a noncommunicable disease. We have a reputation in the market, and patients believe in our product.

- For Target 3.8 (Achieve universal health coverage, including financial risk protection, access to quality essential health-care services, and access to safe, effective, quality, and affordable essential medicines and vaccines for all)

Our product is cost-efficient and accessible to needed manufacturers who sell medicine to patients at affordable prices.

- For Target 3.b (Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all)

Our R&D teams work tirelessly to improve existing products, discover new analytical parameters, and develop the latest products, such as bioactive vitamins, liposomal minerals, injectable iron, and so on. This involves extensive testing, analysis, and the development of processes that consistently produce safe and reliable chemical products.

We have a proper research and development team and an Intellectual property law team. We are continuously focusing on research and development, our patent 388898, which has been granted by the Indian Patent Office, and our organization's continuous work for reputation and customers after following all compliances.

Impact of the Invention:

Our Patent is essential to good health and well-being, which fulfills the goal of sustainable development and achieves its target through continuous research and development, and commercialization.

West Bengal Chemical Industries Limited (WBCIL) has become one of the trusted API pharma companies in India through our quality products of APIs (Active Pharmaceutical Ingredients) and numerous fine chemicals that are used in the formulation of medical drugs.

Commercialization Details:

We are reaching our customers by selling our Active pharmaceutical ingredients to needed manufacturer

Photographs:

API & Fine Pharmaceutical Manufacture in India

WEST BENGAL CHEMICAL INDUSTRIES LIMITED

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FERRIC DERISOMALTOSE

WBCE - API / FINE CHEMICALS / NUTRACEUTICAL - IRON - FERRIC DERISOMALTOSE

$C_{14}H_{14}FeO_{28}^{-1}$

Product name	FERRIC DERISOMALTOSE
Molecular Formula	C ₁₄ H ₁₄ FeO ₂₈ ·3
Molecular Weight	562.3 g/mol
CAS No.	134550-43-1
HSN Code	282300
ICD Code	90278348
Shelf Life	3 years - 20°C powder
DTP of Products	<ul style="list-style-type: none">Ferric Derisomaltose is often administered as a single - dose infusion, which can simplify treatment regimens for patients.Ferric Derisomaltose can be given in higher doses since it is devoid of potent hypersensitivity reactions.

3. Improved and Cost Effective Process for Preparing Iron-Isomaltoside

Summary:

The present invention provides a simple and cost-effective process for the preparation of an iron-isomaltose complex with high iron content, good stability, and reduced toxicity. In an aspect, the process for the synthesis of the iron-isomaltose complex comprises; i. adding portion-wise sodium

borohydride to dextran 5 solution in a ventilated reactor, maintaining the temperature below 5°C to obtain reduced dextran, wherein the concentration of unreduced dextran in the solution is between 0.05 to 0.1%; ii. Add reduced dextran to the precipitated aqueous ferric hydroxide, followed by the addition of citric acid to form the citrate iron-isomaltose complex; iii. heating the complex, cooling and adjusting the pH in the range of 7.0-8.0 using ammonia; and iv. Filter and dry the filtrate in a spray dryer to obtain the product. The dextran is selected for molecular weight in the range of 300kda to 500kda, preferably for a molecular weight of 500kda (dextran-5). The sodium borohydride to dextran-5 ratio is maintained in the range of 0.010 to 0.25: 1, preferably at 0.019:1.

The reduction process is performed at a controlled condition of a residual reducing agent such as sodium borohydride in the reacting solution and at low temperature, i.e., below 5°C. The 'in-situ' controlled reduction of dextran avoids the need for costly purification steps to obtain reduced/hydrogenated dextran of molecular weight in the range of 900 to 1200 Da. Further, the low concentration of unreduced dextran in the solution during the reduction process diminishes the chances of reduction of ferric ions to undesired ferrous ions, thereby reducing impurity formation. In another aspect, the Ferric hydroxide obtained by alkaline hydrolysis of ferric chloride is made substantially free of chloride impurities before reacting with reduced dextran. Thus, the process of the present invention reduces the steps of further purification, which decreases the cost of manufacturing the iron-isomaltose of good quality.

Patent No: 381772

Date of Grant: 12/11/2021

**Applicant: West Bengal
Chemical Industries**

Inventor(s): Samanta Niladri



Salient Features:

Iron Isomaltoside is one of the latest injectable irons accepted worldwide due to its much lesser hypersensitivity reactions & anaphylactic shock.

Application of Iron Isomaltoside

- Iron deficiency anemia in adults with inflammatory bowel disease (IBD)
- Gynecological Disorders like menorrhagia or uterine fibroids.
- Post-Surgery Recovery
- Chronic Kidney Disease
- Hemodialysis Patients

The present invention relates to an improved and cost-effective process for preparing water-soluble Iron isomaltoside, which is stable, has reduced toxicity, and is useful in the treatment of iron deficiency anemia.

Patients with iron deficiency are given iron supplementation to correct anemia and replenish body stores. Supplementing iron intravenously (IV) benefits significant proportions of patients.

Problems Addressed:

Our Patent 381772 is targeting goal 3 of Sustainable Development Goals 2030.

GOAL 3: GOOD HEALTH AND WELL-BEING

Ensure healthy lives and promote well-being for all at all ages

- For Target 3.1 (By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births)

Our Invention targets iron deficiency in the human body, especially in women. Iron is one of the essential elements for women during pregnancy after childbirth.

- For Target 3.2, (By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births)

Our invention is helping to reduce the mortality of children below 5 years and neonatal through iron sufficiency in the mother's body and baby's body.

- For Target 3.4 (By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being)

Our invention cures anemia, a non-communicable disease. We have a reputation in the market, and patients believe in our product.

- For Target 3.8 (Achieve universal health coverage, including financial risk protection, access to quality essential health-care services, and access to safe, effective, quality, and affordable essential medicines and vaccines for all)

Our product is cost-efficient and accessible to needed manufacturers who sell medicine to patients at affordable prices.

- For Target 3.b (Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all)

Our R&D teams work tirelessly to improve existing products, discover new analytical parameters, and develop the latest products, such as bioactive vitamins, liposomal minerals, injectable iron, and so on.

This involves extensive testing, analysis, and the development of processes that consistently produce safe and reliable chemical products.

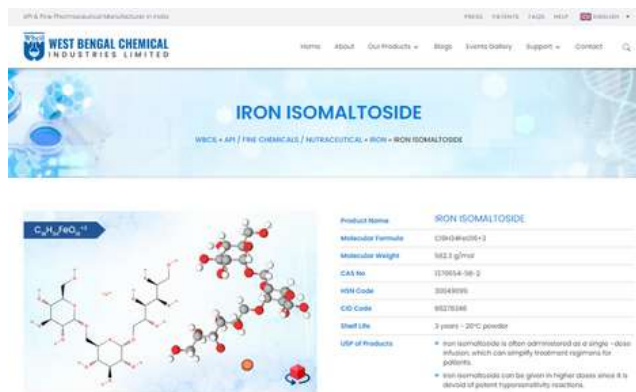
We have a proper research and development team and an Intellectual property law team. We are continuously focusing on research and development; our patent 381772, which has been granted by the Indian Patent Office, and our organization is continuously working for the reputation of customers after following all compliances.

Impact of the Invention:

Our Patent is essential to good health and well-being, which fulfills the goal of sustainable development and achieves its target through continuous research development and commercialization.

West Bengal Chemical Industries Limited (WBCIL) has become one of the trusted API pharma companies in India through our quality API products (Active Pharmaceutical Ingredients) and numerous fine chemicals used to formulate medical drugs.

Photographs:



Commercialization Details:

We are reaching to our customer through selling our Active pharmaceutical ingredients to needed manufacturers

4. Method and Apparatus for Follicular Quantification in 3D Ultrasound Images

Summary:

AI-based 3D imaging technology is used in IVF treatment to accurately and clearly view the follicles present inside the ovary. By tracking the critical parameters, such as location, volume, and rate of growth of follicles, doctors can accurately administer the right dosage of hormones to patients during the treatment.

Salient Features:

The invention uses an AI-based technique to clearly identify even the smallest follicle with 3D segmentation, which can result in an accurate follicle

count and a precise measure of the follicle's volume, size, and position. This helps calculate the right amount of medicine to inject into the ovary for an improved success rate of IVF treatment.

Patent No: 483722

Date of Grant: 15/12/2023

Applicant: Samsung Electronics

Inventor(s): Nikhil Narayan Subbarao, Srinivasan Sivanandan, Kedar Anil Patwardhan, Srinivas Rao Kudavelly



Problems Addressed:

Assisted reproduction techniques, like IVF, require the extraction of a mature egg from the dominant follicle that develops ova in the ovaries. Identifying the dominant follicle involves hormonal stimulation and monitoring its growth through ultrasound imaging. Ultrasound imaging provides valuable information about the ovary's internal structure, helping with medical observations and diagnoses. However, the existing methods do not track the growth of follicles at regular time intervals for automatic follicle quantification and tracking of follicle growth.

Impact of the Invention:

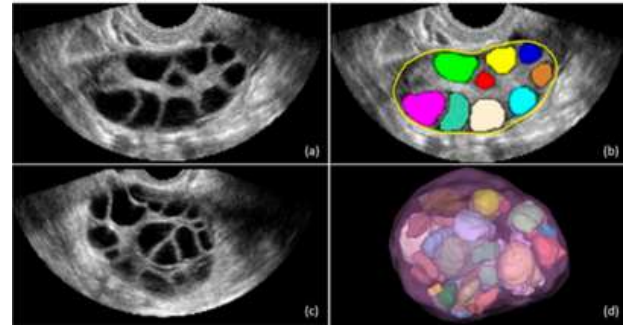
Enabled a significant success rate of IVF procedure in India with this AI-based 3D solution as compared to the current 25% success rate. Adverse health effects on women were prevented by avoiding inaccurate or excessive hormone dosage.

Commercialization Details:

Feature: 3D Transvaginal Ultrasound Image/Volume Scan in Assisted Reproduction

Ultrasound System Used: Women's Health Ultrasound Segment systems – WS80, HERAW9, HERAW10, V6, V7, V8, HS40, HS50, HS60 and HS70

Photographs:



5. An Instrument to Prepare an Intrauterine Device for Insertion

Summary:

The invention pertains to an intrauterine device (IUD) insertion instrument that is designed to simplify and enhance the precise placement of an IUD within the female uterus. An IUD is a contraceptive device used for long-term or medium-term birth control, facilitating effective family planning. The instrument comprises a downfolding device, a graduated tube, a push rod, a stopper, and an intrauterine device, generally known as an IUD, encased in a transparent pouch. The downfolding device has a concave depression on either side, an open channel of a circular orifice having a sector of angle measuring at least 220° and an exit opening initially marginally less than the external diameter of the graduated tube, a root thickness of the base in-between the open channel such that the exit opening increases by the base flexing; the graduated tube has an internal diameter of a far-end opening of the graduated tube sufficient to capture the stem and both arms of the IUD in a downward triangular formation.

Patent No: 346161

Date of Grant: 31/07/2019

Applicant: Pregna

International

Inventor(s): Mukul Taparia



Thus, the invention significantly contributes to achieving the United Nations Sustainable Development Goal 3, Target 7, which aims to ensure universal access to sexual and reproductive health care services, family planning, and education by addressing the issue of intrauterine devices inserted into women's uteruses

Salient Features:

- The device is designed to load or prepare intra-uterine devices (IUDs) hygienically.
- Features a simple instrument to load or prepare the intrauterine device, which is downloadable.
- Capable of loading the intra-uterine device consistently.
- Engineered to minimize trauma to the woman during the insertion process.
- Economically designed without compromising on effectiveness.
- Single hand operation device, which gives access to one free hand during the procedure

Problems Addressed:

The primary problem addressed by the invention is the complex and sensitive nature of the IUD loading and insertion process, which is crucial for the practical placement and functioning of the IUD within the uterus. Specifically, the IUDs must be in the shape of “T”; they cannot be inserted in this form as the opening of the cervix is small. Arms forming “T” of the IUD are folded either upwards or downwards so that the IUD can be contained in the opening of a narrow tube, which then can be inserted in the uterus. This process of folding the IUD so that the instrument is ready to insert is known as loading or preparing the IUD. Loading or preparing an IUD needs to be done minutes before it is required to be inserted in the uterus. If done earlier, or if supplied duly loaded, then the IUD shall not return to the desired “T” shape in the uterus and shall not work effectively. Due to this requirement, the process of loading has to be performed by service providers just before inserting and placing the IUD in the uterus. Up-folding IUDs and down-folding IUDs have a significant difference in their preparation. There is a substantial difference in the process of inserting and placing an up-folding IUD and a down-folding IUD in the uterus. An up-folding IUD is more straightforward to load and difficult to put in the uterus. In contrast, a downfolding IUD is relatively more challenging to load and relatively more straightforward to place. The invention effectively and economically addresses the loading or preparation of downfolding IUDs for subsequent insertion and placement in the uterus.

Impact of the Invention:

Our invention and the subsequent product, Safeload, seamlessly align with the United Nations Sustainable Development Goals (SDGs), particularly contributing to SDG 3: Good Health and Well-being and target 3.7, which ensures universal access to sexual and reproductive health-care services, including family planning, information, and education, as well as the integration of reproductive health into national strategies and programs.

By delivering a contraceptive device at the right depth in the uterus, we are improving the quality of women's contraception and family planning, actively participating in the global pursuit of sustainable and inclusive development. This alignment emphasizes our dedication to positively impacting society and addressing pressing challenges through technological innovation.

Commercialization Details:

- Product Name - SafeLoad T Cu 380A
- Product Link - <https://www.pregna.com/safeload.html>
- Company Name - Pregna International Limited
- Company Description—Pregna is a leading Contraceptive Solutions Organization that has been serving women since 1991. It is spread across 140 countries and partners with social marketing organizations and private distributors of intrauterine devices.
- Relevance - Family Planning
- Device is self-marketed by the company

Photographs:



6. Methods and Systems for Examining an Eye to Detect a Disease

Summary:

An AI-based solution detects eye diseases by taking pictures of users' eyes using a smartphone. The invention is being used to screen patients in rural India for eye diseases that could potentially lead to blindness. It enables clinical assistants to visit rural locations and obtain pictures of patients' eyes for diagnosis by doctors.

Salient Features:

1. Capturing an image of the eye using an ophthalmoscope connected to a mobile phone camera and examining the image of the eye using an on-device artificial intelligence (AI) module of the mobile phone to detect eye disease.
2. Recommending a treatment for the detected disease at a fraction of the cost of commercial instruments used by medical professionals.

Problems Addressed:

The fundus of a human eye is the interior surface of the eye, which includes the important structures of the eye, such as the retina, optic disc, macula, fovea, and posterior pole. The fundus can be examined using methods such as ophthalmoscopy and/or fundus photography to check for any signs of eye diseases. Existing fundus/retinal imaging instruments & systems are costly and lack on-device classification capability. Therefore, there is a need for a low-cost, affordable smartphone-based on-device solution that can provide an end-to-end fundus diagnosis.

Patent No: 508281

Date of Grant: 07/02/2024

Applicant: Samsung

Electronics

Inventor(s): Vijay Narayan

Tiwari, Ankur Trisal



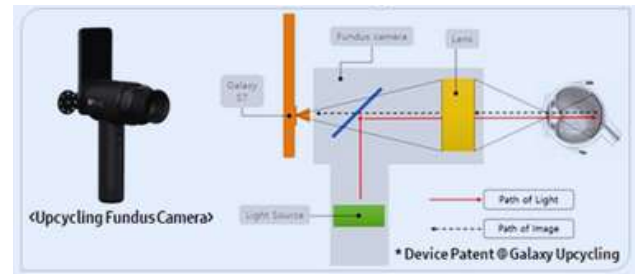
Impact of the Invention:

Samsung has partnered with 5 Indian Hospitals (Sitapur Eye Hospital in Sitapur, Uttar Pradesh; Aravind Eye Hospital in Pondicherry; Guru Hasti Chikitsalya in Jodhpur, Rajasthan; Sewa Sadan Hospital Bhopal, Madhya Pradesh and Dr. Shroff's Charity Eye Hospital in New Delhi) and various health clinics associated with these hospitals including public health centers to conduct eye-care camps using this solution. Enables clinical assistants to visit rural locations and obtain pictures of patients' eyes for diagnosis by doctors. So far, this solution has screened around 15000 patients (30000 Eye scans) for eye diseases.

Commercialization Details:

- This invention is commercialized as the Samsung EyeLike Fundus camera.
- So far, Samsung has upcycled nearly 200 units of older Galaxy smartphones and distributed EYELIKE™ Fundus Cameras to partners in India.

Photographs:



7. A System for Simultaneous Cell Imaging and Growing

Summary:

The invention provides a state-of-the-art 3D-printed microfluidic bioreactor designed to revolutionize Healthcare with Personalized Cancer Care through Organ-on-Chip technology. It enables simultaneous live-cell growth and imaging, facilitating personalized drug screenings to enhance quality of life. This system integrates a microfluidic chip with multiple

culture wells, a thermally conductive base for temperature regulation, and an oven cap to maintain a controlled environment, making it pivotal for preclinical and clinical drug trials.

Salient Features:

- Organ-on-Chip Technology: Facilitates personalized drug screenings by simulating human physiological conditions.
- Integrated Imaging System: This system allows for in-situ observation of cell growth and interactions, which is critical for understanding drug effects and viral behavior.

Patent No: 404439

Date of Grant: 24/08/2022

Applicant: IIT Madras

Inventor(s): Anil

Prabhakar, Ikram Khan



- **Thermal Management:** Ensures optimal growth conditions through a precise temperature control system.
- **Eco-Friendly and Cost-Effective:** Designed to be sustainable, reducing environmental impact while providing cutting-edge medical technology.

Problems Addressed:

The bioreactor addresses critical healthcare challenges, particularly in cancer treatment, by providing a platform for personalized medicine. This technology helps combat the high incidence of cancer, which is expected to rise significantly, by offering tailored therapeutic interventions. It also addresses the need for sustainable and efficient healthcare solutions in the face of rising healthcare costs and environmental concerns.

Impact of the Invention:

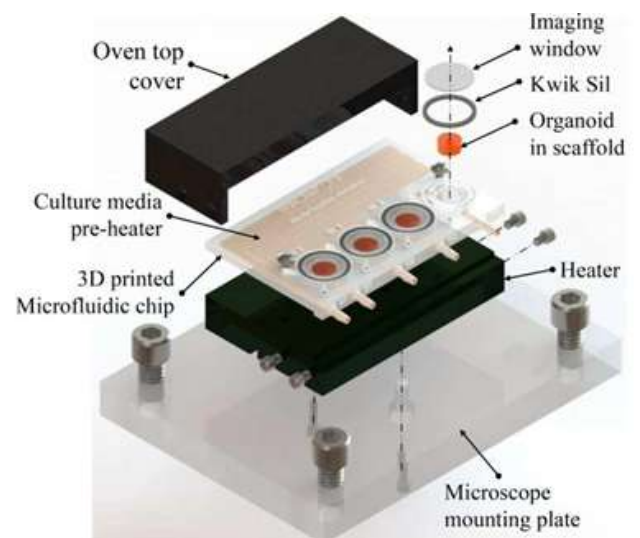
The 3D-printed microfluidic bioreactor impacts several areas:

- **Healthcare Efficiency:** Improves drug screening accuracy, reducing the time and cost associated with drug development.
- **Quality of Life:** Enhances patient care by providing personalized treatment options, leading to better health outcomes.
- **Societal Impact:** Contributes to the global effort of reducing cancer mortality rates and improving healthcare accessibility.
- **Economic and Environmental Impact:** Reduces the environmental footprint of medical research and lowers healthcare costs through innovative technology.

Commercialization Details:

The technology has been licensed to ISMO-Bio-Photonics Private Limited, which is taking a step forward in providing streamlined treatment that leads to a lifesaving healthcare system. This innovation enhances users' independence and contributes to their overall health and well-being. The innovation exemplifies IIT Madra's commitment to enhancing lives through pioneering organ-on-chip technology and Microfluidic solutions. These directly contribute to good health and well-being, reduced inequality, industry, innovation and infrastructure, and partnerships for the goals. Indirectly, it said that innovation contributes to alleviating poverty and hunger, is lifesaving, and even knocks down architectural barriers to access education. ISMO is working with leading pharma companies to accelerate drug screening and personalized drug screening

Photographs:



8. Saline Solution Rundown Monitoring and Alerting Device

Summary:

Saline Solution Rundown Monitoring and Alerting Device is a novel solution for addressing SDG 3 aimed to ensure healthy lives and well-being for all. The countries with health care worker shortages and shortfalls in healthcare systems leveraged the lessons learnt during the pandemic to build their resilience against health care. In the Indian scenario, India has 1.7 nurses in over 1000 people, which is 43% less than the WHO norm, which is 3 per 1000. In hospitals, the patients undergoing treatment may need to administer saline solution through intravenous (IV) injection. Maintaining and monitoring the level of saline solution in the bottle remotely in places with a shortage of healthcare workers is very demanding. If the saline solution for intravenous infusion gets over and the bottle is empty, and if the needle is not removed from the vein, the blood flows outward into the bottle (backward flow of blood into the body). The nurse sets the IV drip according to the drip rate, which is calculated manually. It is time-consuming and is prone to errors. The product we developed is to overcome this critical situation by automatically shutting off the IV valve and informing the concerned person in charge when the infusion reaches the threshold. The drip rate calculation is also automatically done. Calculating the flow of drops using a sensor mount helps calculate the residual volume, and once the volume has reached the threshold, the alarm is given, and the actuator is enabled. An app is designed to display the drip rate of each bed in real-time. The outcome of the device has enhanced the work of doctors/nurses/healthcare workers. The invention addresses achieving universal health coverage, which ensures everyone can access quality health services without financial hardship, and this falls under Target 3.8, Indicator 3.8.1 of SDG 3.

Patent No: 479911

Date of Grant: 11/12/2023

Applicant: R.Valli

Inventor(s): R.Valli,

Arunmozhi S, Manojkumar

K, Rajesh V



Salient Features:

Saline Solution Rundown Monitoring and Alerting Device counts the drops and calculate the real-time drop rate. It also has a fine flow regulator to adjust the fluid flow, so that the nurse can set rate precisely and easily. The salient feature of this device is the Infrared Sensor placement. The IR placement is in 45° Refraction model where the fluid drops are calculated even when the chamber is tilted. Once the threshold is reached, a linear actuator is used to cut-off the IV flow. The device is WiFi-enabled, thus all the data can be easily accessed in the nurse's station. Also, notifications are sent to the healthcare workers and one click monitoring is also made available. To consolidate, the salient features include

- Placement of IR sensors
- Automatic & accurate drip rate calculation
- Safe delivery of the IV fluid without backflow of blood
- Remote monitoring
- Auto cut-off
- Battery operated

Problems Addressed:

Three vital issues in SDG 3 have been addressed in this invention:

The first problem addressed is, IV infusion method is vulnerable to human error, i.e., it possess risk of backflow of blood if unattended when the IV bottle is empty and the second problem is building a product that can be easily used by the medical practitioners and less traumatizing for the patients. Both these problems support Target 3.b: Support research, development and universal access to affordable vaccines and medicines. The solution to this problem is given through developing an alerting device that consists of an infrared sensor to detect the drops which is employed to monitor the fluid level. The system facilitates live monitoring through a Mobile Application that triggers an alarm once the threshold level of the IV bottle is reached and the actuator is enabled that cuts off the fluid flow. This helps in eliminating back flow of flood which at times is fatal. The third problem is, In general wards the calculation of drip rate is manual (mostly mental calculation) which is prone to error. There need to be a device which calculates the drip rate automatically without human intervention. This problem statement directly impact on Target 3.c: Increase health financing and support health workforce in developing countries. To address this, the drip rate is automatically calculated by specifying drip factor, the volume of the IV bottle, and time in the invention. By addressing these issues to overcome the shortcomings in the health care sector, our invention, “Saline Solution Rundown Monitoring and Alerting Device”, aligns with the global call for vital healthcare services and achieving sustainable development.

Impact of the Invention:

The product improves clinical efficiency, safety, and patient experience in hospital and home care compared to the existing products in the market and costs only one-sixth of it, which happens to be the prime concern in Target 3.8 and 3. b of SDG 3. The device is WiFi-enabled, so all the data can be easily accessed from the nurse’s station. Generally, a nurse has to check the flow of the drip manually every now and then. Now, the healthcare worker can monitor multiple patients at a given time. Any variation in the functioning of the drip will be notified by the device via the software program that is provided at the nurse's station. When the threshold of 10 ml is reached, a linear actuator is used to cut off the IV flow and give notification to concerned healthcare workers. It will help the patients and ensure that the correct dosage is provided at the right time, eliminating anxiety when the dripper bag is empty. The beneficiaries of this innovation include general hospitals, hospital chains, multi-specialty hospitals, patients who are under prolonged medication for various illnesses, and those who are under prolonged bed rest. These impacts directly ensures healthy lives and promotes well-being for all at all ages thereby contributing to sustainable development.

Commercialization Details:

A pilot study about the requirements for the product was done with the interns and doctors of Sri Manakula Vinayagar Medical College and Hospital (SMVMCH), Pondicherry. The survey group also shared their issues and challenges regarding their fight during the COVID War, and the device was designed using these inputs. 6 Minimum Viable Products have been under testing in Sri Manakula Vinayagar Medical College and Hospital (SMVMCH), Pondicherry, since June 2023, and these products have been performing satisfactorily.

Photographs:



9. Dalbergia Sissoo Derived Extract and Compounds for the Prevention of Osteo-Health-Related Disorders Designated as Osteo Natural Care

Summary:

Osteoporosis is a medical condition in which the bones become brittle and fragile due to a decrease in bone mass and bone mineral density, leading to frequent fragility fractures. Worldwide, one in three women over the age of 50 years is at risk of developing osteoporosis. It can be due to hormonal changes or calcium and vitamin D deficiency. Along with increased incidences of fractures in older, postmenopausal women, osteoporosis may often lead to mobility loss and perhaps morbidity and death. The major reason for developing this disease and associated bone loss in women is due to estrogen deficiency. Other important risk factors are genetics, advanced age, underweight, smoking, alcohol abuse, etc. Preventing postmenopausal osteoporosis with nonpharmacologic means can be improving nutrition

which can be done with adequate intake of protein, calcium, and vitamin D. Doctors also suggest regular physical activity and avoiding smoking and consumption of alcohol in order to lower the risk. For perimenopausal women (women naturally approaching menopause) and having low bone density and other risk factors, estrogen and drugs to improve bone density and strength are recommended, and such patients are counseled to lower their risk of falling.

In search of a safer and more effective solution to these problems, a scientific team from the Endocrinology & Medicinal Chemistry Division of CSIR-Central Drug Research Institute, Lucknow, has come up with a novel medicine, Reunion, a product that prevents bone breakdown, stimulates new bone formation and reduces bone turnover markers. Bone Markers are indicators that increase in proportion to fracture risk, independent of bone mineral density. The team has used leaves of Dalbergia sissoo (North Indian Rosewood or shisha), a deciduous tree, to develop the medicine.

The present invention introduces a compound, Caviunin 7-O- [β -D-apiofuranosyl-(1 6)- β -D-glucopyranoside], along with its pharmaceutically acceptable salts, sourced from the leaves of the plant "Dalbergia sissoo." This compound showcases significant therapeutic potential for addressing bone disorders, characterized by its capacity to enhance osteoblast differentiation, boost bone mineralization, and stimulate bone morphogenic protein expression. Moreover, it demonstrates non-toxicity to cells within a specific concentration range and supports the normal growth of osteoblastic cells. The compound can be extracted from targeted plant extracts and formulated into pharmaceutical compositions using various diluents. The administration of these compositions, through diverse routes, provides a flexible approach to prevent or treat bone disorders such as osteoporosis, bone loss, and fracture healing, among others. These compositions are adaptable to various dosage forms and regimens, catering to diverse patient needs and medical applications.

Patent No: 401730

Date of Grant: 21/07/2022

Applicant: CSIR

Inventor(s): Maurya Rakesh,

Dixit Preety, Trivedi Ritu,

Khedgikar Vikram, Gautam

Jyoti, Kumar Avinash, Singh

Divya, Singh Sheelendra

Pratap, Wahajuddin, Jain

Girish Kumar, Chattopadhyay

Naibedya



Salient Features:

The invention presents a breakthrough compound, Caviunin 7-O- [β-D-apiofuranosyl-(1 6)-β-D-glucopyranoside], from natural origins.

This compound and its pharmaceutically acceptable salts are crafted into pharmaceutical compositions designed for preventing and treating bone disorders.

Extracted from natural sources, notably the leaves of *Dalbergia sissoo*, it is skillfully formulated into pharmaceutical compositions using appropriate excipients and diluents.

Caviunin 7-O- [β-D-apiofuranosyl-(1 6)-β-D-glucopyranoside] showcases properties that stimulate osteoblast differentiation and enhance bone formation, potentially bolstering bone health and mitigating the risks associated with osteoporosis and fractures.

Its safety and efficacy profiles are well-demonstrated, which is evident in its ability to promote bone marrow stromal cell mineralization without inducing toxicity or impeding cell growth.

The pharmaceutical compositions are versatile in administration, encompassing oral, percutaneous, intramuscular, intraperitoneal, intravenous, or local routes. Dosage flexibility spans from 1 to 5000 mg/kg body weight, facilitating customized dosing regimens tailored to individual requirements.

Problems Addressed:

This invention tackles several key challenges related to developing bioactive fractions and compounds from *Dalbergia sissoo*. These challenges include addressing osteo-health-related disorders, both estrogen-dependent and independent, in humans and animals. It also focuses on achieving Peak Bone Mass (PBM) during skeletal growth and maintaining bone health while ensuring the compounds remain non-toxic to cells. Furthermore, the invention aims to provide compounds that exert bone anabolic effects rather than anti-resorptive effects. It also emphasizes the importance of formulating compositions that are devoid of uterine estrogenicity.

Impact of invention:

The discovery and characterization of Caviunin 7-O- [β-D-apiofuranosyl-(1 6)-β-D-glucopyranoside] mark a significant advancement in natural product-based drug discovery. This innovation provides a comprehensive process for extracting, isolating, and quantifying compounds from *Dalbergia sissoo*, offering promising avenues for preventing or treating estrogen-dependent or independent diseases and enhancing bone health. By addressing previous challenges associated with managing such conditions, this method presents potential solutions for both humans and animals. The invention's versatility in providing various dosage regimens and administration routes allows for adaptable application based on the specific disorder being addressed. This breakthrough is poised to have a profound impact on healthcare by introducing new approaches for treating estrogen-related diseases and improving overall bone health. Consequently, this innovation is expected to enhance health outcomes, reduce disability, and prolong longevity. These benefits extend to cost savings and improved allocation of healthcare resources.

The underlying technology has been licensed to M/s. Pharmanza Herbal Pvt. Ltd. has undergone rigorous clinical trials approved by the DCG(I). It is now available in India under the Tradename 'Reunion', further solidifying its credibility and accessibility.

Commercialization Details:

Licensed to M/s. Pharmanza Herbal Pvt. Ltd. has undergone rigorous clinical trials approved by the DCG(I). It is now available in India under the Tradename 'Reunion', Reunion was launched for marketing in India on 17 February 2016.

Licensing of REUNION to AVETA Biomics Inc. to develop, make, and sell the PRODUCT as a Botanical drug based on Dalbergia sissoo PRODUCT in the USA after seeking regulatory approval from the US-FDA.

Photographs:



10. Formulation for the Prevention and Treatment of Bone Related Disorders

Summary:

In India, ~39% of people suffer from Osteoarthritis. Out of this, 45% of women above 65 years experience symptoms, and 70% of them have x-ray evidence of Osteoarthritis. Postmenopausal women with osteoarthritis have a 20% increased risk of fracture

Many factors can contribute to the development of the condition, including genetics, weight, and joint injury. Wear-and-tear injuries can be common, and joint pain is something many if not most, people will experience at certain points.

At present, there are no drugs on the market, especially any orally available drug for osteoarthritis. Only symptomatic treatments are available with painkillers like ibuprofen and naproxen.

There are reports that these drugs on long-term use show liver toxicity. The innovation introduces the development of a product based on nanoemulsion pre-concentrate formulation comprising specific markers extracted from the Spinach family Amaranthaceae (*Spinacea oleracea*) aimed at preventing and treating various bone-related disorders, including estrogen-dependent and independent conditions. This formulation incorporates pharmaceutically acceptable carriers, surfactants, and co-surfactants and incorporates active compounds utilizing percolation and fractionation processes during extraction. Notably, the formulation significantly improves therapeutic efficacy in terms of bone volume/tissue volume by enhancing bioavailability and subsequent reduction in the dose. For human consumption, the solid dosage form was customized by blending the extract with fillers, alongside the inclusion of GRAS

Patent No: 516610

Date of Grant: 28/02/2024

Applicant: CSIR

**Inventor(s): Ritu Trivedi,
Prabhat Ranjan Mishra,
Sulekha Adhikary, Naseer
Ahmad, Dharmendra**

**Choudhary, Naresh Mittapelly,
Sudhir Kumar, Kapil Dev,
Rakesh Maurya**



category excipients to improve dissolution and absorption with patient acceptability. The overarching goal of this formulation is to effectively address bone-related disorders, ensuring ease of consumption and improved efficacy.

Salient Features:

This formulation is enriched with specific compounds derived from Spinach, strategically targeting bone health.

It incorporates pharmaceutically acceptable carriers, additives, surfactants, and co-surfactants to ensure optimal delivery. Detailed embodiments outline the composition, dosages, and various administration methods.

The preparation process involves meticulous extraction, fractionation, and formulation of the active ingredients. Beyond bone health, this versatile formulation extends its benefits to treating osteoarthritis and functioning as a chondroprotective agent.

Notable improvements include enhanced bioavailability and significant enhancements in bone volume/tissue volume. The preparation method yields solid pharmaceutical dosage forms, suitable for human consumption. Granules or powder variants are tailored with fillers, acids, bases, and water-soluble additives to improve dissolution and enhance patient acceptability.

Each ingredient's specific role in the formulation, including fillers, acids, bases, and water-soluble additives, is comprehensively elucidated.

Additionally, customization options allow for the inclusion of additional adjuvants and active ingredients to meet specific needs.

Problems Addressed:

The invention addresses the formulation and preparation of a pharmaceutical composition derived from spinach extract to prevent and treat estrogen-dependent or independent diseases, particularly bone-related disorders. This formulation offers effective treatment for conditions such as osteoporosis, fractures, postmenopausal osteoporosis, inflammation, pain, and cartilage regeneration associated with osteoarthritis. Additionally, it facilitates achieving peak bone mass and overall skeletal health. It also addresses the challenge of preparing a solid pharmaceutical dosage form suitable for human consumption by blending the bioactive extract with fillers and other excipients by utilizing a soluble fraction from *Spinacea oleracea* leaves. Overall, this invention provides a pharmaceutically acceptable form of standardized extract for managing, preventing, or treating these bone-related disorders in both humans and animals.

Impact of the Invention:

The described formulation carries substantial potential for societal, economic, cultural, and technological impacts. It is poised to tackle prevalent bone-related disorders such as osteoporosis and osteoarthritis, potentially enhancing quality of life and curbing healthcare expenses. Culturally, it contributes to reshaping perspectives on aging and healthcare maintenance. Moreover, its incorporation of advanced drug delivery technology holds broader implications for pharmaceutical advancements. Proven efficacy has significantly benefited society by bolstering bone health and expanding medical treatment options. The underlying technology has been licensed to M/s. Pharmanza Herbal Pvt. Ltd. and has been successfully manufactured and marketed under the Tradename 'Joint Fresh', further amplifying its reach and impact.

Commercialization Details:

The technology was licensed to M/s. Pharmanza Herbal Pvt. Ltd. and has been successfully manufactured and marketed under the Tradename 'Joint Fresh'. Joint Fresh was launched as nutraceutical product for marketing on 13th March, 2018.

Photographs:



11. A Prosthetic Knee for Uneven Terrain

Summary:

KADAM is a novel four-bar mechanical prosthetic knee joint mechanism designed to optimize functionality for individuals with above-knee or trans-femoral amputation, focusing on achieving optimal stability, toe clearance, and ease of use during walking. It utilizes a carefully engineered four-bar linkage configuration to provide maximum flexion,

high toe clearance, stability, and support, particularly on uneven terrain. The mechanism incorporates customizable features to enhance adaptability and usability, ensuring a comfortable and natural gait for users. Furthermore, the design prioritizes affordability and accessibility, aiming to make advanced prosthetic technology more widely available to those in need. The proposed invention belongs to the category of Sustainable Development Goal (SDG) 3: Good Health and Well-Being.

Salient Features:

- KADAM utilizes a four-bar linkage mechanism carefully designed to optimize stability, toe clearance, and flexion capabilities. This configuration enables natural and efficient movement for users, mimicking the functionality of a biological knee joint.
- The prosthetic knee joint mechanism offers customization options to accommodate users' individual needs and preferences. These include features such as anterior-posterior stability adjustment, friction control for different walking speeds, and optional extension assistance, allowing for a tailored fit and enhanced usability.
- By simplifying the design & eliminating the need for additional mechanisms, it aims to reduce production costs and make high-quality prosthetic technology more accessible to individuals with above-knee or trans-femoral amputations, particularly in resource-constrained settings.

Patent No: 338006

Date of Grant: 05/06/2020

Applicant: IIT Madras

**Inventor(s): Sujatha Srinivasan,
Anand T S**



Problem Address:

- Existing prosthetic knee joints often fail to provide sufficient stability, toe clearance, and flexion, especially on uneven surfaces, leading to discomfort & an unnatural gait.
- High production costs of advanced prosthetic technology create barriers to access for individuals in low-income or resource-constrained settings, limiting mobility & independence.
- Many prosthetic knee joints lack customization options, resulting in poor fit and functionality, causing discomfort and reduced mobility confidence.

Impact of the Invention:

- KADAM improves prosthetic knee joint functionality, offering superior stability, toe clearance, & flexion capabilities, promoting independent mobility on various terrains.
- By prioritizing affordability and simplicity, KADAM aims to make advanced prosthetic technology accessible worldwide, positively affecting underserved communities.
- KADAM enhances the quality of life for individuals with above-knee or trans-femoral amputations by providing a natural gait and mobility, fostering comfort and confidence in daily activities.
- KADAM empowers users to navigate their environments with confidence, promoting physical health, psychological resilience, and independence.
- Priced at a fraction of its Western counterparts, KADAM redefines accessibility, making prosthetic technology more economically feasible for a wider population.
- KADAM's eco-friendly manufacturing and widespread adoption contribute to sustainability goals, addressing pressing challenges & offering transformative solutions.

Photographs:



Commercialization Details:

KADAM's technology has been licensed with ALIMCO, signaling a step forward in providing quality prosthetic solutions. This innovation enhances users' independence and contributes to their overall health and well-being.

12. ZnO Nanoparticles Tagged Pharmaceuticals for Improved Drug Delivery and Method of Tagging

Summary:

The sustainable ZnO nanoparticles tagged pharmaceuticals and the method of tagging for improved drug delivery is an innovative solution designed to tackle the global challenge of providing affordable essential medicines, and access to quality essential health-care services for all. As the drug is tagged with ZnO by a physical method, it is highly cost-effective, and allows for scalability and easy

customization. Again, the absence of chemical tagging drastically lessens the burden on the environment. The ZnO nanoparticles-tagged pharmaceuticals offer sustainable drug delivery as a substantially lesser amount of ZnO-tagged pharmaceuticals provides the desired efficacy and bioavailability. The amount of ZnO tagged pharmaceutical required is of the order of 1000 times lesser in comparison to the untagged form. The ZnO-tagged pharmaceuticals suppress the formation of large amounts of acid in the stomach, which helps better release the desired drugs for improved bioavailability. By addressing the critical issues of affordable medicines, this sustainable ZnO nanoparticles tagged pharmaceuticals represents a significant step towards achieving the United Nations Sustainable Development Goal 3 of ensuring access to quality essential healthcare services for all.

Salient Features:

The sustainable ZnO nanoparticles tagged pharmaceuticals suppress the formation of large amounts of acid in the stomach that helps in better release of the desired drugs for improved bioavailability, and the method of tagging for improved drug delivery integrates physical tagging methods that eliminate chemical tagging, hence considerably reducing the burden on the environment. Additionally, the ZnO-tagged pharmaceuticals provide Zn supplements to the patient. As the quantity of ZnO-tagged pharmaceuticals required is 1000 times less than the quantity of untagged forms, the same amount of pharmaceuticals caters to the needs of 1 million patients instead of 1000 of the currently available ones. As the tagging method is physical, the technology allows seamless scalability and effortless adaptation without being concerned about the environment and effluent disposal.

Problems Addressed:

The Sustainable ZnO nanoparticles tagged pharmaceuticals directly tackle several pressing issues outlined in Sustainable Development Goal 3: Ensure healthy lives and promote well-being for all at all ages. Specifically, it addresses the prevalent challenge of achieving universal health coverage, including financial risk protection, access to quality essential healthcare services, and access to safe, effective, quality, and affordable essential medicines for all, as outlined in target 3.8.

Impact of the Invention:

The ZnO nanoparticles tagged pharmaceuticals, and the method of tagging for improved drug delivery stands as a ray of hope for communities grappling with the economic challenge of receiving medicines

Patent No: 502431

Date of Grant: 23/01/2024

Applicant: Kaushik Palicha,

Harinipriya Seshadri

Inventor(s): Harinipriya

Seshadri, Kaushik Palicha



at an affordable cost. Its implementation heralds a transformative shift in providing a basic necessity, safeguarding public health, alleviating poverty, and fostering sustainable development. Furthermore, the ZnO-tagged pharmaceuticals provide Zn supplements that help improve immunity, blood sugar levels, and eye, heart, and skin health. Reducing the amount of drug intake empowers individuals in underdeveloped and developing countries and individuals in the lowest economic strata in developed countries to save from their earnings. Furthermore, while providing affordable drugs, it promotes the happiness level of the communities as they spend less, contributing to quality essential health care. Through its multifaceted impact, this invention symbolizes a palpable pledge to several Sustainable Development Goals, including the fundamental goal of ensuring access to good health and well-being.

Commercialization Details:

- Technology Readiness Level (TRL): 6/7
- The drug was implemented on human blood; further pre-clinical and clinical trials in Phase 1 are in progress.
- During pre-clinical trials, the drug-tagged system is scaled up to study 1000 volunteers with stroke-inflicted blood vessel blockage and specially-abled persons for motor activity enhancement studies and data.
- Pre-clinical by the end of 2024.
- Clinical trials by mid-2025.
- Scale up and commercialization by partnering with the pharmaceutical industry by the end of 2025.
- Commercial Partnerships: Confidential: In the first phase of outreach, four pharmaceutical companies have shown interest in the technology. The Applicants have shortlisted two of them, and further discussions with them are in progress.

Photographs:



13. Digital Urine Tank

Summary:

The invention is a digital urine tank designed for easy and hygienic urine collection and measurement. The device comprises a locking cap to prevent spilling of collected liquid, a handle for easy portability, and a rubberized pad to hold the urine tank for volume measurement. The urine tank is made of silicone rubber and is kept in a hygienic atmosphere. A recharging power inlet provides a charging facility for the built-in rechargeable battery, and an on/off switch

powers the device whenever necessary. The device also features a waterproof digital volume indicator to show the measured value of urine, a digital time display to show the current time, and a master time set switch to set the time whenever necessary. A slave set switch enables time-set in ascending/descending mode. The device is controlled by an Atmel microcontroller that compiles, processes and executes the given task. A load cell amplifier amplifies the measured signal and feeds it to the microcontroller to output the measured value through the volume display. A reset switch resets the volume display to zero. The software to run the program is hexa-coded and embedded in the microcontroller with suitable surrounding components and a 12MHz crystal oscillator. The urine tank supporting wall prevents the urine tank from slipping and falling from the device.

Salient Features:

The digital urine tank is a hygienic and convenient urine collection and measurement device. Its salient features include a locking cap to prevent spills, a handle for easy portability, and a rubberized pad to hold the tank in place for volume measurement. The tank is made of silicone rubber and is kept in a hygienic atmosphere. The device is powered by a rechargeable battery, a recharging power inlet, and an on/off switch. It features a waterproof digital volume indicator to display the measured value of urine, a digital time display to show the current time, and master and slave set switches for time-setting. The device is controlled by an Atmel microcontroller and uses a load cell amplifier to output the measured value through the volume display. The program's software is hexa-coded and embedded in the microcontroller. The urine tank supporting wall ensures stability and prevents slipping and falling. A reset switch is also provided to reset the volume display to zero.

Problems Addressed:

The digital urine tank addresses several problems associated with traditional urine collection and measurement methods. It provides a convenient, hygienic, and efficient urine collection and measurement solution. One of the main problems is the risk of spills and contamination, which can be prevented by the device's locking cap and hygienic design. The device also provides easy portability with its handle, stable base, and urine tank supporting wall. The rubberized pad holds the tank in place for accurate volume measurement. The device is powered by a rechargeable battery, eliminating the need for frequent battery replacements. The digital volume indicator and time display provide clear and accurate readings, while the master and slave set switches allow for easy time-setting. The load cell amplifier and Atmel microcontroller ensure reliable and efficient operation. The reset switch allows for easy resetting of the volume display.

Patent No: 415720

Date of Grant: 28/12/2022

Applicant: Kalasalingam

University , P. Jayakumar

Inventor(s): P. Jayakumar,

S.Shasi Anand



Impact of the Invention:

The digital urine tank can impact the healthcare industry by providing a convenient, hygienic, and efficient urine collection and measurement solution. The device addresses several problems associated with traditional methods, such as the risk of spills and contamination, the need for frequent battery replacements, and the lack of clear and accurate readings, mainly with no manual handling. The digital urine tank's locking cap, hygienic design, and stable base helps prevent spills and ensure a clean and safe environment. The rechargeable battery eliminates the need for frequent battery replacements, and the digital volume indicator and time display provide clear and accurate readings. The master and slave set switches allow for easy time-setting, while the load cell amplifier and Atmel microcontroller ensure reliable and efficient operation. The reset switch allows for easy resetting of the volume display. The device has the potential to improve patient care and reduce the workload of healthcare professionals, making it a valuable addition to the healthcare industry without manual intervention in handling urine bags.

Photographs:



Commercialization Details:

We have developed a prototype model used in the hospital and are waiting for customers' feedback.

14. Wheel Chair with Balanced Stability

Summary:

The invention is a wheelchair with balanced stability, featuring a collapsible front wheel support system that can be raised or lowered. This system includes a hydraulic plunger connected to a pump, a front steering wheel, a front wheel supporting hub, and a rider's seat. The wheelchair is equipped with four wheels: two larger rear wheels for propulsion and two smaller front wheels with swiveling capabilities for easy steering.

A hydraulic manual-operated pump is fixed on the left-hand side of the wheelchair, with a hand-operated

Patent No: 462219

Date of Grant: 26/10/2023

**Applicant: Kalasalingam
Academy**

**Inventor(s): S. Shasi Anand,
P. Jaya Kumar**



lever positioned at a convenient angle for the rider. The plunger of the hydraulic cylinder is connected to the swiveling front wheel, allowing the wheel to be raised or lowered through the plunger's hydraulic action.

The front two sides of the wheelchair can be raised or lowered simultaneously using the hydraulic action, stabilizing the wheelchair's position while negotiating slopes. This is achieved by connecting both sides of the front wheel with the hydraulic plunger and interconnecting them with a hydraulic fluid pipe.

The front wheel supporting hub is connected with the front swiveling wheel shaft, raising the plunger while the wheels rest on the floor, stabilizing the rider's seat in a balanced position. The hand-operated lever is used to raise the front wheel while negotiating slopes, maintaining the steering wheel parallel with the floor surface and the center of gravity line passing through the central axle of the wheelchair, ensuring stability for the rider.

Salient Features:

The salient features of the wheelchair with balanced stability include a collapsible front wheel support system that can be raised or lowered, providing improved stability and maneuverability. The wheelchair is equipped with four wheels, including two larger rear wheels for propulsion and two smaller front wheels with swiveling capabilities for easy steering.

The invention provides a wheelchair with improved stability, maneuverability, and ease of use, particularly when navigating slopes and uneven terrain. The hydraulic front wheel support system is an important feature that sets this wheelchair apart from traditional designs, offering enhanced functionality and practicality for users.

A hydraulic, manual-operated pump is fixed on the left-hand side of the wheelchair, with a hand-operated lever positioned at a convenient angle for the rider. The plunger of the hydraulic cylinder is connected to the swiveling front wheel, allowing the wheel to be raised or lowered through the hydraulic action of the plunger. This feature enables the wheelchair to negotiate slopes and uneven terrain with greater ease and stability.

The front two sides of the wheelchair can be raised or lowered simultaneously using the hydraulic action, stabilizing the wheelchair's position while negotiating slopes. This is achieved by connecting both sides of the front wheel with the hydraulic plunger and interconnecting them with a hydraulic fluid pipe.

The front wheel supporting hub is connected with the front swiveling wheel shaft, raising the plunger while the wheels rest on the floor, stabilizing the rider's seat in a balanced position. The hand-operated lever is used to raise the front wheel while negotiating slopes, maintaining the steering wheel parallel with the floor surface and the center of gravity line passing through the central axle of the wheelchair, ensuring stability for the rider.

Problems Addressed:

The wheelchair with balanced stability invention addresses several problems commonly encountered by wheelchair users, particularly when navigating slopes and uneven terrain. These problems include instability, as traditional wheelchairs can become unstable when navigating slopes or uneven surfaces, which can be dangerous for the user and increase the risk of tipping over.

Traditional wheelchairs can be difficult to maneuver on slopes or uneven terrain, requiring added effort from the user to maintain control and navigate safely.

Traditional wheelchairs lack adjustability in their front wheel support, which can make it challenging to adapt to different environments and surfaces.

The invention aims to address these problems by providing a wheelchair with a collapsible front wheel support system that can be raised or lowered using hydraulic action. This feature improves stability, maneuverability, and adjustability, allowing the user to navigate slopes and uneven terrain with greater ease and safety. The hand-operated lever provides convenient control over the front wheel support, enabling the user to adapt to changing environments quickly and easily.

Impact of the Invention:

The invention of the wheelchair with balanced stability has had several positive impacts on users and society.

The invention provides improved mobility for wheelchair users, particularly when navigating slopes and uneven terrain. This enhances their independence and enables them to participate more fully in social and recreational activities.

The collapsible front wheel support system improves stability and reduces the risk of tipping over, enhancing the safety of wheelchair users. This is particularly important for elderly or disabled individuals who may be at higher risk of injury.

The invention provides a more comfortable riding experience for wheelchair users. The hydraulic front wheel support system absorbs shocks and reduces vibrations, which can help reduce fatigue and discomfort during prolonged use.

The invention can help make public spaces and transportation more accessible to wheelchair users. By providing improved stability and maneuverability, it enables wheelchair users to navigate a wider range of environments with greater ease.

Commercialization Details:

Commercialisation is under process.

Photographs:



15. A Multi-Position Wheelchair

Summary:

The Sustainable multi-position wheelchair is an innovative solution designed to tackle the global challenge of providing the arise standing wheelchair. The claimed invention aids a user to exist in a standing, reclining, seating position by means of a support from the wheelchair. The instant invention comprises a wheelchair base frame, a main link, a bar supporting the main link, an actuator link for standing mechanism, a link connecting the actuator link and wheelchair base frame, a seat, a coupler link, a link connecting the coupler link and the main link, a backrest, a link connecting the coupler link and the backrest or a backrest supporting link, a spring capable of reducing the efforts to stand up; and locks to hold the backrest in a fixed position. The multi-position wheelchair further comprises a footrest. The instant invention further consists of a six-bar linkage formed by aided by springs to effect transition from the sitting to the standing position. An additional link with a slider provides the ability to transition to a reclining position. The proposed invention belongs to the category of sustainable development goal (SDG) 3: good health and well-being.

Patent No: 351385

Date of Grant: 11/11/2020

Applicant: IIT Madras

Inventor Name: Sujata

Srinivasan, Harshal Girish

Chaudhari



Salient Features:

- A few salient features of the sustainable multi-position wheelchair are illustrated below.
- The multi-position wheelchair aids a user in various positions, for example, standing position, by means of support from the wheelchair.
- The multi-position wheelchair appears like a regular wheelchair in its seating position.
- The user is integrated with the wheelchair frame by means of supportive belts at the trunk and the legs.
- In its standing position, the wheelchair's seat becomes vertical and aligns with the backrest to support the user from the back.
- As the user is belted to the wheelchair frame, his body moves along with it, achieving a standing posture.
- The present invention applies a four-bar mechanism based on criteria such as safety, comfort, and maintenance, and it is well-suited for household use.

Problem Address:

- The Sustainable multi-position wheelchair directly tackles several differently-abled user requirements, such as changing the wheelchair position. Firstly, it addresses the challenge of many physical and mental health-related issues such as a sore body, the building of pressure points in the body, lowered blood circulation due to lack of movement, and depression due to dependence on other people for basic needs. Further, conventional wheelchairs suffer from one or more of the following disadvantages: wheelchair users are confined to a sitting position, leading to physical health issues, limited access to overhead spaces, and a lack of eye-to-eye interaction. The absence of standing functionality also presents a psycho-social barrier. Hence, there is a need for an efficient & completely manual multi-position wheelchair that addresses the above issues.

- To address the above issues, the claimed sustainable standing wheelchair provides a solution by assisting a wheelchair user in assuming a standing position by means of support from the wheelchair. The proposed invention belongs to the category of sustainable development goal 3, which illustrates inventions related to good health and well-being.

Impact of the Invention:

The sustainable multi-positioned wheelchair enhances the physical and psychological well-being of users. Offering a transformative sit-stand-sit experience promotes healthy posture, eye-level interactions, and inclusivity. Its affordability widens access, particularly in low-resource settings, leading to increased mobility and community participation. Indirectly, IP product helps create livelihood opportunities for the otherwise marginalized disability population, thereby alleviating poverty and reducing hunger. The IP product is priced at just 20% of its Western counterparts; this solution redefines accessibility. It is noted that the manufacturing of said wheelchair is a great demand. Its adoption has spurred significant interest, with several hundred devices already sold.

Commercialization Details:

The technology is transferred to Phoenix Medical Systems Pvt. Ltd and Neomotion Assistive Solutions Pvt. Ltd. The IP product “Arise” has been developed by Phoenix in partnership with Wellcome Trust, UK, and directly aims at better health and wellbeing for persons with disabilities, reducing inequalities in the community, and the innovation bridges the affordability gap. With the use of the product(s), a person with disability aims at a better health and well-being lifestyle, which reduces inequalities in the community, and said IP product bridges the affordability gap.

Photographs:



16. Easy to use portable manual standing wheelchair with safety features and for outdoor use

Summary:

The Sustainable portable manual standing wheelchair with safety features is a pioneering solution designed to tackle the global challenge of physical & mental health issues related to inequalities in the community and said IP product bridges the affordability gap. The present invention relates to a wheelchair assembly for disabled user, incorporated with a mechanism which allows the user to get into standing position easily

and independently. The instant invention enables an easy manual standing mechanism for outdoor applications and ensures several levels of safety for the standing mechanism. The wheelchair of the instant invention is provided with a 3-wheel base, including a front castor wheel and 2 rear wheels. The longer base length between the rear wheels and the large front castor provides stability and ease of maneuverability in uneven terrain. A standing handle provided in front of the user's leg includes push levers and a smooth contoured portion to give continuous contact and enhance the feeling of security as the chair is raised to the standing position. A support means is provided below the knee, which enables the user to stand. The proposed invention belongs to the sustainable development goal (SDG) 3 category: good health and well-being.

Patent No: 376689

Date of Grant: 08/09/2021

Applicant: IIT Madras

Inventor(s): Sujata

Srinivasan, Vivek Sarda,

Swostik Sourav Dash



Salient Features:

- A few salient features of the sustainable portable manual standing wheelchair are illustrated below.
- The multi-position wheelchair aids a user in various positions, such as standing, by means of support from the wheelchair, which is applicable for outdoor use.
- The user is integrated with the wheelchair frame by means of supportive belts at the trunk and the legs.
- In its standing position, the wheelchair's seat becomes vertical and aligns with the backrest to support the user from the back.
- As the user is belted to the wheelchair frame, his body moves along with it, achieving a standing posture.
- The wheelchair provides a 6-bar linkage mechanism, which includes a 4-bar linkage and a driver dyad. The standing handle actuates the linkage mechanism.
- An extra safety lock mechanism is provided, which disables the standing mechanism without activating the knee support.
- An additional lock at the handle enables the operation of the standing mechanism only on actuation of both the side standing handles simultaneously, even when the knee support is in activation.
- An alternative safety configuration states that the armrest attached to the backrest forms an obstruction to the rotation of the standing mechanism actuating handle.

Problems Addressed:

The sustainable portable manual standing wheelchair directly tackles several differently-abled user requirements, such as changing the wheelchair position and changing safety locks. Firstly, it addresses

the challenge of many physical and mental health-related issues such as the body, the building of pressure points in the body, lowered blood circulation due to lack of movement, and depression due to dependence on other people for basic needs. Further, conventional wheelchairs suffer from one or more of the following disadvantages, like getting into a standing position without knee support, which could potentially harm. Hence, there is a need for an efficient support system & safety mechanism that addresses the above issues.

To address the above issues, the claimed portable standing wheelchair provides a solution by aiding a wheelchair user in assuming a standing position by means of support from the wheelchair. The proposed invention belongs to SDG 3, which illustrates inventions related to good health and well-being.

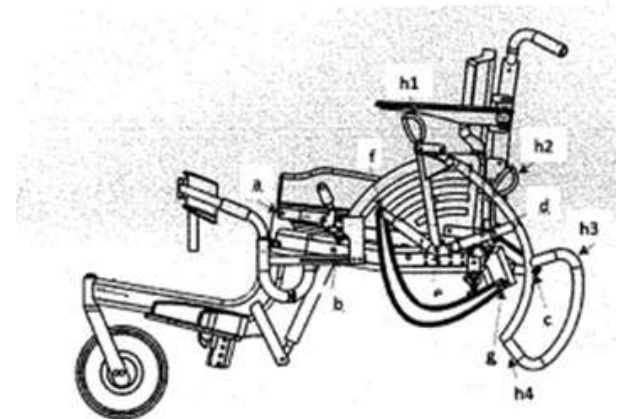
Impact of the Invention:

The sustainable portable standing wheelchair with safety features enhances the physical and psychological well-being of users. Offering a transformative sit-stand-sit experience promotes healthy posture, eye-level interactions, and inclusivity. Its affordability widens access, particularly in low-resource settings, leading to increased mobility and community participation. Indirectly, IP product helps create livelihood opportunities for the otherwise marginalized disability population, thereby alleviating poverty and reducing hunger. The IP product is priced at just 20% of its western counterparts, this solution redefines accessibility. It is noted that the manufacturing of said wheelchair is a great demand. Its adoption has spurred significant interest, with several hundred devices already sold.

Commercialization Details:

The technology is transferred to Phoenix Medical Systems Pvt. Ltd. and Neomotion Assistive Solutions Pvt. Ltd. Arise was developed by Phoenix in partnership with Wellcome Trust and directly aims at better health and well-being for persons with disabilities, reduce inequalities in the community and the innovation bridges the affordability gap. With the use of the product, a person with disability aims for a better health and well-being lifestyle, which reduces inequalities in the community. IP products bridge the affordability gap.

Photographs:



17. Method and System for Aggregating a Plurality of Learning Technologies with an E-Commerce Layer

Summary:

The methods and systems of the patent deals with an e-commerce layer over a variety of learning modes. The publishers can place their content and enable search and purchase of learning technologies. The users can use the same in a seamless and easy-to-use learner interface. This platform also helps a learner follow a journey of learning to apply acquired competencies in the corporates. Further, it provides revenue management between all participating entities. It also provides an activation token engine, which helps to manage enrolments/de-enrolments for

different learning technologies via an activation token engine. The aggregation of the plurality of learning technologies is designed in two setups: a platform model and an enterprise model. In the platform model, there exists an ecosystem of publishers, distributors, institutions, and corporates other than the learners with a platform owner enabling trade between all the different participants in the system, and in the enterprise model where there exists a single publisher and may or may not have distributors. By addressing the critical issues of educational institutes or in other organizations associated with learning content and content management. the e-commerce layer of the patent represents a significant step towards achieving the United Nations Sustainable Development Goal 4 of ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all.

Salient Features:

The methods and systems provide an enrolment service framework that enables different learning management services to integrate easily with a platform. Further, the learning content could be on any platform technology or mode and is offered to the users through a single channel. It is an e-commerce layer over a variety of learning modes wherein publishers can place their content and enable the purchase of learning technologies. The aggregation of the plurality of learning technologies is designed in two setups: a platform model and an enterprise model. The e-commerce layer of the patent does not require rebuilding the system or migrating all its learning content to a new system, which is a very difficult and daunting task, often limiting the organization's decision to shift towards new technology and adaptability.

Problems Addressed:

In the current scenario, various independent learning management systems (LMSs) are being implemented in educational institutes or other organizations. Different modes of learning may be offered by an institute/governing body to the learners using multiple systems. However, no single aggregated layer may help the learners access through a single system for multiple content delivery systems. Also, no system provides an ecosystem for multiple publishers and distributors of learning platforms to exist in a marketplace with unique revenue models. If organizations already have an internal LMS system and would like to provide new modes of learning to their learners, they would need

Patent No: 503399

Date of Grant: 25/01/2024

Applicant: TCS

Inventor(s): Viral Prakash

Shah, Annie Dhairamani,

Santosh Dharamanna

Kusanale, Siddhant

Mahendra Jadhav



It is a very difficult and daunting task to rebuild the system or migrate all their learning content to a new one. This often limits the organization's decision to shift towards new technology and adaptability. The aggregation of learning technologies aims to provide a single platform for learners to search for and consume learning modes and materials that suit their needs. Further, the platform may help different publishers set up and configure their learning content and enable trading for their applications, thus monetizing them.

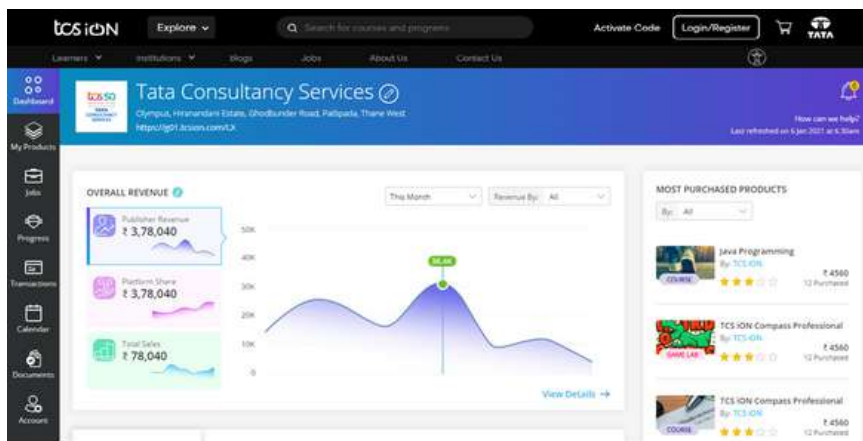
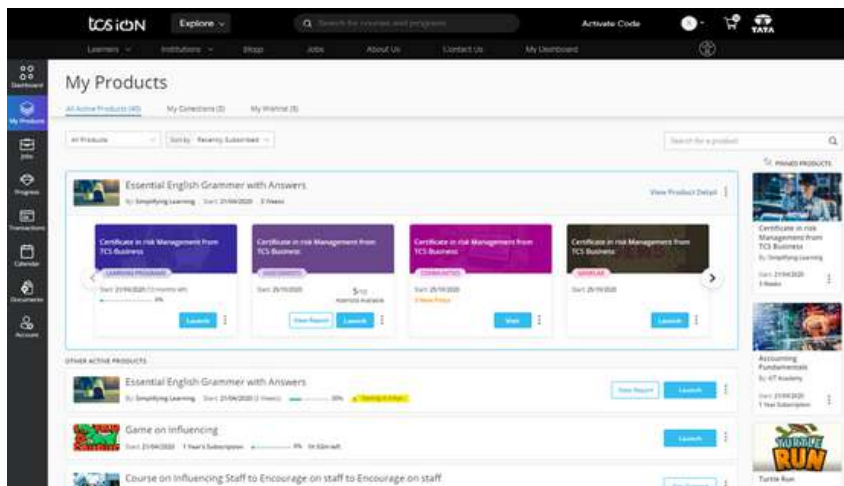
Impact of the Invention:

The e-commerce layer of the patent enables learners to avail themselves of various learning modes and content seamlessly and with an easy-to-use single-channel learner interface. This platform also helps learners follow a journey of learning to the application of acquired competencies in the corporates and manage enrollments /de-enrollments for different learning technologies.

Commercialization Details:

TCS iON Digital Learning Hub is a complete learning solution for a varied segment of learners. It will help users learn and upskill their knowledge from the wide range of courses offered. User can Prepare, test, and analyze their understanding through the Assessments, Share their ideas, and learn from others by being a part of the Communities.

Photographs:



18. Rain Water Harvesting Hopper with Ceramic Membrane Filter and UV Disinfectant

Summary:

The invention is a portable rain water harvesting system designed to collect, filter, and treat rainwater for regular use. The system features a metal cabin with a cotton netting wall and an inverted frustum-shaped hollow ceiling that collects and stores rainwater at the rooftop. The collected water then passes through a ceramic membrane filter, which removes micro dust particles. After filtration, the water is treated with UV light to disinfect any remaining bacteria or harmful germs. The UV purification process destroys 99.99% of harmful

microorganisms, making the water safe for use. The entire cabin is foldable and transportable, with a chequered plywood flooring and a safety door for entry. The filtered and treated water is drained through a valve for regular use.

Salient Features:

The Rainwater harvesting hopper with a ceramic membrane filter and UV disinfectant has several salient features that make it an effective and convenient solution for collecting and treating rainwater. The system is designed to be portable, with a foldable metal frame that can be easily transported and set up in any appropriate location. The inverted frustum-shaped hollow ceiling and hopper allow for efficient collection and storage of rainwater. The cotton woven netting provides shelter to the cabin from dusty breezes and diffuses harsh sunlight. The ceramic membrane filter effectively removes microdust particles and pollutants from the collected rainwater. The UV filter treats the filtered water with ultraviolet rays, destroying 99.99% of harmful microorganisms and making the water safe for regular use. The chequered plywood flooring provides rigid flooring, and a safety door is provided for easy entry into the cabin. The drain valve allows for easy access to the treated water. The entire design is an innovative and practical solution for collecting and treating rainwater for regular use.

Problems Addressed:

It provides a solution for collecting and storing rainwater, which can be a valuable source of water in areas where water is scarce. The system addresses the problem of water pollution by filtering and treating the collected rainwater and removing microdust particles, pollutants, and harmful microorganisms. This ensures the water is safe for regular use and reduces the risk of waterborne diseases. The system is designed to be portable and transportable, making it a convenient solution for use in different locations and during times of emergency. The use of UV disinfection technology provides an effective and efficient way to treat water without the use of chemicals, making it a sustainable and eco-friendly solution. The device addresses the problems of water scarcity, pollution, and accessibility, providing a practical and sustainable solution for collecting and treating rainwater for regular use.

Patent No: 380434

Date of Grant: 27/10/2021

**Applicant: S. Shasi Anand,
P. Jayakumar**

**Inventor(s): P. Jayakumar,
S. Shasi Anand, T.R.**

**Neelakantan, C.
Shivapragasam**



Impact of the Invention:

The invention has the potential to significantly impact water scarcity and quality issues, particularly in areas where access to clean water is limited. By providing a portable and efficient solution for collecting and treating rainwater, the system can help reduce the strain on existing water resources and provide a sustainable source of water for regular use.

Ceramic membrane filters and UV disinfection technology ensure that the collected rainwater is safe for use, reducing the risk of waterborne diseases and improving public health. This is particularly important in developing countries where access to clean water is often limited, and waterborne diseases are a significant health concern.

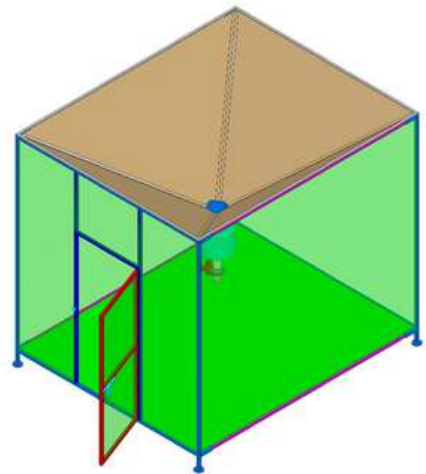
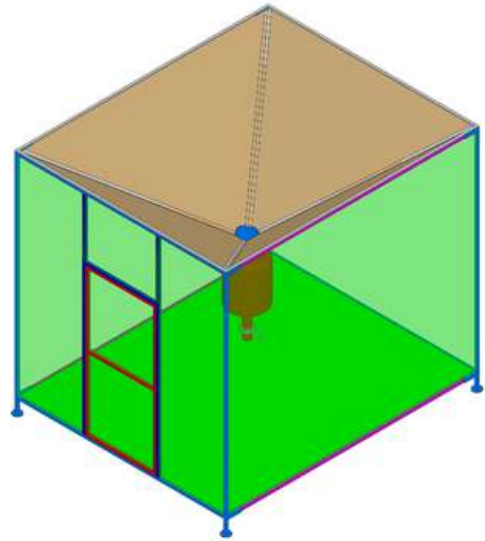
The system's portability and ease of use make it a valuable tool for emergency response and disaster relief efforts. In the aftermath of natural disasters, access to clean water is often disrupted, and the rainwater harvesting hopper with ceramic membrane filter and UV disinfectant can be deployed quickly to provide a reliable source of clean water for affected communities.

The invention has the potential to improve water security, public health, and disaster response efforts, making it a valuable innovation for sustainable water management.

Commercialization Details:

Prototype model has been developed and commercialisation is under process.

Photographs:



19. Water Glass with UV Sterilized with Solar Stirrer Lid

Summary:

This innovative design comprises a base pedestal, a drinking water glass, and a lid with a stirrer. The base pedestal houses a rechargeable battery to power a cluster of UV LEDs arranged in a circular pattern and fixed on the top surface. The UV light penetrates the water in the glass to disinfect any germs present. The lid, designed to cover the glass, has an integral stirrer powered by a solar cell fixed on its top surface. The

stirrer is activated by a slim PCB motor fixed on the inside surface of the lid. The base pedestal is designed to hold the glass, which is made of transparent material, in a provided cavity. The circuitry to ignite the UV LEDs is fixed within the base pedestal, and the UV light with a wavelength of 254 nm sterilizes the water. The drinking water glass is fitted with a closure lid and a solar panel on the top to power the stirrer. A mini switch on the side of the glass activates the stirrer motor, which stirs the water inside the glass. The lid also has a built-in solar panel to run the stirrer motor, and a mini PCB motor with low torque is fixed on the lid, connected with a stirrer shaft to mix the water.

Salient Features:

It uses UV LEDs to sterilize the water, effectively eliminating germs and ensuring safe drinking water. The device is powered by a rechargeable battery, which can be charged through external sources, making it energy-efficient and eco-friendly. The lid is equipped with a solar-powered stirrer, which ensures the water is mixed well, enhancing the effectiveness of the UV sterilization process. The glass and the lid are made of transparent material, allowing the UV light to penetrate effectively. The device is user-friendly, with a mini switch on the side of the glass to activate the stirrer, making it convenient to use.

Problems Addressed:

The invention addresses several problems related to water consumption. It tackles the issue of water contamination by using UV LEDs to sterilize the water, ensuring that it is free from harmful germs and safe to drink. It addresses the problem of uneven distribution of additives or substances in water by using a solar-powered stirrer to mix the water thoroughly. It solves the problem of energy consumption by using a rechargeable battery and a solar panel, making it an eco-friendly and sustainable solution. It addresses the inconvenience of manual stirring and the need for separate stirring devices, making it a user-friendly and convenient solution for everyday use.

Patent No: 424084

Date of Grant: 06/03/2023

**Applicant: Kalasalingam
Academy**

**Inventor(s): S. Shasi Anand,
P. Jaya Kumar**



Photographs:



Impact of the Invention:

The Water glass with UV sterilization and solar stirrer lid has the potential to impact public health and the environment significantly. By sterilizing water using UV LEDs, the device ensures it is safe to drink, reducing the risk of waterborne diseases. The solar-powered stirrer ensures that any additives or substances in the water are evenly distributed, enhancing the effectiveness of the sterilization process. The device is energy-efficient and eco-friendly. It uses a rechargeable battery and a solar panel, reducing reliance on non-renewable energy sources. This makes it a sustainable solution for everyday use, contributing to the reduction of carbon footprint.

Commercialization Details:

The prototype model has been designed and tested successfully.

20. A Water Filter Candle System for Removal of Arsenic Including Associated Impurities from Arsenic Contaminated Ground Water and a Method of Manufacturing a Water Filter Candle

Summary:

The invention described here is a water filter candle system designed specifically to remove arsenic and other impurities from arsenic-contaminated groundwater. The system consists of at least two chambers and at least three water filter candles. These candles are made using a mix of conventional water filter materials and fines generated in the cold rolling mill of an integrated steel plant. The invention also includes a method for manufacturing these arsenic and impurity removal water filter candles. This

innovative system effectively eliminates arsenic, heavy metals, hazardous contaminants, bacteria, and other unwanted impurities from groundwater, providing a reliable solution to the problem of arsenic contamination. The water filter candles are made using a combination of integrated steel industry cold rolling mill fines and traditional water filter materials such as China clay, Ball clay, Quartz, Feldspar, Calcium Carbonate, and Charcoal.

Patent No: 298807

Date of Grant: 12/07/2018

Applicant: Tata Steel

Inventor(s): Bhagwati

Prasad, Chiradeep Ghosh,

Manish Kumar Bhadu,

Anindita Chakraborty



Salient Features:

This invention pertains to a filter system designed to remove arsenic and other impurities, such as heavy metals, hazardous substances, bacteria, and unwanted impurities from arsenic-contaminated groundwater, resulting in potable water. Additionally, the invention encompasses a method for manufacturing the filter system intended for the removal of arsenic and associated impurities from arsenic-contaminated groundwater. The primary objective of this invention is to propose a water filter system that effectively reduces arsenic and other heavy metals to an acceptable limit in arsenic-

and other heavy metals and eliminates bacteria and impurities from the arsenic-contaminated groundwater, providing portable water. Lastly, the invention aims to propose a water filter system that is easy to manufacture, operate, and maintain while effectively reducing arsenic and other heavy metals to an acceptable level in arsenic-contaminated groundwater.

Problems Addressed:

Arsenic in drinking water, arising from natural sources or human activities, poses a global health threat, as it is linked to cancers and heart diseases. To address this, clean water devoid of arsenic and other pollutants is essential. The European Union and the United States cap arsenic levels at 10 µg/L for safe consumption. Consequently, affordable arsenic removal technologies are in high demand, particularly in less affluent nations. Techniques like oxidation, precipitation, and adsorption, including membrane filtration and ion exchange, are employed, each with its pros and cons. Iron-based adsorbents are prevalent due to their cost-effectiveness and availability. Market solutions range from SDND to aqua pro and ion-exchange filters. Notably, domestic filters, approved by the Bureau of Indian Standards, effectively diminish arsenic and iron levels using a two-stage process involving a unique soil and paddy husk candle, followed by activated alumina. Despite the existence of commercial systems, their costliness and complexity limit accessibility. Thus, there is an imperative need for an economical and straightforward system to purify arsenic-laden groundwater, ensuring a supply of potable water for affected communities.

Impact of the Invention:

The invention describes the creation of a water filter candle capable of eliminating arsenic-contaminated groundwater, along with other harmful contaminants such as heavy metals and various unwanted impurities. This is achieved by utilizing iron oxide fines sourced from various operations within the integrated steel industry. An analysis of the chemical composition and particle size of these fines determined that those from the Cold Rolled Mill (CRM), with a size range of 100-300 nanometers, are the most effective for constructing a cost-efficient system for arsenic removal. X-ray diffraction analysis of the CRM fines revealed the presence of predominantly ferrous oxide (Fe₂O₃) peaks. To fabricate the water filter candle that targets arsenic and other impurities, CRM fines, comprising 15-40% by weight, are blended with traditional water filtration materials such as china clay, ball clay, quartz, feldspar, calcium carbonate, and charcoal.

Commercialization Details:

Extensive plant trials have been conducted to remove arsenic using this process effectively.

21. A Process for Removing Arsenic and Associated Impurities from Underground Water

Summary:

The invention proposes a method for contaminant sequestration using surface complication and particle aggregation. It focuses on the removal of toxins from the environment, particularly for particle sizes around 70-100 nm. These nanophases' sorption capacity and surface molecular structure differ from bulk material. The invention discusses factors affecting the geochemical reactivity of these nanophases and

includes recent studies on nano goethite growth, aggregation, and sorption processes. In terms of practical application, the invention utilizes naturally occurring iron hydroxide composite nanoparticles to remove arsenic and other heavy metals. It employs an innovative technique of adsorption-co precipitation and settlement for their removal. The invention evaluates the effectiveness of this method in removing arsenic, lead, and mercury from water. Manual mixing and prolonged settlement are found to achieve about 90% removal of these heavy metals after 24 hours. Furthermore, when the iron levels are sufficiently high, a simple shaking of the container and allowing the iron-arsenic complex to settle for 3 days reduces the arsenic concentration from 0.10 mg/l to 0.05 mg/l.

Salient Features:

A process for removing arsenic from underground water involves using goethite-based composite nanoparticles derived from beneficiated iron slime. The nanoparticles are contacted with the underground water under absorption conditions at a pH range 7.8. The goethite-based rejects slime used has a minimum iron content of 30% with particles smaller than 100nm. Double distilled water is used for specimen preparation. GR-grade chemicals are used without purification. Arsenic As (III)/lead/mercury solutions in 0.5 M/l HCl are prepared from pure metal oxide with a concentration of PPM. The pH is adjusted with 0.1 M NaOH. Glassware is cleaned with chromic acid and distilled water. Blank tests confirmed no loss of arsenic through adsorption onto the glassware. Arsenic is measured using Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES). Mixing is necessary for aeration, flocculation, and chemical dispersion. Shaking is a simple method for mixing at the village level. Mechanical mixing is used for reference purposes. Filtration is introduced for reference purposes, but sedimentation is the main focus for achieving solid-liquid separation after the initial As-Fe, As-Pb, and As-Hg interaction.

Problems Addressed:

Natural geochemical weathering of subsurface soil has now reached an unacceptable level of dissolved arsenic in groundwater in many regions of the Asiatic subcontinent. Rainfall in this geographical area is quite high, but the surface water is not fit for drinking. Due to the poor sanitation system prevailing in the region, practices with the potential for an outbreak of waterborne diseases remain in the surface water. To mitigate this problem, thousands of well-head units attached to manual hand pumps were sunk during the last four decades to provide safe, potable water to millions of villages in the region. As the presence of unacceptably high levels of arsenic does not prima-facie alter the taste, color, or odor of

Patent No: 296770

Date of Grant: 14/05/2018

Applicant: Tata Steel

Inventor(s): Supriya

Sarkar, Pinakpani Biswas,

Manindra Manna



water, it is not possible to easily defect in a geographical area, even if the arsenic concentration in groundwater exceeds well over 100 µg/L. An estimated 100 million people in the Asia-Pacific region are currently affected. Arsenic in the groundwater was first detected in 1993, based on several reports indicating that many people are suffering from arsenic skin diseases. Further investigations revealed that water supply in large areas of the country is affected, and millions of people are at serious risk of arsenic poisoning. Technology for arsenic removal from water already exists. However, socioeconomic conditions do not permit the implementation of this type of technology because of its high cost. A further problem in the groundwater in parts of the world is the presence of iron. While iron content is not a health hazard, it maintains a better taste and is usually removed from drinking water staining problems.

Impact of the Invention:

The process of eliminating arsenic and related impurities from underground water includes treating the water in a free state at a pH level of 7.8 with goethite-based composite nanoparticles. These nanoparticles are derived from the by-products of beneficiated iron slime, which contains a minimum of 30% iron and more than 70% nanoparticles smaller than 100 nm. This method effectively and economically removes arsenic and other impurities from the water without requiring an additional purification step. Moreover, it is environmentally friendly.

Commercialization Details:

Extensive plant trials have been conducted to remove arsenic using this process effectively.

22. A Process for Removal of Cyanide from Waste-Water

Summary:

This patented invention pertains to a method for eliminating free cyanide (CN⁻) from water that contains cyanide. This is achieved by treating the cyanide-laden water with a specialized supramolecular metallo cage denoted as [L{M}], which effectively purifies the water by removing the cyanide contaminants. Additionally, this disclosure encompasses the provision of the supramolecular metallo cage [L{M}], a procedure for its synthesis, and an application for the extraction of free cyanide (CN⁻) from industrial wastewater.

Patent No: 500927

Date of Grant: 18/01/2024

Applicant: Tata Steel ,
Indian Association for The
Cultivation of Science

Inventor(s): Priyanka
Saha,Supriya Sarkar,Tamal
Kanti Ghosh,Pradyut Ghosh



Salient Features:

- Unimpacted by temperature.
- Ease of application.
- Minimal CAPEX,

Eliminating free cyanide from water containing cyanide entails applying a supramolecular metallo cage, designated as compound (I), to extract the cyanide. The application of compound (I) is specifically for the purpose of purifying water by removing free cyanide. Additionally, this process describes the structure of compound (I) itself, as well as the method for synthesizing this compound, which involves a chemical reaction between a ligand with an amine group, also referred to using the formula (1), and copper sulfate, conducted in the presence of a certain solvent.

Problems Addressed:

Cyanides are utilized in various chemical productions and arise from metallurgical processes. These ions stand out as particularly harmful pollutants in industrial effluents, posing significant environmental and public health risks due to their high toxicity. Major industries such as steel manufacturing, chemical production, and electroplating are responsible for generating cyanide as a byproduct. Prolonged exposure to even low levels of cyanide can elevate the likelihood of developing health issues, including skin cancer, difficulty breathing, rapid heartbeat, and loss of consciousness. Consequently, it is crucial to eliminate cyanide from wastewater containing it before releasing it into the surroundings. In the iron and steel sector, wastewater from coke ovens and blast furnace operations contributes to cyanide contamination in water. Nonetheless, the nature of cyanide in these effluents differs greatly, complicated by the presence of various other substances. The cyanide in coke oven effluent coexists with additional contaminants like ammonia, thiocyanate, sulfides, pyridine, oil, tar, phenol, cresol, benzol, polycyclic aromatic hydrocarbons (PAH), etc. In contrast, blast furnace effluent not only contains different cyanide forms but also has high levels of chloride and ammonia, along with other stubborn inorganic elements such as iron, sodium, potassium, and sulfate ions.

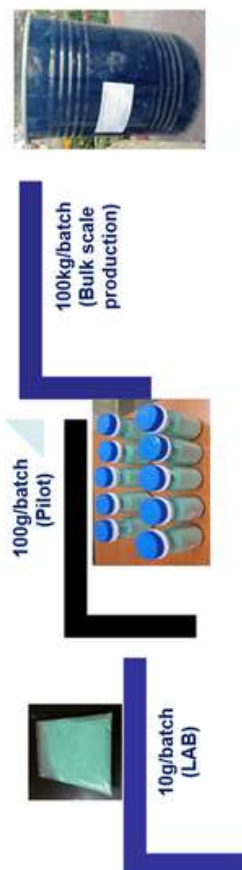
Impact of the Invention:

The invention describes the creation of a water filter candle capable of eliminating arsenic- contaminated groundwater and other harmful contaminants such as heavy metals and various unwanted impurities. This is achieved by utilizing iron oxide fines sourced from various operations within the integrated steel industry. An analysis of the chemical composition and particle size of these fines determined that those from the Cold Rolled Mill (CRM), with a size range of 100-300 nanometers, are the most effective for constructing a cost-efficient system for arsenic removal. X-ray diffraction analysis of the CRM fines revealed the presence of predominantly ferrous oxide (Fe_2O_3) peaks. To fabricate the water filter candle that targets arsenic and other impurities, CRM fines, comprising 15-40% by weight, are blended with traditional water filtration materials such as china clay, ball clay, quartz, feldspar, calcium carbonate, and charcoal.

Commercialization Details:

Extensive plant trials have been conducted to remove cyanide from waste water using this process effectively.

Photographs:



23. A Homogenizing Device for Mixing Sludge of a Septic Tank.

Summary:

A homogenizing device for mixing septic tank sludge comprises a shaft with piercing members, two sets of blades, and a motor. The shaft is rotatable and connectable to the motor. The piercing members pierce through and rake the sludge while the blades homogeneously mix it. Blades are pitched at 30° to 45° angles and radially spaced apart. Viscosity control is managed by a control unit coupled to sensors. A gearbox varies shaft speed. The device can be handled and aligned vertically in the tank, creating a vortex for effective sludge movement. A method involves piercing, rotating, raking, and mixing the sludge.

Salient Features:

- **Efficient Mixing:** The device mixes septic tank sludge efficiently using a combination of piercing members and two sets of blades.
- **Variable Speed:** It features a gearbox integrated with the motor, allowing for the selective variation of shaft rotation speed based on viscosity and operational signals.
- **Sensor Integration:** A control unit coupled to sensors determines the viscosity of the sludge volumes, enabling precise control of the mixing process.
- **Vortex Formation:** Piercing members create a vortex, facilitating the movement of sludge for effective raking by the blades.
- **Versatile Design:** With a handle for easy maneuvering, vertical alignment, and concentrically mounted blades, the device is versatile and adaptable to various septic tank configurations.

Problems Addressed:

The technical problem addressed relates to Sustainable Development Goal 6: Clean Water and Sanitation. Firstly, the invention tackles the challenge of effectively managing septic tank sludge in both urban and rural areas. Traditional methods involve manual scavenging or costly, water-intensive processes, posing health risks and environmental concerns. The accumulation of solid waste in septic tanks leads to odors and potential overflow, posing health hazards and environmental pollution. By introducing a homogenizing device with piercing members and multiple blades, the invention offers a safer, more efficient solution to mix and manage sludge, promoting improved sanitation and reducing health risks associated with manual cleaning.

Patent No: 453309

Date of Grant: 21/09/2023

Applicant: IIT Madras

Inventor(s): Prabhu

Rajagopal, Divanshu

Kumar, Bhavesh Narayani



Photographs:



Impact of the Invention:

The Homogenizing Device for Septic Tank Sludge emerges as a beacon of progress in the critical realm of sanitation management. Its introduction marks a pivotal step forward, addressing the challenge of sludge accumulation and safeguarding public health, enhancing living standards, and fostering sustainable development. Effectively mixing and managing septic tank sludge reduces the risk of overflow and the spread of diseases, thus promoting healthier environments and reducing mortality rates, particularly among vulnerable populations. Furthermore, offering a safer alternative to manual scavenging and minimizing environmental impact promotes ecological sustainability and resilience. In achieving these objectives, the device aligns closely with several Sustainable Development Goals, notably ensuring access to clean water and sanitation for all.

Commercialization Details:

LICENSOR: IIT MADRAS

LICENSEE: SOLINAS INTEGRITY PRIVATE LIMITED (<http://solinas.in/>)

COMMERCIAL PRODUCTS: HomoSEP (Septic tank cleaning robots)

24. A Composition for Water Treatment

Summary:

The invention of the patent application relates to a composition for water treatment. The composition includes two portion of rice husk ash, each bonded with a different bactericidal agent. A first portion of the composition is bonded with a bactericidal agent, and a second portion of the composition includes material like ground charcoal. The second portion may also include iodine-containing resin coated on a suitable substrate, activated carbon, activated carbon treated with nano silver, terra-cotta treated with nano silver, fired clay treated with nano silver, a mixture of RHA, and a suitable binder with or without nano silver, and other materials suitable for water purification. The two portions enable the effective removal of bacteria from water. More specifically, the water is passed over the composition for the treatment of water at a flow rate that ensures that the water remains for a sufficient period over the composition. The composition of rice husk ash and the bactericidal agent synergistically work together to remove the bacteria content from water. In particular, the rice husk ash bonded with nano silver particles effectively removes bacterial content from water efficiently and economically. By addressing the critical issues of water cleanliness and sanitation, pollution, and health risks associated with contaminated water, the composition for water treatment provided in this patent specification represents a significant step towards achieving the United Nations Sustainable Development Goal (SDG) 3 of good health and well-being, SDG 6 of ensuring access to clean water and sanitation, and SDG 7 of affordable and clean energy.

Appl. No: 1569/MUM/2008

Applicant: TCS

**Inventor(s): Kalyan Kumar Das,
Chetan Premkumar Malhotra**



Salient Features:

The composition of the patent application for water treatment is inexpensive, easy to use, and effective in removing bacterial contamination from drinking water. The composition includes rice husk, a perennially renewable agro-waste available at virtually no cost. Furthermore, water treatment using the composition of this patent application is a low-maintenance approach compared to conventional filter devices, which are high-cost maintenance and tend to be bulky in nature.

Problems Addressed:

Clean, potable water is a basic human requirement. However, many of the world's population, especially those in developing countries, do not have access to clean potable water.

Growing population, lack of sanitary conditions, poverty, poor planning, industrial pollution, over-exploitation of natural water, and national disasters are the main reasons for the contamination of water. This contaminated water is the source of many diseases, such as diarrhea, dysentery, fever, abdominal pain, and constipation, caused due to bacterial contamination transmitted through water.

Many water purification devices, such as in-line (electricity-operated) devices, terminal end devices, countertops, faucet-mounted filtration, and self-contained batch systems, including gravity-fed systems, have been introduced into the market. However, many communities in developing countries do not "have access to piped water or reliable electricity connection to make use of inline or electrically driven purification units. They also do not have access to central water purification units installed near the water bodies from where they source their water. Moreover, the people in these communities cannot afford the point-of-use water purifiers currently available on the market. The maintenance requirements and the high cost of consumables of these purifiers pose further hurdles to the adoption of these devices.

Impact of the Invention:

According to the World Health Organization, safe water alone can reduce diarrheal and enteric disease by up to 50%, even without improved sanitation and other hygiene measures. The composition of the patent application for water treatment is inexpensive, easy to use, and effective in removing bacterial contamination from drinking water. The water treatment approach provides hope for communities grappling with water contamination issues. The composition of the patent application not only addresses the basic needs of society but also works to safeguard public health and foster sustainable development. The composition for water treatment includes rice husk, a perennially renewable agro waste that reduces carbon footprint, contributing to climate resilience and ecosystem preservation.

Photographs:



Commercialization Details:

Tata Swach® Nanotech Water Purifier includes a process to impregnate nano-silver onto the surface of RHA, resulting in a purification media capable of inactivating both bacterial and viral contaminants. Tata Swach® was launched in the Indian market as one of the world's most cost-effective water purifiers.

25. Automatic Water Tap Dispenser with Water Storage Tank

Summary:

The invention is an "Automatic Water Tap Dispenser with Water Storage Tank" that has a protective enclosure, a main water storage tank, a water outlet spout, and an electronic interface. The water storage tank has a capacity of at least 100 liters and is designed with a safety lid to prevent dust contamination. The automatic detection feature uses an infrared proximity sensor placed on the lid's top surface and a DC battery housed inside the protective enclosure. A submersible DC water pump is located at the bottom, connected to the delivery outlet of the external spout. The infrared proximity sensor is also fixed near the external spout, and when a vessel is detected, it triggers the DC water pump to deliver water from the storage tank to the outlet spout. The protective enclosure is plastic and accommodates all the electronic circuitry, IR sensor interface, DC suction pump, and battery backup provision. The main water storage tank is made of FRP material and has a refilling port at the top side of the tank. The water outlet spout delivers water whenever a vessel is placed near it, and the electronic interface controls the entire device, operated by a 6-volt DC internal battery.

Patent No: 433222

Date of Grant: 30/05/2023

**Applicant: Dr. S. Malarkkan,
Dr.R.Valli**

**Inventor(s): Dr. S.
Malarkkan, V. Rajesh, Dr. S.
Arunmozhi, Dr.R.Valli**



Salient Features:

The salient features of the "Automatic Water Tap Dispenser with Water Storage Tank" invention are

- **Automatic Detection:** The device uses an infrared proximity sensor to detect the presence of a vessel near the water outlet spout and automatically dispenses water.
- **Large Water Storage Tank:** The device has a main water storage tank with at least 100 liters capacity, providing sufficient water.
- **Protective Enclosure:** The device is enclosed in a protective cabinet made of plastic material that accommodates all the electronic circuitry, IR sensor interface, DC suction pump, and battery backup provision.
- **Submersible DC Water Pump:** The device uses a submersible DC water pump placed at the bottom of the storage tank to deliver water from the tank to the outlet spout.
- **FRP Material:** The main water storage tank is made of FRP material, which is durable and resistant to corrosion.
- **Refilling Port:** The tank has a refilling port at the top side, which allows you to fill the water inside the tank without opening the lid.
- **Electronic Interface:** The device is controlled by an electronic interface that operates on a 6-volt DC internal battery, which powers up the device, the IR sensor, and the DC suction pump.
- **Water Outlet Spout:** The outlet spout is the outlet water passage that delivers water whenever a vessel is placed near it.
- **Recharging Port:** The device has a recharging port sideways, which charges the battery from an external source.
- **Safety Lid:** The water storage tank is designed with a safety lid to protect the water from dust contamination.

Problems Addressed:

Traditional water taps often lead to water wastage as they require manual operation, and people tend to leave the tap running longer than necessary. The automatic detection feature of this device ensures that water is dispensed only when required, reducing water wastage.

Traditional water taps can be a breeding ground for germs and bacteria as they require manual operation, and people touch them with unwashed hands. The automatic detection feature of this device eliminates the need for manual operation, reducing the risk of germs and bacteria spreading.

Conserving water is essential in areas where water scarcity is a concern. This device's large water storage tank provides sufficient water for use, ensuring that water is available even in areas with water scarcity.

Traditional water pumps require a constant power supply to operate, making them ineffective during power outages. This device's battery backup provision ensures it can operate even during power outages.

Traditional water taps and pumps require frequent maintenance, which can be time-consuming and expensive. This device's submersible DC water pump is low maintenance and durable, reducing the need for frequent maintenance.

Traditional water tanks made of metal are prone to corrosion, which can lead to water contamination. The FRP material used in this device is resistant to corrosion, ensuring that the water stored in the tank remains safe for consumption.

Traditional water taps and pumps require manual operation, which can be inconvenient, especially for people with disabilities. This device's automatic detection feature eliminates the need for manual operation, making it convenient for everyone to use.

Impact of the Invention:

The automatic detection feature of this device ensures that water is dispensed only when required, reducing water wastage. This can lead to significant water conservation, especially in areas where water scarcity is a concern.

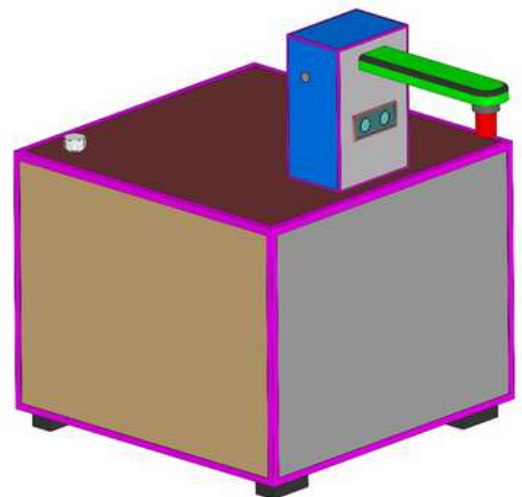
This device's automatic detection feature eliminates the need for manual operation, reducing the risk of germs and bacteria spreading. This can lead to improved hygiene, especially in public places such as hospitals, schools, and restaurants.

This device's automatic detection feature makes it convenient for everyone to use, especially for people with disabilities. This can improve accessibility and make it easier for people to access clean water.

The battery backup provision of this device ensures that it can operate even during power outages. This can be especially useful in areas where power outages are frequent, ensuring people have access to clean water even during power outages.

This device's submersible DC water pump is low maintenance and durable, reducing the need for frequent maintenance. This can save time and money, making it a cost-effective solution for providing clean water.

Photographs:



26. An Electrolyzer System with Nonprecious Electrocatalysts for Green H₂ Production by Electrolysis of Water

Summary:

The sustainable electrolyzer system is feasible for producing green hydrogen from natural water resources, i.e., treated seawater, groundwater, and salty groundwater. Said electrolyzer system comprises an anode catalyst layer, a cathode catalyst layer, and a catalytic support for the anode catalyst layer and cathode catalyst layer, characterized in that the anode catalyst layer comprises Prussian blue analog (PBA) and nitrogen-doped carbon nanotube (NCNT or CNT)

composite, the cathode catalyst layer comprises Metallic nickel particles encapsulated inside nitrogen-doped carbon tubules (Ni/NCT). The present invention also discloses a method for developing an electrolyzer system. The invention belongs to the category of sustainable development goal (SDG 7): affordable and clean energy.

Patent No: 419116

Date of Grant: 24/01/2023

Applicant: IIT Madras

Inventor(s): R amaprabhu

S, Anamika Ghosh, Dipsikha

Ganguly



Salient Features:

The Sustainable electrolyzer system has salient features expressed herein below:

- The proposed prototype of the electrolyzer system is feasible for producing green hydrogen from seawater, including the natural resource of water.
- The electrolyzer system is non-precious and straightforward to synthesize. It uses seawater electrolysis, with cathode and anode catalysis, for efficient H₂ production.
- The unique green H₂ production mechanism enhances the eco-friendly process, safety process, cost-effectiveness, and easy access to hydrogen.
- This invention widens access to natural fuel hydrogen, particularly in low/medium/and high-scale hydrogen production based on configuration setup.
- The prototype product facilitates a groundbreaking production of hydrogen and oxygen.

Problems Addressed:

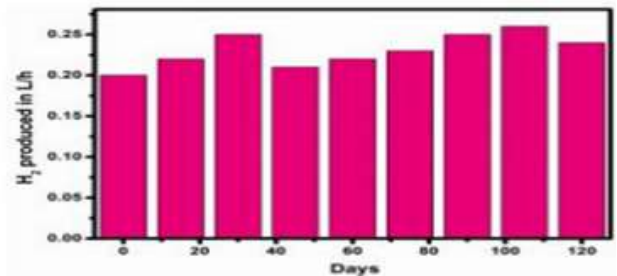
The Sustainable electrolyzer directly tackles hydrogen production issues outlined in Sustainable Development Goal 7: affordable and clean energy. The production of hydrogen is a tedious process, and the electrolysis process includes sea water for the production of hydrogen. The major issue caused while using real sea water during the electrolysis process is that water contains several salts. That form participates on the cathode surface, which obstructs reaching the benchmark of current density, including other issues like chlorine corrosion, impurities & multiple ions present in the water. Moreover, there are also several ion adsorptions on the cathode & anode surface, further making both the Oxygen Evolution Reaction (OER) & Hydrogen Evolution Reaction (HER) sluggish. Hence, an electrolyzer system and framework are needed to overcome the above issues.

Impact of the Invention:

The Sustainable prototype of the electrolyzer enhances the feasibility of hydrogen and oxygen production from natural resources of water. Offering this sustainable technology, it promotes another

resource of natural fuel generation can be applicable in different areas, including fishing boats in seawater. Its affordability widens access, particularly in low/medium/and high-scale hydrogen production based on configuration setup, leading to increased usage of Hydrogen vehicles and community participation. The innovation bridges the affordability gap. Said invention generates socio-economic benefits by generating manufacturing units of green hydrogen production assembly. Indirectly, the Proposed prototype helps create livelihood opportunities for the large population, including the finishing community, thereby alleviating poverty and reducing hunger. The prototype of the invention is priced in a cost-effective manner & therefore, the solution defines accessibility. It is noted that the manufacturing of said prototype is in great demand. The technology is sustainable and cost-effective, & the adoption has spurred significant interest, with a huge prototype in demand. This innovation represents a pivotal step toward sustainable green hydrogen production in an eco-friendly manner.

Photographs:



Commercialization Details:

The Technology Licensing is in progress with DREAMGREEN Technologies Private Limited with a License fee and other terms/clause(s).

27. Photo Electric Candle

Summary:

The invention is a photo electric candle that simulates a real candle flame using an LED and electronic circuitry. The main body of the candle is made of molded wax with a central through hole, and a flame-shaped molded tip is placed on top. The candle sits on a raised plastic pedestal that houses the electronic circuitry, a rechargeable battery, and a solar panel. The solar panel charges the battery

during the day, and the electronic circuitry powers the LED inside the flame-shaped tip to simulate a real flame with uniform illumination. The central through hole in the wax candle allows for the passage of

Patent No : 421147

Date of Grant: 10/02/2023

**Applicant: S. Shasi Anand,
P. Jayakumar**

**Inventor(s): P. Jayakumar,
S. Shasi Anand, Priya. P**



wires from the bottom circuit to the LED bulb. The flame-shaped molded tip is made of diffused plastic material and has a hollow blind hole inside to fix the warm white colored LED. The base tip of the bulb is fixed on the top side of the wax candle, resembling a real candle appearance. The raised pedestal has a frustum-shaped base with a closed bottom cabin and a hollow portion on the top side where the wax candle is fixed. The solar panel supplies regulated DC voltage to the entire circuit, and the flame simulator LED circuit is connected to the warm white LED fixed inside the flame-shaped molded tip to ignite the LED with real flame simulation.

Salient Features:

- The photo electric candle has a molded wax body with a central through hole and a flame-shaped molded tip on top, giving it a realistic appearance.
- The candle sits on a raised plastic pedestal that houses the electronic circuitry, a rechargeable battery, and a solar panel.
- The solar panel charges the battery during the day, providing a sustainable power source for the candle.
- The electronic circuitry powers an LED inside the flame-shaped tip to simulate a real flame with uniform illumination.
- The flame-shaped molded tip is made of diffused plastic material and has a hollow blind hole inside to fix the warm white colored LED.
- The base tip of the bulb is fixed on the top side of the wax candle, resembling a real candle appearance.
- The raised pedestal has a frustum-shaped base with a closed bottom cabin and a hollow portion on the top side where the wax candle is fixed.
- The solar panel supplies regulated DC voltage to the entire circuit, and the flame simulator LED circuit is connected to the warm white LED fixed inside the flame-shaped molded tip to ignite the LED with real flame simulation.
- The central through hole in the wax candle allows for the passage of wires from the bottom circuit to the LED bulb.
- The invention provides a safe and energy-efficient alternative to traditional candles.

Problems Addressed:

The invention addresses climate action universally and is an innovative first-time approach to lower the cost of green hydrogen production using nature-inspired solar to green hydrogen generation utilizing solar photovoltaic electrolysis. This approach has formed the key energy vector to convert solar energy to power green hydrogen bikes, which are directly used for mobility solutions. This approach is one of the interesting, viable, feasible, and scalable renewable energy sources available for mobility applications. The mobility solution has non-fossil fuel sources and no greenhouse gas (GHG) emissions. Hydrogen mobility showcase India's proactive stance in climate action and achieve world leader in sustainability.

Photographs:



Impact of the Invention:

The invention demonstrates saving the planet from carbon emissions by adopting various chains of renewable energy sources, such as solar power, through which hydrogen is germinated and utilized for hydrogen-powered mobility bikes. The innovation has direct and indirect positive impact on the spectrum of Sustainable Development Goals - SDGs developed by the United Kingdom: (#7 - Affordable and clean energy, 9 - Industry Innovation and Infrastructure, 11 - Sustainable Cities and Communities, 12 - Responsible Consumption and Production, 13-Climate Action, and 15 - Life on Land). The invention facilitates the achievement of the National Hydrogen Mission, National Solar Mission, and Smart Cities mission, thereby leading to achieving net zero emission by 2070 and making India a global hub for hydrogen mobility solutions. Additionally, the solution facilitates the growth of startup domain and MSME sectors, leading to achieving विकसित भारत@2047 (Viksit Bharat), Atmanirbhar Bharat (आत्मनिर्भर भारत) thereby promoting Make in India and vocal for local products. The frugal solution will enhance the global partnership, especially the Indo-German hydrogen task force, a subregion of South Asia (BBIN) - Bangladesh, Bhutan, India, and Nepal. The technology would initiate Global Capability Centers (GCCs) in India and enhance skilling, up-skilling, and re-skilling, creation of a center of excellence, demo innovation mobility zones, and academia-industry interface through research and development. The technology would increase the capstone projects in hydrogen mobility. Hydrogen bikes would be a testament to India's green economy development.

Commercialization Details:

The prototype model was designed and works well. Samples of the design have been distributed to some customers, and we have received positive feedback. The process for commercialization is in progress.

28. A Catalytic Process to Convert Renewable Feedstock into Aromatics Rich Aviation Fuel

Summary:

The Sustainable Aviation Fuel is an innovative solution to the global challenge of providing renewable, green aviation fuel. The aviation industry is facing increasing pressure to reduce its carbon footprint, and developing sustainable alternative fuels is crucial for achieving this goal. The present invention introduces a catalytic process to convert renewable feedstock into aromatics-rich aviation fuel comprising the processing of renewable feedstock in a fixed bed reactor with a sulfide catalyst. In the present invention, renewable feedstock such as Jatropha oil, Algal oil, and Jatropha and gas oil

mixture is converted to hydrocarbon fuels. The aviation range hydrocarbon produced after distillation contains some aromatics required to meet aviation fuel's lubricity and other critical properties. The present invention relates to a catalytic process for the manufacture of the n-paraffins, iso-paraffin, cyclo-paraffins, and aromatics for the aviation turbine fuel and diesel range from renewable sources such as oils originating from vegetable and animal fats as such or along with petroleum fraction.

This single-step catalytic process utilizes hydrogen and hydroprocessing catalysts under defined operating conditions to achieve hydroconversion reactions. The uniqueness of the process is: (a) single-step/single reactor process, (b) non-noble metal-based catalyst, (c) aromatics are present in the kerosene range hydrocarbon cut, (c) feed agnostic (any vegetable oil fats could be used as feedstock). Aromatics in neat fuel make it a potential candidate for 100 percent drop-in Sustainable Aviation Fuel (SAF). The fuel has been demonstrated on civilian aircraft (Bombardier Q400 Turboprop) with 25% blending with Jet A1 and military transport planes (Antonov AN-32) with 10% blending with Jet A1. By addressing the critical issues of CO₂ emission and energy security, the Sustainable Aviation Fuel represents a significant step towards achieving the United Nations Sustainable Development Goal 7 of ensuring access to affordable and clean energy for all.

Salient Features:

The Single-step catalytic HEFA process developed by CSIR-IIP efficiently converts a variety of lipid feedstocks, including tree-borne oils like Jatropha and Pongamia, as well as derived lipids such as palm stearin and Used Cooking Oil (UCO), into drop-in biofuels. The present invention relates to a catalytic process for the manufacture of the n-paraffins, iso-paraffin, cyclo-paraffins, and aromatics of the aviation turbine fuel and diesel range from renewable sources such as oils originating from plant, algae, and animal fats along with hydrotreating of petroleum fraction. The renewable feedstock is converted into paraffin by decarboxylation/ decarbonylation and hydrodeoxygenation along with cracking, isomerization, and aromatization, whereas sulfur of petroleum fraction is reduced by hydrodesulfurization. The product selectivity is optimized by suitably selecting the catalyst and process conditions. The (re)sulfidation of the catalyst during the neat vegetable oil processing helps maintain the desired activity. In addition, there are favorable changes in the product pattern, thereby lowering

Patent No: 388197

Date of Grant: 31/01/2022

Applicant: CSIR

**Inventor(s): A K Sinha,
Mohit Anand, Saleem**

Farooqui, Rakesh Kumar, R

K Joshi, Rohit Kumar, B S

Rana, Deepak Verma



hydrogen consumption. The supports used for this process are mesoporous alumina, silica-alumina, zeolite, or a combination of two or more. Preferably, high-surface-area mesoporous zeolite is used as support due to the high dispersion of nanoparticles of active metals in the mesopores and on the surface and to diffuse bulky reactants and product molecules better. The present invention is a more cost-effective and attractive route to prepare aviation fuel without adding aromatics separately, as the aromatics are produced in the process.

Additionally, the process yields diesel range hydrocarbons and high-value gasoline by-products suitable for strategic sectors like aviation and defense. Despite being at a pilot scale, economic calculations demonstrate favorable cost competitiveness compared to international biojet prices attributed to low-cost catalysts and a single-step process. This process presents a promising avenue for sustainable biofuel production with significant environmental and economic advantages.

Problems Addressed:

Creating sustainable aviation fuel from vegetable oils presents significant obstacles addressed by the CSIR-IIP's cutting-edge Bio-Jet fuel technology. They ensure high-quality fuel while limiting catalyst deterioration by successfully removing contaminants like metals and phosphorus by developing an in-house pretreatment technique. This technique makes Large-scale degumming possible by maximizing feed use and oil recovery. CSIR-IIP's Bio-Jet fuel, tested at Pratt & Whitney Canada, performs better than traditional methods due to its increased efficiency and ability to produce aromatics throughout the process, in contrast to rivals. It is especially lubricating than substitutes such as the two-step HEFA procedure, which indicates that equipment life will be prolonged. Beyond technological breakthroughs, this invention has enormous promise for India, providing manufacturers and farmers with new avenues for economic growth while reducing the environmental effects of fuels generated from petroleum. By generating sulfur-free, low-emission Bio-Jet fuel. By producing low-emission, sulfur-free Bio-Jet fuel, CSIR-IIP's technology significantly reduces pollution and aligns with global efforts towards sustainable energy solutions.

The process's single-step/single reactor design, non-noble metal-based catalyst, aromatics, and feed-agnostic nature make it distinctive. Neat fuel has aromatics, which makes it a possible option for 100% drop-in Sustainable Aviation Fuel (SAF). The fuel has been tested in military transport aircraft with a 10% blend with Jet A1 and commercial aircraft (Bombardier Q400 Turboprop) with a 25% blend. CSIR-IIP has generated about 14,000 liters (3700 US gallons) of SAF in the Dehradun pilot plant. CSIR-IIP SAF fuel, a 10% blend with fossil jet fuel, has been thoroughly tested by the Indian Air Force (IAF) on Russian Antonov An-32 and Dornier aircraft. CEMILAC has officially certified the fuel for use with a 10% mix (SAF) with jet A1 on all IAF aircraft.

Impact of the Invention:

The CSIR-IIP has developed an innovative single-step catalytic HEFA method that promises to transform India's economic development and environmental sustainability. This breakthrough can help manufacturers make money, create jobs for farmers cultivating barren land, and address environmental issues related to feedstocks generated from petroleum by providing a low-cost alternative to complex and costly methods. The product is eligible for international certification since it satisfies quality criteria established by the Bureau of Indian Criteria and ASTM. The demand for biofuel is expected to increase due to India's aggressive plans to become a global aviation leader and lessen its reliance on imports, particularly with the implementation of CORSIA and the promotion of domestic fuel use.

The Indian aviation sector's rapid growth underscores the significance of this innovation, with projections indicating substantial increases in fleet size, passenger numbers, and airport infrastructure.

Achieving commercial success for the CSIR-IIP method would provide several advantages, such as bettering rural and tribal people's standard of living, lowering carbon emissions by using bio-aviation fuel and renewable diesel, and aligning with national goals. The concept offers tremendous promise for sustainable development and energy independence by making India a leader in manufacturing bio-aviation fuel. While necessitating capital support for viability gaps, first manufacturing at a demonstration or semi-commercial size might fill the gap between invention and mainstream acceptance, meeting the needs of both military and civilian aircraft.

The process's single-step/single reactor design, non-noble metal-based catalyst, aromatics, and feed-agnostic nature make it distinctive. Neat fuel has aromatics, which makes it a possible option for 100% drop-in Sustainable Aviation Fuel (SAF). The fuel has been tested in military transport aircraft with a 10% blend with Jet A1 and commercial aircraft (Bombardier Q400 Turboprop) with a 25% blend. CSIR-IIP has generated about 14,000 liters (3700 US gallons) of SAF in the Dehradun pilot plant. CSIR-IIP SAF fuel, a 10% blend with fossil jet fuel, has been thoroughly tested by the Indian Air Force (IAF) on Russian Antonov An-32 and Dornier aircraft. CEMILAC has officially certified the fuel for use with a 10% mix (SAF) with jet A1 on all IAF aircraft.

Commercialization Details:

India has a sizable market for bio-jet fuel technology developed by the CSIR-IIP; the technology is expected to be blended with conventional Jet A1 fuel at a rate of 0.8 million metric tons yearly, or around INR 44,000 million. The Indian Air Force wants to use bio-jet fuel generated locally to cut fuel consumption by 10%. The fuel is projected to be consumed in around 100,000 tons yearly, or INR 7 billion. Furthermore, Spicejet and Air India also want to use bio-jet fuel for their commercial aircraft; Spicejet estimates they will need 17,500 tons of the fuel yearly, worth INR 1.25 billion. Globally, groups such as Airbus and the International Air Transport Association (IATA) are advocating for the mixing of renewable fuels and their more significant usage.

In India, about 25 units with a capacity of 100 tons per day are needed to satisfy the demand for a 10% bio-jet fuel blend; each unit would cost about INR 300 crores. The first commercial unit with a capacity of 35 KL of SAF per day is planned at Mangalore Refinery and Petrochemicals Limited (Capital cost ~42 million USD) and is expected by 2027. For a commercial plant with a capacity of 30 KTPA SAF, the Capex is ~120 Million USD (1000 crores INR) \pm 30%. The average Opex for the unit is ~Rs 26 per Kg of SAF (0.3 \$/kg; Feed price and H2 excluded). The Capex charge per Kg of SAF (4-year payback basis) is ~Rs 83.

Photographs:



29. An Improved Process to Produce Aromatics Rich Aviation Fuel along with Other C1-C24 Hydrocarbons

Summary:

The Sustainable Aviation Fuel is an innovative solution to the global challenge of providing renewable, green aviation fuel. The aviation industry is facing increasing pressure to reduce its carbon footprint, and developing sustainable alternative fuels is crucial for achieving this goal. This invention falls within the processing field of hydroconversion, more specifically, hydroprocessing of vegetable triglycerides and free fatty acids using an energy-efficient catalytic process to produce paraffin, iso-paraffins, cyclo-paraffins, and aromatics with higher kerosene yield, contoured exothermicity with better heat utilization, no additional quench gas requirement, reactor bed temperature control, and better process control.

The present invention relates to a catalytic process for the manufacture of the n-paraffins, iso-paraffins, cyclic and aromatics for gasoline and aviation turbine fuel and diesel range hydrocarbons (C1-C24 range) from renewable sources such as oils originating from jatropha and similar feedstocks such as algae, animal fats, karanj oil, etc. Accordingly, the present invention provides a single-step catalytic process for the preparation of aromatic-rich aviation fuel from renewable resources in the presence of a hydrogen stream and one or more hydroprocessing catalysts, under operating conditions for hydroconversion reactions, as defined herein, with mixed hot and cold streams of the renewable feed and getting the desired product after separation of water, lighter hydrocarbon gases, and carbon oxides; the product comprises hydrocarbons C6-C24, rich in aromatic content in the aviation fuel range, including the kerosene range.

This single-step catalytic process utilizes hydrogen and hydroprocessing catalysts under defined operating conditions to achieve hydroconversion reactions. The uniqueness of the process is that it involves (a) a single-step/single reactor process, (b) a non-noble metal-based catalyst, (c) the presence of aromatics in the kerosene range hydrocarbon cut, (c) feed agnostic (any vegetable oil fats could be used as feedstock). Aromatics in neat fuel make it a potential candidate for 100 percent drop-in Sustainable Aviation Fuel (SAF). The fuel has been demonstrated on civilian aircraft (Bombardier Q400 Turboprop) with 25% blending with Jet A1 and military transport planes (Antonov AN-32) with 10% blending with Jet A1. By addressing the critical issues of CO₂ emission and energy security, the Sustainable Aviation Fuel represents a significant step towards achieving the United Nations Sustainable Development Goal 7 of ensuring access to affordable and clean energy for all.

Salient Features:

The conversion of renewable feedstocks into aviation fuel and other hydrocarbons is energy intensive. These are highly exothermic reactions with very high hydrogen consumption, a major concern for commercial realization of these processes. These highly exothermic reactions decrease the catalyst life and lead to unwanted cracking and coke formation reactions in catalyst pores, further leading to

Patent No: 399830

Date of Grant: 23/06/2022

Applicant: CSIR

Inventor(s): Anil Kumar

Sinha, Mohit Anand,

Saleem Akhtar Farooqui,

Rakesh Kumar, Rakesh

Kumar Joshi, Rohit Kumar,

Tasleem Khan, Parvez Alam



high-pressure drop, low catalyst life, and costly process. The hydrogen requirement is increased as the unsaturated hydrocarbons formed due to unwanted cracking reactions get saturated, requiring extra hydrogen, which further increases the cost. The process and catalyst discussed in earlier literature do not describe the utility of cold feed streams and their advantages in processing these renewable feedstocks.

Also, the process discussed an efficient heat utilization methodology for these highly exothermic reactions. A single-step process where the hydrogen requirement for conversion of these renewable feedstocks would be less, along with reactions with controlled exothermicity, is highly desirable.

The HEFA process developed by CSIR-IIP efficiently converts a variety of lipid feedstocks, including tree-borne oils like jatropha and Pongamia, as well as derived lipids such as palm stearin and Used Cooking Oil (UCO), into drop-in biofuels. This innovative process involves multiple simultaneous reactions in a single reactor, facilitated by a patented non-noble-metal catalyst, resulting in bio-jet range hydrocarbons with 55-60 % yields. The produced bio-jet fuel meets ASTM D7566 specifications (with additional aromatics), boasting properties similar to conventional Jet A / Jet A-1 fuels. Notably, the process is easily adaptable to existing refinery infrastructure, offering a cost-effective solution.

Additionally, the process yields diesel range hydrocarbons and high-value gasoline by-products suitable for strategic sectors like aviation and defense. Despite being at a pilot scale, economic calculations demonstrate favorable cost competitiveness compared to international bio jet prices, attributed to low-cost catalysts and a single-step process. This process presents a promising avenue for sustainable biofuel production with significant environmental and economic advantages.

Problems Addressed:

The objective of the present invention is to develop a methodology for controlling these exothermic reactions and maintaining the desired conversions and yields of desired products with reduced hydrogen consumption. By utilizing the energy generated on the catalyst surface, the activation barrier for other feed molecules is reached, which drives the reaction further and maintains a stable reaction temperature without any runaway. This energy utilization also prevents unwanted side reactions over the catalyst surface, which consume additional hydrogen. An innovative methodology combining hot and cold streams of the same feed for controlling these exothermic reactions is used, resulting in higher yields of desired aviation kerosene. The cold feed stream is heated in situ due to exothermic reactions already taking place over the catalytic surface with the hot stream.

The fuel has been demonstrated on civilian aircraft (Bombardier Q400 Turboprop) with 25% blending with Jet A1 and military transport planes with 10% blending with Jet A1. CSIR-IIP has produced approximately 14,000 liters (3700 US gallons) of SAF in the pilot plant in Dehradun. The Indian Air Force (IAF) has extensively tested CSIR-IIP SAF fuel (10% blend with fossil jet fuel) on the Russian Antonov An-32 and Dornier aircraft. The fuel is now approved for use on all IAF aircraft with a 10% blend (SAF) with jet A1 by CEMILAC.

Impact of the Invention:

The innovative single-step catalytic HEFA process developed by CSIR-IIP has the potential to revolutionize both environmental sustainability and economic growth in India. By offering a cost-effective alternative to multi-step and expensive technologies, this innovation can foster employment opportunities for farmers cultivating barren lands, provide economic benefits for industrialists, and address environmental concerns associated with petroleum-derived feedstocks.

The product meets quality standards set by ASTM and the Bureau of Indian Standards, positioning it for international certification. With India's ambitious goals to become a global aviation leader and reduce

dependency on imports, the demand for biofuel is poised to rise, especially with initiatives like CORSIA and the push for indigenous fuel usage. The Indian aviation sector's rapid growth underscores the significance of this innovation, with projections indicating substantial increases in fleet size, passenger numbers, and airport infrastructure. Successful commercialization of the CSIR-IIP process promises various benefits, including livelihood improvement for rural and tribal populations, reduced carbon footprint through bio-aviation fuel and renewable diesel, and alignment with national missions. The innovation's potential to establish India as a leader in bio-aviation fuel production presents significant opportunities for sustainable development and energy independence. Initial production at a demonstration or semi-commercial scale could bridge the gap between innovation and widespread adoption, supplying both military and civilian aviation requirements while requiring viability gap funding on the capital front.

Commercialization Details:

The market demand for the CSIR-IIP's bio-jet fuel technology in India is substantial, with an estimated demand of 0.8 million metric tons per annum for blending with conventional Jet A1 fuel, valued at approximately INR 44,000 million annually. The Indian Air Force aims to reduce fuel consumption by 10% through domestically produced bio-jet fuel, with an expected demand of around 100,000 tons annually, equating to INR 7 billion annually. Additionally, both Air India and Spicejet are interested in using bio-jet fuel for commercial flights, with Spicejet projecting a demand of approximately 17,500 tons per year, valued at INR 1.25 billion annually. Internationally, organizations like the International Air Transport Association (IATA) and Airbus are pushing for increased use of renewable fuels, with expectations of blending bio-jet fuel up to 30% by 2030. To meet the demand for a 10% bio-jet fuel blend, approximately 25 units of 100 tons per day capacity each are required in India, with an estimated investment of INR 180 crores per unit. The laboratory/LRF expects revenue of approximately Rs. 100 lakhs, along with running royalties and license fees for commercial partners. Return on investment analysis suggests a viable financial proposition, with a payback period dependent on feedstock costs and bio-jet fuel selling prices.

CSIR-IIP SAF is under evaluation by ASTM. Currently, the Basic Engineering design package for the CSIR-IIP SAF process is being developed by one Indian Engineering company (Engineers India Ltd.) for the commercial plant erection in India. The first commercial unit with a capacity of 35 KL of SAF per day is planned at Mangalore Refinery and Petrochemicals Limited (Capital cost ~42 million USD) and is expected by 2026. The pilot plant at CSIR-IIP has been running for the last 2 years for a continuous supply of An-32 flights and Dornier engines/aircraft.

Photographs:



30. Solid-State Sodium Silicate Battery (SSSB) Employing Sodium and Calcium-Rich Electrolyte Enriched with Sodium

Summary:

The sustainable solid-state sodium silicate battery (SSSB) is an innovative solution to the global challenge of providing affordable and clean energy. The SSSB uses a solid-state-electrolyte (SSE) formed by coating a separator membrane with a naturally Sodium (Na) and Calcium (Ca) rich material (Na-Ca rich material) with the positive electrode (cathode) comprising sodium silicate as cathode active material (CAM), and the negative electrode (anode) comprises carbon black as anode active material (AAM), wherein the SSSB exhibits a specific capacity of up to 208.48 mAh/g, and cycle stability of up to 10,000 cycles, with more than 3000 cycles retaining 80% capacity. The use of the naturally available Na-Ca-rich material, i.e., phyllosilicates having high sodium ion conductivity of the order of 1.41 mS/cm, allows faster transport of the Na⁺ ions in the solid state, hence making it suitable for energy storage applications. By addressing the critical issues of energy efficiency and renewable energy, the sustainable SSSB represents a significant step towards achieving the United Nations Sustainable Development Goal 7 of ensuring access to affordable, reliable, modern, and clean energy for all.

Patent No: 488659

Date of Grant: 26/12/2023

**Applicant: Kaushik Palicha,
Harinipriya Seshadri**

**Inventor(s): Harinipriya
Seshadri, Kaushik Palicha**



Salient Features:

The sustainable solid-state sodium silicate battery (SSSB) integrates naturally available phyllosilicates to eliminate Lithium-Ion Batteries (LiBs), which are the dominant commercialized batteries for portable electronics today. The SSSB, made using earth-abundant materials and exhibits excellent specific capacity and cycle stability, ensures its eco-friendliness and energy efficiency. The sustainable SSSB possessing excellent flexibility and having no dead weight paves the way for modular designs, especially fabrication in all form factors, i.e., cylindrical, Pouch, and prismatic, enabling scalability and customization to meet varying sizes and requirements. The SSSB is dendrite-safe, and there is no concern about loss of electroactive sodium via insoluble salt formation. Its ability to function in a wide range of pH, temperature, and operating conditions promises longevity and minimal ecological impact, and it is completely recyclable and reusable.

Problems Addressed:

The sustainable solid-state sodium silicate battery (SSSB) directly tackles several pressing issues outlined in Sustainable Development Goal 7: affordable and clean energy. Firstly, it addresses the prevalent challenge of paucity of Li metal to cater to Lithium-Ion Batteries (LiBs) by providing a reliable battery that is made from earth-abundant materials, hence making it cost-effective and a well-fit for portable electronic devices, stationary storage applications, toys, drones, and e-mobility. Furthermore, the SSSB confronts the risks associated with currently used Lithium-Ion Batteries (LiBs), the manufacturing of which requires a dry environment, organic solvents, and thermal run-away problems. By mitigating these risks, the invention contributes to improved safety for the workers and users and alleviates the economic and infrastructural burdens on the battery manufacturers. Additionally, the complete recyclability of the SSSB promotes long-term sustainability. Moreover, the SSSB's utilization of

earth-abundant materials and minimization reliance on the scarce Li metal aligns with Sustainable Development Goal 7: affordable, reliable, sustainable, and modern energy for all while increasing the global rate of improvement in energy efficiency.

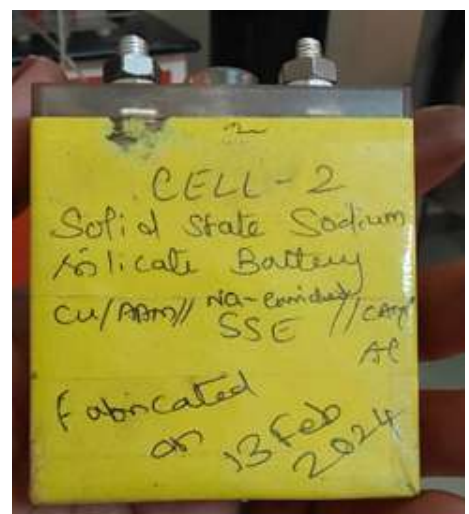
Impact of the Invention:

The solid-state sodium silicate battery (SSSB), with its recyclability and exhibiting the specific capacity and cycle stability that is well-fit for portable electronic devices, stationary storage applications, toys, drones, and e-mobility presents a promising technology for the world that grapples with the challenge of accessing affordable, reliable, sustainable, and clean energy. Its implementation heralds a transformative shift for fostering sustainable development. By mitigating the risks associated with Li-ion batteries and reducing the dependency on the scarce Li metal, the SSSB provides a sustainable energy, efficient alternative to the global communities that have become over-dependent on Li-ion batteries. Through its multilayered impact, this invention instills confidence in the scientific society that works in the direction of alternate energy and energy efficiency; the invention also holds an encouraging commitment to the Sustainable Development Goal of accessing affordable, reliable, sustainable, and modern energy for all.

Commercialization Details:

- Technology Readiness Level (TRL): 7/9
- Demonstrated the SSSB battery cell in different form factors such as Coin cell, Prismatic cell (3Ah)
- Tested the 3Ah prismatic cell in the simulator for cycle stability and longevity for more than 20000 cycles in environmental conditions
- Commercial Partnerships: Confidential: In the first phase of outreach, few automobile industries have shown interest in the technology. The Applicants have short-listed two of them, and further discussions with them are in progress

Photographs:



31. Electrochemical Conversion of Carbon Dioxide into Value-Added Products

Summary:

A method for sustainable reduction of carbon dioxide (CO₂) into value-added products (VAPs) such as ethanol, acetates, and acetaldehyde is an innovative solution designed to deal with the global challenge of alleviating air pollution and contributing to the zero-emission goal of the chemical industries. The method utilizes an electrochemical reactor having metallic Copper (Cu) or Cu-alloy symmetric electrodes

(cathode and anode), The metallic Cu or Cu-alloy electrodes act as an electrocatalyst, and acidified water (H₃O⁺) acts as an electrolyte for generating H₂ gas. Again, the major product in this sustainable technology is ethanol, an asset as a fuel for automobile industries and an essential precursor to the medicinal and food industries. With customizable reactors for electrochemical operation, this technique offers a sustainable and reliable method for converting CO₂ into VAPs in small-scale as well as large-scale industries. The adaptable engineering and design of the reactors allow scalability to meet varying emissions rich in CO₂, ensuring optimal performance and minimal maintenance needs. By addressing the critical issues of emission disposal, air pollution, and health risks associated with industrial emissions and simultaneously producing ethanol as the major product, the sustainable carbon dioxide (CO₂) reduction technique presents a significant step towards achieving the United Nations Sustainable Development Goal 13 (Climate Action), Goal 7 (Affordable and Clean Energy), and Goal 3 (Good Health and Well-being).

Salient Features:

The sustainable electrochemical technique for the reduction of carbon dioxide (CO₂) into value-added products (VAPs) effectively handles industrial pollution and significantly contributes to the zero-emission goal of the chemical industries, as well as produces ethanol as the major product - an asset as a fuel for automobile industries, and an essential precursor to medicinal and food industry. The simplicity of the reactor set-up for this electrochemical operation is an added advantage. The globally distressing CO₂ being the raw material, Cu electrodes or Cu alloy electrodes as electrocatalyst employed being an earth-abundant material and hence highly cost-effective with very minimal amounts of chemical and energy consumption, this technology shows the path for promising sustainability with zero ecological impact.

Problems Addressed:

The sustainable electrochemical technique for reducing carbon dioxide (CO₂) into value-added products (VAPs) addresses several pressing issues outlined in various Sustainable Development Goals. Firstly, it addresses the prevalent challenge of dealing with CO₂ emissions from various sources, including industries. Furthermore, the electrochemical technique for the reduction of CO₂ produces H₂ gas in situ, eliminating the hazards and costs associated with H₂ gas handling. More specifically, the electrochemical technique for the reduction of CO₂ addresses the concerns of achieving the following sustainable development goals.

Sustainable Development Goal 13: Climate Action. This technology for reducing carbon dioxide (CO₂)

Patent No: 524748

Date of Grant: 13/03/ 2024

**Applicant: Kaushik Palicha,
Harinipriya Seshadri**

Inventor(s): Harinipriya

Seshadri, Kaushik Palicha



gases can be integrated into national policies, strategies, and planning as a sustainable climate change measure, as outlined in target 13.2. It can also be an asset to controlling total greenhouse gas emissions per year, as outlined in target 13.2.2.

Sustainable Development Goal 7: Affordable and Clean Energy i.e., target 7.1: by 2030, ensure universal access to affordable, reliable, and modern energy services; target 7.2: by 2030, increase substantially the share of renewable energy in the global energy mix; and target 7. a: by 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.

Sustainable Development Goal 3: Good Health and Well-being, i.e., target 3.9: by 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination; and target 3.d: strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks

By comprehensively addressing these interrelated challenges, the Sustainable electrochemical technique for reducing carbon dioxide (CO₂) into value-added products (VAPs) plays a vital role in advancing the global targets for sustainable development and ensuring access to a cleaner environment while simultaneously producing ethanol, a source of energy.

Impact of the Invention:

The electrochemical technique for the reduction of carbon dioxide (CO₂) into value-added products (VAPs) stands as a guiding light for the global population eagerly looking for a solution to the ominous challenge of accessing clean air. To process tonnes of CO₂ per day, the use of a continuous flow electrochemical reactor can easily help scale up and mass produce VAPs, the major being ethanol. With 85% efficiency per tonne of flue gas containing CO₂, 128.85 kg of ethanol is expected, enabling faster breakeven of the investment. Its implementation heralds a transformative shift in safeguarding public health and promoting sustainable development. Mitigating air pollutants and reducing health risks associated with them empowers industries and Governments to better plan economic development without worrying about the factor of pollution, and at the same time, getting carbon credits due to CO₂ reduction. Again, by harnessing ethanol from environmentally disturbing pollutants, this technology promotes environmental stewardship, aiding in the preservation of ecosystems and climate resilience. Through its multi-layered impact, this invention represents a concrete and perceptible assurance of several Sustainable Development Goals, including the fundamental goal of ensuring access to clean air and energy.

Photographs:



Commercialization Details:

- Technology Readiness Level (TRL): 12
- Demonstrated at a scale of 1.8 TPD CO₂ throughput electrocatalytic reactor with two and four electrodes configuration
- Demonstrated at a scale of 20 TPD CO₂ throughput electrocatalytic reactor with six electrodes configuration
- Commercial Partnerships: Confidential: In the first phase of outreach, a few distillery, steel, oil & gas companies have shown interest in the technology; the Applicants have shortlisted them, and further discussions with them are in progress.
- Commercial orders received from Distillery & Chemical segments.

32. Solar Geo Thermal Hybrid Desalination System

Summary:

The present invention relates to the desalination of seawater by utilizing a solar-geothermal hybrid system; in this, geothermal energy is used as a heating medium or heating energy to drive thermal-based desalination systems like Multiple Effect Evaporator (MEE), and the solar energy will be used for a diving submersible pump for geothermal liquid extraction. This system utilizes energy directly from the hot water extracted from the geothermal well in an open-loop system and solar panel for solar energy utilization. Performance analysis of this solar-geothermal

hybrid desalination system is based on energy necessities, water generation cost, innovation, and thermodynamic and economic considerations.

Salient Features:

The Solar-Geothermal Hybrid Desalination System is an innovative system that combines renewable energy and water production technologies. This system distinguishes itself by utilizing solar and geothermal energy sources, resulting in various notable characteristics. Firstly, incorporating renewable energy ensures a sustainable and eco-friendly functioning, substantially decreasing carbon emissions and reliance on fossil fuels. This dual-energy strategy improves dependability and steadiness, allowing for continued operation even in varying weather conditions. Furthermore, the system demonstrates exceptional energy efficiency, thus maximizing the consumption of resources and decreasing operational expenses in the long run. Due to its scalability & flexibility, it may easily be adjusted to meet the needs of different geographical regions and variable water demands. The hybrid system utilizes advanced control algorithms to optimize water production efficiency and maintain optimal performance

Patent No: 410807

Date of Grant: 02/11/2022

Applicant: Pandit

Deendayal Energy

University

Inventor(s): Tarun Shah,

Manan Shah, Mitul H

Prajapati, Anirbid Sircar



across various operating circumstances. The Solar-Geothermal Hybrid Desalination System is a highly advanced technological advance that provides a potential and sustainable solution to global water scarcity concerns in an economically feasible way.

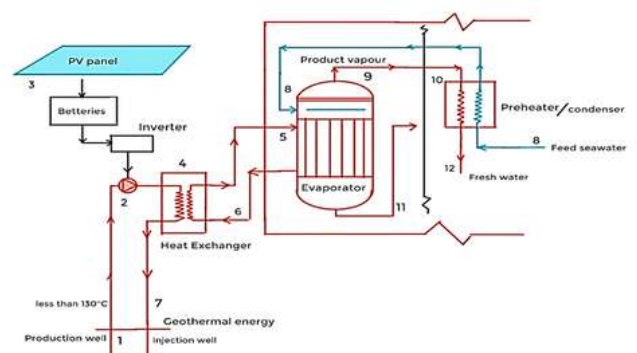
Problems Addressed:

The Solar-Geothermal Hybrid Desalination System incorporates cutting-edge technology to address water scarcity concerns and fit with Sustainable Development Goals (SDGs). This technology demonstrates the optimal integration of renewable energy by utilizing both geothermal & solar energy sources. Using clean & sustainable energy decreases carbon emissions and supports SDG 7 (Affordable & Clean Energy) by fostering access to dependable and sustainable energy sources. Furthermore, the system's high energy efficiency promotes the optimal use of resources, in line with SDG 12 (Responsible Consumption & Production), by reducing energy consumption & operational expenses. The Solar-Geothermal Hybrid Desalination System is technically advanced and promotes water security, an essential aspect of sustainability. Desalination provides a steady supply of fresh water, which helps reach SDG 6 (Clean Water and Sanitation) by ensuring everyone has access to safe and clean drinking water, especially in areas short on water. Supporting SDG 9 (Industry, Innovation, and Infrastructure), its scalability and flexibility make installing water infrastructure in underserved or hard-to-reach places easier. Moreover, the system's incorporation of advanced control algorithms highlights its focus on maximizing efficiency and optimization. This aligns with SDG 13 (Climate Action) by minimizing the effects of climate change through decreased energy usage and greenhouse gas emissions. The Solar-Geothermal Hybrid Desalination System is a comprehensive solution to sustainable development that effectively addresses the critical global issue of water shortage. Utilizing new technology addresses many sustainable development goals (SDGs) holistically.

Impact of the Invention:

The solar-geothermal hybrid desalination system has emerged as a promising solution for communities that suffer significantly from the difficulty of getting potable water. The adoption of this initiative represents a significant and impactful change, not only in meeting a fundamental need but also in protecting public health, reducing poverty, and promoting sustainable development. This revolutionary system utilizes renewable energy sources such as solar and geothermal energy to address water scarcity and guarantee reliable fresh water for communities globally. An effective desalination method significantly reduces the prevalence of diseases caused by water and mortality rates. This empowers people, especially women and children, to freely seek education and economic prospects without being restricted by the weight of waterborne illnesses. Furthermore, by reducing its impact on the environment and promoting responsible management of natural resources, the Solar-Geothermal Hybrid Desalination System actively supports the ability to withstand climate change and the protection of ecosystems.

Photographs:



Commercialization Details:

To advance the Geosolar hybrid desalination system from TRL 6 to TRL 9, focus on technical enhancements, rigorous performance testing, scaling up, cost reduction, regulatory compliance, market analysis, strategic partnerships, demonstration projects, and a robust commercialization strategy. This entails refining technical aspects, validating performance, ensuring scalability, lowering costs, meeting regulations, analyzing markets, forming partnerships, showcasing through demos, and executing a comprehensive commercial plan.

33. Anaerobic Gas Lift Reactor(AGR) for the Treatment of Organic Solid Waste

Summary:

The ANAEROBIC GAS LIFT REACTOR (AGR) is a high-rate biomethanation technology developed and patented by CSIR-IICT (Indian Patent Number: 307102). This innovation is designed to efficiently convert organic solid waste such as poultry litter, food waste, press mud, cattle manure, organic fraction of municipal solid waste (OFMSW), sewage sludge, etc.,

into biogas and bio manure. AGR technology enables the effective co-digestion of feedstocks with low and high C/N ratios, incorporating a specially designed line inhibition control mechanism. AGR is engineered to minimize Hydraulic Retention Time (HRT) and increase Solid Retention Time (SRT) while enhancing the rate of biogas production by incorporating key features of high-rate bio methanation, including mixing, retention of high active biomass, buffering capacity, food to micro-organism ratio, feed slurry concentration, microbial culture inhibition mechanisms, delinking of HRT & SRT, and recycling mechanism. Additionally, AGR technology includes online pre and post-processing mechanisms such as H₂S scrubbing and moisture traps to purify the biogas. This innovation offers a decentralized treatment option for organic waste treatment, enabling the generation of biogas for Combined Heat and Power (CHP) applications. The biogas technology based on AGR is plug-and-play, containerized, affordable, and easy to maintain, featuring high-end engineering and automation.

Patent No: 307102

Date of Grant: 11/02/2019

Applicant: CSIR

Inventor(s): Anupoju

Gangagni Rao, Y.V. Swamy



Salient Features:

- **Improvement on Conventional Anaerobic Digesters:** AGR represents an enhanced version of self-mixed anaerobic digesters developed by CSIR-IICT, offering superior efficiency and performance.
- **High-Rate Anaerobic Digestion:** AGR is designed to treat both organic solid and liquid wastes, efficiently generating biogas and bio manure at a high rate.
- **Pressure-Driven Mixing:** The reactor utilizes the pressure generated by biogas production to facilitate the mixing of slurry within the reactor, eliminating the need for external mixing mechanisms.

- **Inhibition Control Mechanism:** Specially designed inhibition control mechanisms maintain optimal ammoniacal nitrogen levels, ensuring efficient digestion of organic waste.
- **Flexible Waste Treatment:** AGR can effectively treat organic solid wastes with varying C/N ratios, ranging from 20 to 30 or as low as 6, accommodating a wide range of feedstocks, including food waste, the organic fraction of MSW, MSW leachate, poultry litter, cattle manure, fruit and vegetable peels, cooked food waste, Ganji water, used kitchen oil/grease, garden waste, and organic wastewater.
- **Enhanced Biogas Production:** AGR facilitates increased biogas production and methane content by optimizing the digestion process and promoting the conversion of organic components into methane and carbon dioxide.
- **Vertical Cylindrical Tank Design:** The reactor features either the vertical cylindrical tank design with two compartments hydraulically connected, allowing for efficient distribution of influent and separation of biogas, active biomass, and liquid.
- **Continuous Operation:** A three-phase separator mechanism enables continuous operation, with biogas, active biomass, and treated liquid separated and processed at regular intervals based on set pressure.
- **Recycling Mechanism:** Biogas collected at the top of the reactors are partially recycled and injected back into the reactor to boost pressure, enhancing mixing cycles and overall efficiency.
- **Enhanced Degradation Rate:** Thorough mixing within the reactor enhances the volatile solids degradation rate (VSDR), promoting heat transfer between particles and reducing scum formation.
- **Decoupled SRT and HRT:** The three-phase separator mechanism delinks solids retention time (SRT) and hydraulic retention time (HRT), allowing for the retention of active biomass while handling higher throughput.
- **Temperature Flexibility:** AGR can be operated at ambient, mesophilic, or thermophilic temperatures, and it has provisions for measuring the slurry temperature at the reactor outlet.
- **Robust process design:** can handle waste fluctuations in terms of hydraulic and organic load (both, underfeeding and overfeeding scenarios).
- **Mixed microbial consortia:** Selection of special seed culture for inoculation, rapid start-up, acclimatization of microbial culture for work at broad temperature range, and fostering high organic solids break-down efficiency.

Odourless and noiseless performance with little to no maintenance, very good aesthetics and ease of operation and maintenance, and no scum formation are some of the noticeable features of AGR technology. Overall, AGR represents a significant advancement in anaerobic digestion technology, offering improved efficiency, flexibility, and scalability for the treatment of organic wastes and biogas generation.

Problems Addressed:

The innovation “Anaerobic Gas Lift Reactor (AGR)” addresses several critical challenges inherent in conventional digesters and self-mixed anaerobic digesters developed by CSIR-IICT. By effectively eliminating scum formation, providing a scalable design adaptable to various plant sizes, and enhancing methane and biogas generation potential, the innovation represents a significant advancement. Furthermore, the innovation revolutionizes waste management by introducing efficient slurry mixing mechanisms without the need for mechanical equipment, achieved through the incorporation of a three-phase separation mechanism and biogas-induced slurry mixing mechanism. Beyond technical advancements, this innovation promises a paradigm shift in waste management practices. It delivers

societal and economic benefits by creating employment opportunities, enabling safe and scientific waste disposal at the source of generation, and offering financial gains through the utilization or sale of biogas and bio manure produced by the plant. Overall, this innovation not only addresses technical challenges but also contributes to broader societal and economic objectives in the domain of waste management. The utilization of renewable energy in the form of biogas from Renewable waste/biomass sources aligns with Sustainable Development Goal 7: Affordable and Clean Energy by minimizing reliance on fossil fuels and reducing greenhouse gas emissions. By addressing these interrelated challenges comprehensively, the AGR technology already commercialized in India plays a crucial role in advancing the global agenda for sustainable development and ensuring access to affordable and clean energy for all.

Impact of the Invention:

The impact of the ANAEROBIC GAS LIFT REACTOR (AGR) technology is profound, particularly in the domain of decentralized organic solid waste management and biogas generation. AGR offers distinct advantages, including a quicker return on investment (ROI), low auxiliary power consumption, minimal footprint area requirement, high biogas yield, and extended lifespan. Notably, organizations like The Akshaya Patra Foundation (TAPF), operating under ISKCON, have embraced AGR to manage food waste generated in their large-scale kitchens across India. With around 1 ton of food waste per kitchen treated using AGR, TAPF has witnessed success with thirteen biogas plant projects in various locations (Bellary & Hubli in Karnataka; Surat, Ahmedabad, Bhavnagar in Gujarat; Lucknow, etc.). Recognizing the efficacy of AGR, TAPF has designated CSIR-IICT as the primary biogas technology provider, indicating a shift towards AGR over other alternatives. Moreover, AGR's versatility is demonstrated through projects like the one sanctioned by the Indo-US science and technology forum, where a 5 Ton/day biogas plant is installed in the MSW dump yard in Hyderabad, where it addresses the treatment of organic fraction of municipal solid waste for off-grid biogas-based power generation. As a part of this project, there are four biogas plants installed in the vegetable markets of Erragadda (500 kg/day), Kukatpally (500 kg/day), Batasingaram (500 kg/day) and Bowenpally (10 ton/day). By indigenously developing AGR with features akin to sophisticated European technologies, CSIR-IICT has addressed technical and financial barriers, positioning AGR as a viable solution for organic waste treatment in India. Currently, there are about 31 biogas plants of various capacities that have been installed and operated across India to treat a variety of organic wastes.

Photographs:



Commercialization Details:

The AGR technology is currently at TRL – 9 and has been commercialized which is evident from the number of installations and the success stories till date. The AGR technology has been out-licensed to about 8 private companies that execute the projects on a turnkey basis based on the designs and know-how given by CSIR-IICT. The licensees of AGR technology are:

- Ahuja Engineering Services Private Limited, Hyderabad
- Khar Energy Optimizers, Hyderabad
- Nirmalya Bioengineering solutions private limited, Hyderabad
- Amflind private limited, Hyderabad
- VS Lignite Power private limited, Hyderabad
- Green New Future Tech Private Limited, Uttar Pradesh
- Ellison Oil Fields Private Limited, Gujarat
- BEIL Research and Consultancy, Gujarat

34. Secure offline Payments in Low-Cost Phones

Summary:

This invention enables secure digital payments even when the internet is not available. The invention includes performing a one-time authentication of the electronic device with an application server to create a secure token that is stored locally on the device. Thereafter, the electronic device can perform a secure payment using the secure token, even while disconnected from the network.

Users can add bank accounts registered with their phone number using UPI and payment wallets to Samsung Pay Mini and perform secure offline payments. This solution works across most Samsung phones, including low-cost and mid-range phones.

Salient Features:

- Users of low/mid-tier mobile phones can add bank accounts registered with their phone numbers using UPI and wallets like Paytm, Mobikwik, etc. to Samsung Pay Mini.
- If a retailer or merchant accepts one of the wallets or bank accounts supported by Samsung Pay Mini, users can use Samsung Pay Mini to make purchases offline securely without any server dependency.

Problems Addressed:

Offline payment includes non-electronic payment methods, such as money, cheques, bank drafts, and postal orders. As technology has advanced, electronic means of payment have been introduced (e.g., contactless payments using mobile phones such as tap-and-pay without carrying credit and debit cards). However, these payment transactions require an electronic device to perform cloud/server-based authentication in a secure memory area on the electronic device. However, low or mid-cost mobile phones don't come with specialized hardware requirements, i.e., secure memory area. Further, internet connectivity may not always be available to authenticate with the server. Therefore, there is a need for a solution that can equally provide a secure offline payment on an electronic device without relying on a server.

Impact of the Invention:

This solution has added nearly ~50 Million users having low/mid-tier phones for mobile-based payments, bringing financial inclusivity in rural areas.

Commercialization Details:

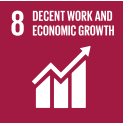
- This invention is commercialized as Samsung Pay Mini, a lighter version of the digital payments app Samsung Pay, with the launch of the Galaxy J7 Max smartphone.
- Samsung Pay Mini was further made available for the Galaxy A and Galaxy M series smartphones.
- Samsung Pay mini is now called a Samsung Wallet.

Patent No: 498773

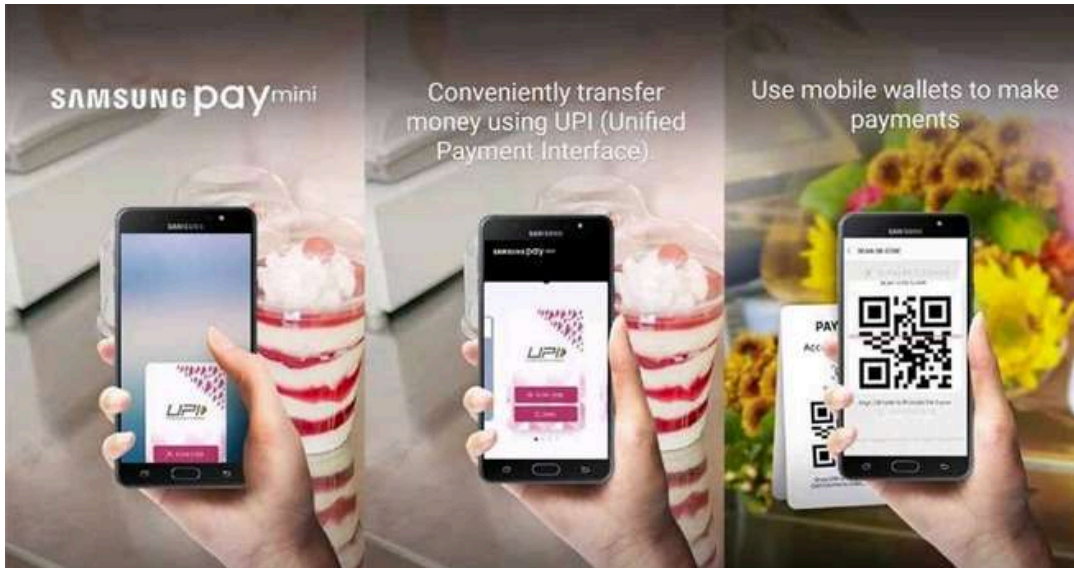
Date of Grant: 12/01/2024

**Applicant: Samsung
Electronics**

**Inventor(s): Venkata
Subramanian Madhu,
Nishant Roopalwal,
Srikanth Mandalapu,
Ramanath Vishnu Pai**



Photographs:



35. Hydrogen-Fuelled E-Bike

Summary:

Hydrogen e-bike innovation is for the first time realized as an emerging zero-emission, zero-fuel, last-mile cutting-edge mobility solution to achieve three principles such as Mission Life, Green Credit, and climate justice, thereby leading to affordable, low cost, less return of investment (ROI) effective renewable energy technology. The technology is expected to utilize green hydrogen for mobility, which is harnessed from solar photovoltaic technology. The modularity and customized design allow feasibility and scalability to meet the energy demands and

customer needs globally. Nature-inspired indigenous design uses predictive modeling technology to ensure safety and low-cost maintenance. The real-time monitoring of sensors serves the purpose of safety aspects as well. Hydrogen mobility solution presented in the design allows the customer to have an extended driving range for different mobility applications and shorter refueling times. This technology forms the basis for decarbonizing India's mobility sector. The mobility solution is expected to foster frugal innovations of green technologies for the transportation sector. The technology would achieve the goals of Digital Public Infrastructure (DPI).

Salient Features:

The hydrogen-fuelled e-bike holds a novel ergonomic, aesthetic, and elegant look with a scientific and technological design that gives the details of the framework of the design features and characteristics and various elements of the e-bike (such as hydrogen fuel cell and hydrogen storage system). The hydrogen e-bike design is outfitted externally with the hydrogen fuel cell that powers the bike and has an onboard energy storage system to feed the power for the fuel cell. As this hydrogen fuelled e-bike has the main source as hydrogen: powered to fuel cells, meaning it emits heat and water instead of fumes (free from CO2 emissions) thereby reducing the carbon footprints. The innovation is green energy eco-friendly systems, which achieve climate change objectives.

Problems Addressed:

The invention addresses climate action universally and is an innovative first-time approach to lower the cost of green hydrogen production using nature-inspired solar to green hydrogen generation utilizing solar photovoltaic electrolysis. This approach has formed the key energy vector to convert solar energy to power green hydrogen bikes, which are directly used for mobility solutions. This approach is one of the interesting, viable, feasible, and scalable renewable energy sources available for mobility applications. The mobility solution has non-fossil fuel sources and no Green House gas (GHG) emissions. Hydrogen mobility showcases India's proactive stance in climate action and achieves world leader in sustainability.

Design No: 360094-001

Date of Grant: 27/05/2022

Applicant: T.Senthil Siva

Subramanian, Arun Kumar

Choudhary

Inventor(s): T.Senthil Siva

Subramanian, Arun Kumar

Choudhary



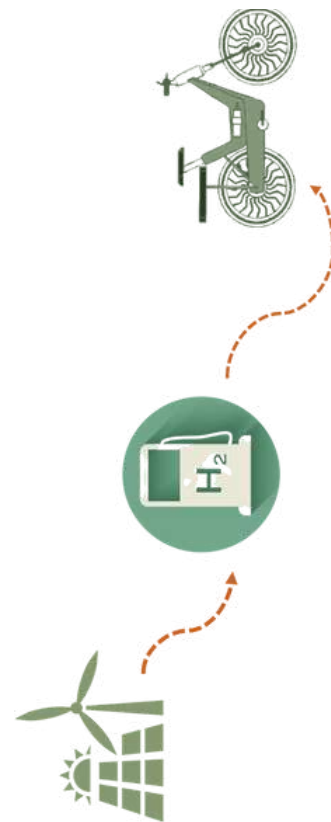
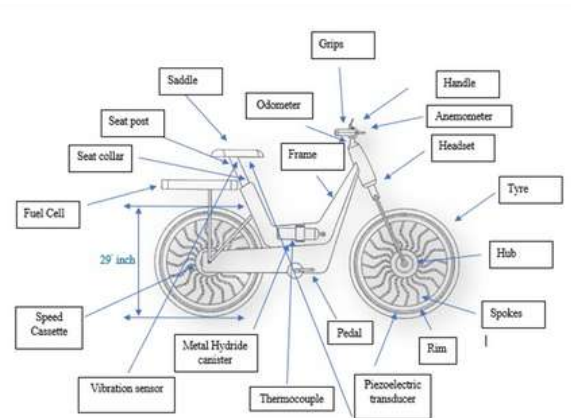
Impact of the Invention:

The invention demonstrates saving the planet from carbon emissions by adopting various chains of renewable energy sources, such as solar power, through which hydrogen is germinated and utilized for hydrogen-powered mobility bikes. The innovation has direct and indirect positive impact on the spectrum of Sustainable Development Goals - SDGs developed by the United Kingdom: (#7 - Affordable and clean energy, 9 - Industry Innovation and Infrastructure, 11 - Sustainable Cities and Communities, 12 - Responsible Consumption and Production, 13-Climate Action, and 15 - Life on Land). The invention facilitates the achievement of the National Hydrogen Mission, National Solar Mission, and Smart Cities mission, thereby leading to achieving net zero emission by 2070 and making India a global hub for hydrogen mobility solutions. Additionally, the solution facilitates the growth of startup domain and MSME sectors, leading to achieving विकसित भारत@2047 (Viksit Bharat), Atmanirbhar Bharat (आत्मनिर्भर भारत) thereby promoting Make in India and vocal for local products. The frugal solution will enhance the global partnership, especially the Indo-German hydrogen task force, a subregion of South Asia (BBIN) - Bangladesh, Bhutan, India, and Nepal. The technology would initiate Global Capability Centers (GCCs) in India and enhance skilling, up-skilling, and re-skilling, creation of a center of excellence, demo innovation mobility zones, and academia-industry interface through research and development. The technology would increase the capstone projects in hydrogen mobility. Hydrogen bikes would be a testament to India's green economy development.

Commercialization Details:

Hydrogen-fuelled e-bikes are technology licensed by Comuti Energy Pvt.Ltd., Hyderabad, Telangana. Current Status of Commercialization: Technology know-how has been prepared, and design is conceptualized and realized (energy-to-energy). A theoretical model of calculation for the realization of the technology is prepared. The design features and parameters for the technology have been identified.

Photographs:



36. Catalytic Process to Convert Renewable Feedstocks Directly into Aromatics Rich Feedstock Pool

Summary:

The present invention relates to a step catalytic process to convert renewable feedstock directly into hydrocarbon fuel and aromatics. Particularly, the present invention relates to the hydroconversion of renewable feedstocks. More particularly, the present invention relates to the hydroprocessing of triglycerides, diglycerides, and free fatty acids of renewable sources, waste animal fats, and used cooking oils directly into petrochemical (aromatics rich) feedstock pool along with hydrocarbon-based fuels ranging from C1-C30 carbon atoms using a catalyst. In this invention, the sulfidation of catalysts was carried out using a mixture of diethyl disulfide and gas oil. This single-step catalytic process utilizes hydrogen and hydroprocessing catalysts under

defined operating conditions to achieve hydroconversion reactions. The method is peculiar in that it uses a single reactor, is one step or step, uses a non-noble metal catalyst, and contains aromatics in the hydrocarbon cut range of kerosene. (c) feed indifferent; feedstock might be any type of vegetable oil fat. Neat fuel has aromatics, which makes it a possible option for 100% drop-in Sustainable Aviation Fuel (SAF).

Salient Features:

This process involves the conversion of triglycerides and fatty acids in renewable oils into cyclic or aromatic compounds. This may be obtained by hydrodeoxygenation, decarbonylation, decarboxylation, isomerization, hydrocracking, dehydrogenation, and Dehydro-cyclization or a combination of two or more thereof and by varying the catalyst bed composition along with operating parameters such as temperature, pressure, space velocities, and hydrogen to feed ratio's and by optimizing the partial pressures of hydrogen inside the reactor.

The Single-step catalytic HEFA process developed by CSIR-IIP efficiently converts a variety of lipid feedstocks, including tree-borne oils like jatropha and Pongamia, as well as derived lipids such as palm stearin and Used Cooking Oil (UCO), into drop-in biofuels. This innovative process involves multiple simultaneous reactions in a single reactor, facilitated by a patented non-noble-metal catalyst, resulting in bio-jet range hydrocarbons with 55-60 % yields. Wherein the conversion of renewable feedstock is in the range of 95-100%, and the catalyst is stable up to 2-6 months. The hydrocarbon product can be isomerized if desired to improve cold flow properties.

The produced bio-jet fuel meets International specifications (with additional aromatics), boasting properties similar to conventional Jet A / Jet A-1 fuels. Notably, the process is easily adaptable to existing refinery infrastructure, offering a cost-effective solution. Environmental benefits include lower sulfur content, reduced particulates, and sulfur oxide (SOx) emissions. Moreover, the bio-jet contains aromatics, meeting stringent aviation fuel standards without additional additives.

Patent No: 535808

Date of Grant: 29/04/2024

Applicant: CSIR

Inventor(s): Anil Kumar

Sinha, Mohit Anand,

Saleem Akhtar Farooqui,

Rakesh Kumar, Rakesh

Kumar Joshi, Rohit Kumar,

Bharat S Rana, Deepak

Verma, Malayil Sibi



The process also produces high-value gasoline byproducts appropriate for defense and aviation and hydrocarbons in the diesel range. Economic calculations show that even at pilot size, low-cost catalysts, and a one-step process provide advantageous cost competitiveness compared to international bio jet costs. This method offers a viable path for the manufacture of biofuel sustainably, with major benefits for the environment and the economy.

This also contributes to rural development by giving their products a better price. However, because of their intrinsic issues—such as poor atomization and lubricity, increased viscosity and oxygen content, and higher viscosity—these oils derived from plants and animals cannot be utilized directly in engines or as feedstock in petrochemical complexes.

Problems Addressed:

Developing sustainable aviation fuel from vegetable oils presents significant obstacles addressed by the CSIR-IIP's cutting-edge Bio-Jet fuel technology. They ensure high-quality fuel while limiting catalyst deterioration by successfully removing contaminants like metals and phosphorus by developing an in-house pretreatment technique. This technique makes Large-scale degumming possible by maximizing feed use and oil recovery. CSIR-IIP's Bio-Jet fuel, tested at Pratt & Whitney Canada, performs better than traditional methods due to its increased efficiency and ability to produce aromatics throughout the process, in contrast to rivals.

It is especially lubricating than substitutes such as the two-step HEFA procedure, which indicates that equipment life will be prolonged. Beyond technological breakthroughs, this invention has enormous promise for India, providing manufacturers and farmers with new avenues for economic growth while reducing the environmental effects of fuels generated from petroleum. The method developed by CSIR-IIP significantly reduces pollution. It is in line with worldwide efforts towards sustainable energy solutions by producing low-emission, sulfur-free Bio-Jet fuel.

Impact of the Invention:

The CSIR-IIP has developed an innovative single-step catalytic HEFA method with enormous potential to transform India's economic development and environmental sustainability. This breakthrough can help manufacturers generate money, provide jobs for farmers cultivating barren land, and address environmental issues related to feedstocks generated from petroleum by providing a low-cost alternative to complex and costly methods. The product is eligible for international certification since it satisfies quality criteria established by the Bureau of Indian criteria and ASTM. The demand for biofuel is expected to increase due to India's aggressive plans to become a global aviation leader and lessen its reliance on imports, particularly with the implementation of CORSIA and the promotion of domestic fuel use.

The novel single-step catalytic HEFA method created by CSIR-IIP might completely transform India's economic development and environmental sustainability. This breakthrough can alleviate environmental issues related to petroleum-derived feedstocks, create jobs for farmers cultivating desolate regions, and assist industrialists financially by providing a low-cost alternative to complex and costly technology. The product is eligible for international certification as it satisfies the Bureau of Indian criteria' and ASTM's quality criteria. India aspires to lead the world in aviation and become less dependent on imports; this will increase demand for biofuel, particularly with programs like CORSIA and the drive for domestic fuel use.

Commercialization Details:

India has a sizable market for bio-jet fuel technology developed by the CSIR-IIP; the technology is expected to be blended with conventional Jet A1 fuel at a rate of 0.8 million metric tons yearly, or around INR 44,000 million. The Indian Air Force wants to use locally generated bio-jet fuel to cut fuel consumption by 10%. The fuel is projected to be consumed in around 100,000 tons yearly, or INR 7 billion.

Furthermore, Spicejet and Air India also want to use bio-jet fuel for their commercial aircraft; Spicejet estimates that they will need 17,500 tons of fuel yearly, which is worth INR 1.25 billion. Globally, groups like Airbus and the International Air Transport Association (IATA) are promoting the use of more renewable fuels, with plans to mix up to 30% bio-jet fuel by 2030. In India, about 25 units with a capacity of 100 tons per day are needed to satisfy the demand for a 10% bio-jet fuel blend; each unit would cost about INR 180 crores. An income of about Rs. 100 lakhs is anticipated by the laboratory/LRF, in addition to running royalties and license fees for business partners. Return on investment analysis suggests a viable financial proposition, with a payback period dependent on feedstock costs and bio-jet fuel selling prices.

ASTM is currently evaluating the CSIR-IIP SAF. To erect commercial plants in India, one Indian engineering business, Engineers India Ltd., is currently developing the Basic Engineering design package for the CSIR-IIP SAF process. The Mangalore Refinery and Petrochemicals Limited plans to build the first commercial unit with a 35 KL SAF daily capacity and a capital cost of about 42 million USD by 2026. For the last two years, the CSIR-IIP pilot plant has been operating to provide a steady flow of An-32 flights and Dornier engines and aircraft.

Photographs:



First test flight by Spice-jet (Dehradun to Delhi) with CSIR-IIP Bio-jet (25%) on 27th August 2018



37. A Multi-Use Biopsy Device

Summary:

This invention presents a multi-use biopsy device incorporating a needle assembly comprising a first hollow needle coaxially enveloping a second solid needle with a notch at its distal end for tissue sampling, a needle holder, and a length adjustment mechanism featuring a hollow, internally threaded shaft with a first side wall spaced apart from the shaft and drawing support from it. An actuation button is configured to fire the needle(s) upon activation for tissue sample collection.

Patent No: 416780

Date of Grant: 04/01/2023

Applicant: IIT Bombay

Inventor(s): Bhallamudi

Ravi, Ghyar Rupesh,

Kulkarni Salil, Agarwal

Manish, Mittal Shivam



Salient Features:

- Automated firing of cannula (outer needle) by the inner needle
- Semi-automatic mode allows independent firing of cannula (outer needle) w.r.t. stylet (inner needle)
- Replaceable needles with different gauges (14 to 18 gauge)
- Variable throw length with indicator (12mm to 22mm)

Problems Addressed:

- Needle biopsy has a small risk of infection, bleeding or bruising, tenderness, pain, or problems with wound healing. The site where the needle gets inserted has a lower risk of infection as the incision is small.
- Discomfort: Patients may experience discomfort or pain at the biopsy site after the procedure.

Impact of the Invention:

The invention of this multi-use biopsy equipment has the potential to transform biopsy procedures. Consolidating many needles into a single assembly increases efficiency and precision while reducing patient trauma. A notch on the solid needle's distal end improves safety while increasing tissue sample precision. Its adjustable length mechanism increases adaptability for various biopsy demands and anatomical locales. Furthermore, its user-friendly design, including an actuation button for needle deployment, makes the procedure easier for healthcare personnel. Furthermore, its multi-use capabilities may result in significant cost savings by eliminating the need for specialized devices and decreasing repeat treatments.

Photographs:



Commercialization Details:

The commercialization details for a multi-use biopsy device are currently being processed.

38. System and Non-Intrusive Method for Exercise Posture Detection

Summary:

YogiFi, the world's first smart yoga mat, gracefully merges tradition with technology with modern artificial intelligence for positive health and preventive lifestyle disease management. The innovative mat acts like your personal yoga guide to help individuals seamlessly incorporate yoga into their daily routine, providing personalized sessions through a connected app. The key USP of YogiFi is non-intrusive real-time correctional feedback on the

posture alignment, balance, flexibility. monitoring-all seamlessly integrated into a user-friendly mobile app. With AI-powered yoga mat, online classes become interactive and empowers yoga trainers to monitor the progress of their students remotely enhancing accessibility, engagement, and personalization, YogiFi opens the door to the holistic benefits of Yoga for individuals worldwide.

Problems Addressed:

YogiFi addresses several common problems faced by yoga practitioners, including the difficulty in maintaining proper posture and alignment, the lack of personalized yoga routines and real-time feedback, challenges in tracking fitness and wellness progress, limited access to professional yoga training and guidance, and the need for integration of yoga practice with overall health metrics for comprehensive wellness.

Salient Features:

YogiFi boasts several key features that set it apart. Firstly, its interactive guidance system includes embedded sensors that detect body alignment and posture, offering real-time feedback and corrections. The AI-driven coaching is facilitated through a dedicated app, providing personalized yoga sessions based on individual progress and goals, with real-time audio cues in multiple languages to guide users through poses. The mat offers a personalized experience through adaptive programs tailored based on the user's practice data. Users can set fitness or wellness goals, and YogiFi provides structured plans to achieve them, tracking progress along the way. Detailed progress reports and visualizations highlight improvements and areas for focus. Additionally, YogiFi serves as an integrated wellness companion, correlating essential health vitals data like heart rate, HRV, breathing patterns, and SpO2 (acquired through smart watch, smart ring etc.,) pre and post session with health insights. It seamlessly integrates with Apple Watch and its own YogiFi Smart Ring for remote therapy compliance. Tele-yoga trainer support is another standout feature, where certified yoga trainers review user's practice data to offer personalized guidance in one-on-one sessions. YogiFI also useful for professionals pursuing certifications through programs like Yoga-Instructor-Course at S-VYASA. Finally, YogiFi ensures seamless connectivity with its app, compatible with both iOS and Android devices, offering user-friendly interface for tracking sessions, monitoring progress, and accessing a library of yoga routines. The platform also fosters a sense of community by enabling users to share their progress, participate in leaderboard streak challenges and thus inspire more to get onto the mat daily.

Patent No: 354401

Date of Grant: 23/12/2020

Applicant: Wellnesys

Technologies

Inventor(s): Muralidhar

Somisetty, Pranav

Kanuparthi, Sankar Dasiga



Impact of the Invention:

YogiFi has a profound impact on the yoga community and beyond by merging ancient practices with modern technology to make yoga accessible and effective for everyone. It supports users in achieving their fitness goals, managing lifestyle diseases such as diabetes, obesity or anxiety / stress management for physical and mental health. YogiFi also created positive social impact by helping kids with ADHD and those differently abled. The smart mat promotes proper technique, personalized routines, and real-time feedback, significantly enhancing the efficacy and enjoyment of yoga practice.

Commercialization Details:

YogiFi has successfully commercialized its innovation with three product generations. The Gen-1 was launched in 2021, followed by Gen-2 in 2023, and the Gen2+ in 2024. It has garnered thousands of users in over 18 countries, receiving solid testimonials for its effectiveness and user experience. YogiFi is a proudly made-in-India innovation with 10 global patents granted across India and the US in the fields of flexible sensors, data analysis algorithms, and integration with AR/VR and AI technologies.

39. An Automated Needle Holder and Suturing Device

Summary:

A surgical suture is a medical device used to hold body tissues together after an injury or surgery. The application generally involves using a needle with an attached length of thread. Several different shapes, sizes, and thread materials have been developed over the millennia. There are two broad classifications of needles: curved and straight. A straight needle can be used without instruments.

A curved needle must be handled with forceps and a needle holder. There are two types of curved needles:

- **Cutting Needle:** A cutting needle is used primarily for suturing the skin. It has a very sharp tip and sharp edges, which are needed to pass through the skin. Since you will generally place skin sutures, you will generally use a cutting needle.
- **Tapered Needle:** Tapered needles, or “round-bodied” needles, have a sharp tip with smooth edges and are less traumatic to the surrounding tissues. They are used primarily on the deeper subcutaneous tissues, blood vessels, and intestinal anastomoses.

A tapered needle is not good for simple skin suturing because it is difficult to pass the tapered needle through the skin. Tissue approximation by suturing remained the most reliable, cost-effective method for organ and tissue plane reconstructions. It is said that during suturing, a surgeon should have the ability to instantaneously select the most suitable method of suturing for the operating space available. The surgeon should have advanced knowledge of how the needle holder moves when the method of gripping the needle is modified and the arc of the needle. frame in sentence

Patent No: 416779

Date of Grant: 04/01/2023

Applicant: IIT Bombay

Inventor(s): Bhallamudi

Ravi, Ghyar Rupesh,

Bhansali Hemant



Salient Features:

- Automatically changes pressure based on tissue resistance to prevent harm.
- Precise Control: Ensures consistent sewing by exact needle manipulation.
- Automated Needle Handling: Automatically threads and grips needles to save time and prevent errors.
- Compatible with many suture kinds and sizes, allowing for adaptability.
- Simple interface for surgeons and staff reduces learning curves.
- Safe and sterile.
- Designed for common sterilizing procedures, assuring cleanliness and safety.
- Remote monitoring provides real-time input during procedures.
- Reduces surgical time by streamlining the suturing procedure for increased efficiency.
- Minimizes the risk of needlestick injuries among healthcare practitioners.
- Improves Surgical Precision:
- Helps provide precise suturing results for better patient care.

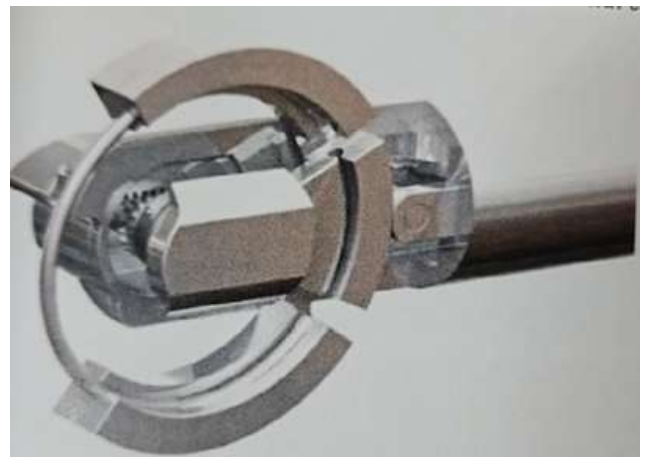
Problems Addressed:

The automated needle holder and suturing equipment transform surgical procedures by solving basic problems in traditional suturing methods. It guarantees precise and consistent stitching regardless of the surgeon's expertise level, eliminating fluctuation in stitch quality. Automating the suturing procedure reduces the risk of wounds from needles to healthcare staff while also streamlining surgeries, saving time, and increasing efficiency. Furthermore, the device provides uniform tension control throughout the suturing procedure, which improves wound healing results. Its interoperability with minimally invasive surgical procedures increases its utility by overcoming constraints such as limited access and instrument movement. The gadget improves surgical procedures' quality, safety, and efficiency, resulting in better patient care.

Impact of the Invention:

The automated needle holder and suturing equipment change surgical operations, significantly advancing patient care and healthcare efficiency. It ensures constant and exact stitching, regardless of surgeon experience, which improves surgical outcomes. Automating needle manipulation minimizes the likelihood of healthcare worker injuries, hence improving workplace safety. Furthermore, the device streamlines processes, reducing surgical time and enhancing patient throughput. Its capacity to maintain constant tension during suturing improves optimal wound healing and prevents post-operative problems. It is compatible with minimally invasive methods and broadens surgical capabilities. This breakthrough establishes new standards for surgical precision, safety, and efficiency, benefiting patients and healthcare practitioners.

Photographs:



Commercialization Details:

The commercialization details for the automated needle holder and suturing device are currently under process.

40. A Surgical Instrument with Multiple Degrees of Freedom

Summary:

This invention describes a surgical instrument with numerous degrees of freedom, which includes a head portion with at least one distal tool head, a spaced-apart body portion that allows for diverse head movement options, and a central system that connects them. The central system consists of a shaft assembly, a rotator mechanism for angular displacement of the head, a universal joint that translates this displacement regardless of its angular position relative to the body, a crank mechanism that connects the shaft assembly to the head, and a collar with a pre-defined slot on at least one shaft's

operative distal end which causes transverse angular displacement of the head as the shaft moves up and down.

Salient Features:

A multi-DOF device with the following features will be used by laparoscopic surgeons to improve maneuverability during procedures.

- 45° articulation
- 180° jaw rotation
- 360° device rotation
- It can pass through 10 mm trocar compatibility
- Completely sterilizable
- Compatible with existing electrocautery machines.

Problems Addressed:

A surgical device with numerous degrees of freedom addresses key surgical issues. Primarily, it improves precision, giving surgeons more control to reduce tissue injury. Its elasticity facilitates navigation through intricate anatomical structures, allowing access to previously unreachable places. Furthermore, its adaptability allows it to handle a wide range of surgical activities while being adaptive to unique procedure requirements. Ergonomic design lowers surgeon fatigue, which is critical for extended procedures. Precision, particularly in minimally invasive surgery, allows for smaller incisions and speedier recuperation. Advanced control mechanisms improve safety by reducing errors. Overall, this novel equipment marks a big step forward in surgical technology, promising better outcomes and altering surgical procedures.

Patent No: 415125

Date of Grant: 22/12/2022

Applicant: IIT Bombay

Inventor(s): Bhallamudi

Ravi, Ghyar Rupesh,

Deshpande Suresh, Rout

Sritam



Photographs:



Problems Addressed:

The development of a surgical device with several degrees of freedom promises to change surgical practice. Its precision and versatility provide surgeons unprecedented control, improving patient outcomes and broadening the range of treatments. Minimizing problems and tiredness promotes safer procedures and enhances surgeon well-being. Furthermore, its introduction encourages innovation, propelling the sector toward ongoing excellence and patient-centered treatment. In essence, this breakthrough represents a critical step toward a more promising future in surgery.

Commercialization Details:

The commercialization details for a surgical instrument with multiple degrees of freedom are currently under process.

41. Multiple Fire Extinguisher Carrier with Trolley

Summary:

The invention is designed for efficient and safe transportation of fire extinguishers. The carrier base supports the fire extinguisher carrier, which includes a frame connected to wheels for easy mobility. A transparent cover made of clear material encloses the fire extinguisher, allowing for easy visibility. The fire extinguishers are arranged vertically to optimize space. An EPDM rubber heading in the form of a ring seal is placed under the transparent cover to prevent gas leakage. A lock nut is designed to easily access the cylinders and securely hold the valve mechanism closed. A rubber cylinder guard surrounds the fire extinguisher cylinder to absorb shocks and prevent accidental gas release. Lastly, a Grip Lock connector adjusts the height of the telescopic handle, requiring only a slight twist to lock it into position. The handle can be equipped with a thread on the top tube and a handgrip on the bottom tube.

Patent No: 409206

Date of Grant: 18/10/2022

**Applicant: Kalasalingam
Academy**

**Inventor(s): S. Shasi Anand,
P. Jaya Kumar, S.**

Bathrinath, T. Raj

Pradeesh, P. Amothak

Kannan



Salient Features:

The device is equipped with several salient features that make it an effective and reliable solution for fire safety. The carrier features a base with a frame connected to wheels for easy mobility, allowing it to be easily rolled and transferred to different locations. A transparent cover made of clear material encloses the fire extinguisher, allowing for easy visibility. The fire extinguishers are arranged vertically to optimize space, and an EPDM rubber heading in the form of a ring seal is placed under the transparent cover to prevent gas leakage. A lock nut is designed for easy access to the cylinders and to securely hold

the valve mechanism closed. A rubber cylinder guard surrounds the fire extinguisher cylinder to absorb shocks and prevent accidental gas release. The Grip Lock connector allows for easy adjustment of the height of the telescopic handle with a slight twist, and the handle can be equipped with a thread on the top tube and a handgrip on the bottom tube. The carrier is made of durable materials to withstand heavy use and harsh conditions, ensuring its longevity and reliability. These features make the Multiple Fire Extinguisher Carrier with Trolley an ideal solution for fire safety in various settings.

Problems Addressed:

The Multiple fire extinguisher carrier with trolley addresses several problems related to fire safety and the transportation of fire extinguishers. One of the main problems is the difficulty in moving multiple fire extinguishers to different locations, especially in large buildings or outdoor areas. The carrier's base, which has a frame connected to wheels, provides a solution to this problem by allowing for easy mobility and transportation of multiple fire extinguishers. Another problem is the lack of visibility of the fire extinguisher, which can make it difficult to locate in an emergency. The transparent cover of clear material solves this problem by allowing for easy visibility of the fire extinguisher. The vertical arrangement of fire extinguishers optimizes space, and the EPDM rubber heading prevents gas leakage. The lock nut provides easy access to the cylinders and securely holds the valve mechanism closed. The rubber cylinder guard absorbs shocks and prevents accidental gas release. The Grip-Lock connector allows for easy adjustment of the height of the telescopic handle, and the handle can be equipped with a thread on the top tube and a handgrip on the bottom tube. These features address the problems related to fire safety and the transportation of fire extinguishers, making the Multiple Fire Extinguisher Carrier with Trolley an effective solution.

Impact of the Invention:

The multiple fire extinguisher carrier with trolley has the potential to impact fire safety in various settings significantly. The carrier's easy mobility and transportation of multiple fire extinguishers allow quick and efficient response to fires, potentially saving lives and property. The transparent cover of clear material provides easy visibility of the fire extinguisher, making it easier to locate in an emergency. The vertical arrangement of fire extinguishers optimizes space, storing more fire extinguishers in a smaller area. The EPDM rubber heading prevents gas leakage, ensuring the fire extinguisher is always ready. The rubber cylinder guard absorbs shocks and prevents accidental gas release, ensuring the fire extinguisher's safety. The Grip-Lock connector allows for easy adjustment of the height of the telescopic handle, making it easier to use for people of different heights. The carrier's durable materials ensure its longevity and reliability, reducing the need for frequent replacements.

Photographs:



Commercialization Details:

Prototype model has been developed.

42. Temporary Speed-Breaker Early Warning Device

Summary:

The invention is a temporary speed breaker early warning device designed to enhance road safety. It comprises a rubberized speed breaker made of tough PVC synthetic molded plastic, an image-capturing sensor with a transceiver, a panel mounting stand, a solar panel, and a red LED cluster indicator. The speed breaker is designed to withstand vehicle impact and has embedded LED indicators for enhanced visibility. The image-capturing sensor captures images of passing vehicles and transmits data to activate blinking LED lights visible from up to 500 meters away. The panel mounting stand securely

holds the solar panel, sensor, and electronic interfaces in a single enclosure. The solar panel powers the circuit, and a solar charger controller with battery backup ensures continuous operation. The wires igniting the LED cluster are concealed inside the mast for improved aesthetics and safety.

Salient Features:

The temporary speed breaker early warning device is a road safety innovation with several important features. It includes a durable rubberized speed breaker designed to withstand vehicle impact and is equipped with embedded LED indicators for better visibility. An image-capturing sensor with a transceiver captures images of passing vehicles and activates blinking LED lights, alerting drivers from a distance. The device also features a panel mounting stand that securely holds the solar panel, sensor, and electronic interfaces in a single, integrated enclosure. The solar panel powers the entire circuit, ensuring continuous operation even at night with the help of a solar charger controller and battery backup. The wires igniting the LED cluster are concealed within the mast for improved aesthetics and safety.

Problems Addressed:

The temporary speed breaker early warning device addresses several road safety problems. One of the primary issues is the lack of visibility of conventional speed breakers, especially during nighttime or poor weather conditions, which can lead to accidents. To tackle this, the device features bright LED indicators embedded within the speed breaker, enhancing its visibility. Another problem is the lack of advance warning for drivers about upcoming speed breakers, which can result in sudden braking and potential accidents. The image-capturing sensor and transceiver in the device address this issue by activating blinking LED lights that are visible from a distance, alerting drivers in advance. The device addresses the challenge of power supply for electronic components by utilizing a solar panel and battery backup, ensuring uninterrupted operation. The concealment of wires within the mast also improves aesthetics and safety, addressing the problem of exposed wiring.

Patent No: 492343

Date of Grant: 30/12/2023

Applicant: Kalasalingam

Academy, P.Jayakumar

Inventor(s): S. Shasi anand,

P.Jayakumar, A. Robert

Singh, K. Suthendran, S.P.

Balakannan, P.

Velmurugadass



Impact of the Invention:

The temporary speed breaker early warning device has a significant positive impact on road safety. By enhancing the visibility of speed breakers through embedded LED indicators; the device reduces the risk of accidents caused by poor visibility, especially during nighttime or adverse weather conditions. The advance warning provided by the blinking LED lights activated through the image-capturing sensor and transceiver allows drivers to slow down in a timely manner, promoting smoother traffic flow and reducing the likelihood of sudden braking-related accidents. The use of a solar panel and battery backup ensures continuous operation, even in the absence of grid electricity, contributing to energy efficiency and sustainability. The concealment of wires within the mast improves aesthetics and eliminates potential hazards associated with exposed wiring. The device contributes to safer roads and more efficient traffic management.

Photographs:



Commercialization Details:

The prototype model has been developed and is still under further improvement for commercialization.

43. Remote Operating Movable Fire Extinguisher

Summary:

The invention is a remotely controlled portable fire extinguisher designed to enhance safety and efficiency in firefighting operations. The device is mounted on a wall for easy visibility and access, and it's equipped with a pressure gauge to indicate the level of the extinguishing media inside, which could be water or powder. A lock pin is placed at the top to prevent leakage of the extinguishing media. The fire extinguisher is powered by a 12V battery, charged by a battery charging unit at the bottom of the device. It is fitted with two remote-controlled motors: one for moving the extinguisher forward and backward and the other for left and right movements. The device is mounted on rolling wheels for easy mobility to the fire-catching area. The control unit, situated at the bottom of the portable fire extinguisher, manages the operations of the device once it reaches the fire-catching area. The fire extinguishing media is discharged through a deformable discharge hose and a nozzle, which can be remotely controlled to direct the jet from side to side in a sweeping motion, targeting the base of the flame. This design aims to provide a safer and more effective way to combat fires.

Patent No: 266426

Date of Grant: 05/05/2015

Applicant: P. Jayakumar

**Inventor(s): P. Jayakumar,
S.M. Seeni Mohaideen**



Salient Features:

- **Wall-mounted design:** The remote unit is mounted on the wall in a safe and visible area, ensuring easy access for operators.
- **Versatile extinguishing media:** The portable fire extinguisher can be filled with various fire extinguishing media, such as water or powder, at the required pressure.
- **Pressure gauge:** A pressure gauge is provided to indicate the pressure of the extinguishing media inside the device.
- **Lock pin:** A lock pin is placed at the top of the extinguisher to protect the extinguishing media from leakage.
- **Battery charging unit:** A 12V battery charging unit is located at the bottom of the fire extinguisher, providing power for its operations.
- **Remote-controlled motors:** Two remote-controlled motors enable the fire extinguisher to move forward, backward, left, and right.
- **Rolling wheels:** The portable fire extinguisher is mounted on rolling wheels for easy mobility to the fire-catching area.
- **Control unit:** A control unit is located at the bottom of the portable fire extinguisher, managing the operations of the device once it reaches the fire-catching area.
- **Deformable discharge hose:** The device features a deformable discharge hose that directs the fire-extinguishing media to the base of the flame.
- **Adjustable nozzle:** The nozzle can be remotely controlled to direct the jet from side to side in a sweeping motion, ensuring efficient and targeted fire suppression.

These features collectively contribute to a safer and more effective firefighting solution, enabling operators to combat fires remotely and with precision.

Problems Addressed:

The remotely controlled portable fire extinguisher addresses several problems commonly associated with traditional firefighting methods.

- **Safety risks for firefighters:** Traditional firefighting methods often require firefighters to approach the fire at close range, exposing them to potential hazards such as smoke inhalation, burns, and structural collapses. The remotely controlled portable fire extinguisher allows operators to combat fires from a safe distance, significantly reducing these risks.
- **Limited accessibility:** In some cases, fires may occur in hard-to-reach areas or confined spaces, making it difficult for firefighters to extinguish them effectively using conventional methods. This invention's portable design, remote-controlled motors, and rolling wheels enable better accessibility to such areas.
- **Inefficient use of extinguishing media:** Traditional fire extinguishers may not always direct the extinguishing media effectively to the base of the flame, leading to wastage and reduced efficiency. The adjustable nozzle and deformable discharge hose of the remotely controlled portable fire extinguisher ensure targeted and efficient application of the extinguishing media.
- **Difficulty controlling fire spread:** In large or complex fire scenarios, firefighters may find it challenging to contain the fire and prevent it from spreading. The nozzle's remote-controlled operation and sweeping motion allow operators to quickly and effectively address multiple areas of the fire, helping to control its spread.

- Time-consuming firefighting operations: Traditional firefighting methods can be time-consuming, particularly when firefighters need to navigate through complex environments or deal with large-scale fires. The remotely controlled portable fire extinguisher enables faster response times and more efficient fire suppression, potentially minimizing property damage and saving lives.

Given the above challenges, the remotely controlled portable fire extinguisher offers a safer, more efficient firefighting solution.

Impact of the Invention:

The remotely controlled portable fire extinguisher offers numerous benefits and impacts firefighting and public safety in various ways. It significantly enhances firefighter safety by allowing operators to combat fires from a safe distance, reducing risks associated with traditional firefighting methods, such as smoke inhalation, burns, and structural collapses.

The portable design and remote-controlled operation improve accessibility, enabling firefighters to extinguish fires effectively in hard-to-reach areas or confined spaces.

The adjustable nozzle and deformable discharge hose ensure targeted and efficient application of extinguishing media, reducing wastage and improving fire suppression efficiency. The remotely controlled portable fire extinguisher allows for faster response times, potentially minimizing property damage and saving lives in emergency situations. Its remote-controlled operation and sweeping nozzle motion help control fire spread by quickly addressing multiple areas of the fire. The invention's versatility in accommodating various extinguishing media, such as water or powder, makes it suitable for use in different fires and environments. The increased efficiency and reduced risk of property damage offered by the remotely controlled portable fire extinguisher can lead to potential cost savings in terms of firefighting operations, property repair, and insurance claims.

Commercialization Details:

Commercialization is under process.

Photographs:



4.4. A Novel Composite Catalyst for Eco-Friendly Production of Pulegone Free De-Mentholized Oil (DMO)

Summary:

The present invention is related to the semi-synthesis of menthone/iso-menthone from pulegone present in decentralized oil (DMO). In the reported fumigation bioassays, pulegone is the most toxic monoterpene, which is only permitted in essential oil with a trace percentage. To limit the percentage of pulegone in essential oil, an eco-friendly semi-synthesis process is needed to convert the pulegone to high-value commercially important compounds, viz. menthone/iso-menthone. Now, the present process is

related to an eco-friendly process for the selective conversion of pulegone in DMO to menthone/iso-menthone without affecting the other major compounds. Presently, we claim new catalysts such as b-zeolite-Pd/AC or g-zeolite-Pd/AC or g-Na-zeolite-Pd/AC or Ag-zeolite-Pd/AC or SiO₂-Pd/AC for semi-synthesis of menthone/iso-menthone from the unwanted compound Viz. pulegone. All these catalysts are prepared easily through the impregnation method and are very effective in the above conversion under 4 to 10 psi hydrogen pressure. After modification, the pulegone content is declined to less than <0.5%, which can overcome the regulatory restrictions. The modified oil may find better application in the fragrance, flavor, and cosmeceutical industries.

Salient Features:

India is a global leader in mentha essential oil production, producing more than 30,000 tons of mentha oil per annum. Mentha essential oil contains pulegone, which is an unwanted compound. Pulegone, an unwanted monoterpene, is listed as a carcinogenic compound, and its use in perfumery as well as fragrance is fully prohibited. In the industrial process of menthol crystal separation from Mentha arvensis essential oil, the pulegone content in the remaining decentralized oil (DMO) is enhanced up to 2.8%. In DMO, the pulegone (>1%) is found difficult to trade due to the new restricted guidelines. To overcome the pulegone issue, a novel catalyst has been developed as 2%Pd-3%Si/AC for selective conversion of pulegone to menthone/isomenthone. At the optimized conditions, the menthone/isomenthone was produced 97.5% from the pulegone. In particular, this reaction was effective using DMO with 2.8% pulegone as substrate. After passing through the semi-synthesis process, the pulegone content in the DMO was reduced to less than 0.5% without altering the composition of other major compounds. This modified oil is very suitable for fragrance, flavor, and cosmeceutical preparations.

Problems Addressed:

Pulegone is a natural oxygenated monoterpene reported in many commercially important essential oils. But, it was low valued, renewable starting material for use in high value chemicals. In fumigation bioassays, pulegone was most toxic monoterpene to Rosa chinensis. Pulegone was added to Prop65 by Office of Environment Health Hazard Assessment (OEHA) to the list of chemical known in the state of California to cause cancer for the purposes of the safe drinking water and toxic enforcement Act of 1986

Patent No: 434332

Date of Grant: 09/06/2023

Applicant: CSIR

Inventor(s): Rout Prasanta

Kumar, Chanotiya Chandan

Singh, Yadav Anju, Shasany

Ajit Kumar



(Proposition 651). In 2018, the IFRA (International Fragrance Research Association) reported it as a toxic chemical, and recently, WHO fully prohibited its use. In the present work, pulegone is catalytically transformed into high-value menthone/isomenthone. Menthone/isomenthone has beneficial anti-inflammatory, antioxidant, antimicrobial, and acticachexia activities.

Selective reduction of a β -unsaturated aldehyde is important in the synthesis of value-added products. Pulegone contains two double bonds as C=O and C=C are in conjugate position. Selective reduction of C=C double bond of pulegone was transformed to menthone and isomenthone. Many factors influence product selectivity, such as metal type, morphology, particle size, and use of other metal supports. Hydrogenation of pulegone was reported using Pt/SiO₂ catalyst under flowing H₂ for 4 h at 120 °C. It gave only 58% of menthone/isomenthone, along with 42% of menthol isomers. Bogel-Lukasik has reported the conversion of pulegone to menthone/isomenthone using a Pd/Al₂O₃ catalyst under a supercritical CO₂ medium. Though this process is given 98% conversion, it is effective at high H₂ pressure (580 psi) along with more than 1813 psi overall pressure (CO₂+H₂). The present process is surmounting such limitations by using a cheaper catalyst, a very low concentration of substrate (pulegone), and operating at very mild operating conditions for the semi-synthesis of menthone/isomenthone. For that, the present catalyst (Si-Pd/AC) is reasonably low cost and also effective for selective conversion of pulegone to menthone/isomenthone under mild reaction conditions. The catalytic conversion of the target compound in the essential oil is influenced by the other compounds (terpenoids) in the essential oil. As a result, either the catalytic active sites have been reduced, or constituents other than the target compound are chemically transformed. Therefore, an effective catalyst with selective conversion is of utmost importance. These catalytic processes are very selective as well as effective in the case of pulegone-rich essential oils taken for this transformation. On the other hand, DMO contains 2-3% of pulegone along with menthone (22-27%) and iso menthone (17-20%). Hence, a part of pulegone catalytically transferred to menthone and iso menthone does not alter the quality of the modified oil. This modified oil may find better use in flavour and fragrance industries.

Impact of the Invention:

The pulegone, a carcinogenic compound, poses regulatory challenges, especially in DMO with a trading volume exceeding 5000 tons in the perfumery industry. To address this issue, a novel catalyst (2%Pd-3%Si/AC) was designed to selectively convert pulegone to menthone/isomenthone. The semi-synthesized essential oil displayed significant anti-microbial activities, indicating commercial potential and offering a solution to regulatory challenges. This process overcomes regulatory implications and opens avenues for alternative applications of modified oil in pharmaceutical and perfumery industries.

Commercialization Details:

The invention is currently under discussion and deliberation with industries for licensing.

45.A System and Method for Optimizing Power Consumption in Mobile Devices

Summary:

Typically, signal processing algorithms/use cases/codecs are implemented on Digital Signal processor Instruction set architecture, wherein the SIMD instruction sets have saturation logic embedded to ensure bit-exact results while optimizing the C reference code. In order to beat the competition in power performance, it was decided to implement a voice solution in two parts - speech

codec on the CPU with SIMD extensions only and pre/post-processing modules in the DSP core. In order to achieve up to 8x power optimal solution from the competition, it was essential to implement the speech codecs on the CPU, taking the same MCPS as it would take on a DSP core. The CPU ISA only has a SIMD extension that lacks saturation logic embedded in the SIMD instructions. The optimization was challenging, and overcoming the limitation of ISA and getting a bit of an exact result was innovative in the same MCPS as on a DSP core. The resulting solution is 8x power optimal than the nearest competing solution.

Salient Features:

The novelty of the invention is implementing the signal processing module codecs on the CPU with SIMD extensions only, unlike the usual way of implementing them on the DSP core in the platform Soc. We spotted and exploited loopholes in the specifications (vocoder standards) to implement the vocoder, taking the same/lesser MCPS on a CPU core as it would take on a DSP core. With a pipelined implementation between CPU and DSP cores (speech codecs on CPU and Pre/Post processing in DSP core), the solution offered 8x power optimal performance. As a result, the battery life of the device for talk time increased significantly.

Problems Addressed:

Until now, the focus has been on getting an efficient solution on the DSP core in the SoC platform. With this approach and solution, we could extend the battery life of device usage for talk time use cases as the power consumed in the platform SoC was significantly reduced and conserved for future/other usage. We extended the concept to other areas of signal processing - audio, video, image, computer vision, AI/ML, Drones, and Battery management systems, which are more demanding in power consumption. The cumulative and net gain resulted in an overall increase in the battery life of device usage and reduced heating issues in the SoC.

Patent No: 302522

Date of Grant: 29/10/2018

Applicant: TriSpace

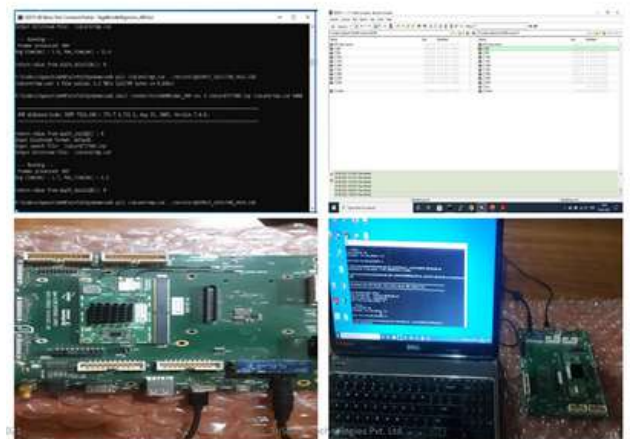
Technologies

Inventor(s): Narasimhan

Vijay Anand



Photographs:



Impact of the Invention:

Because the power consumed is less for the use cases (work), the electrochemistry activity in the battery is reduced, and hence, the wear and tear is reduced. The physical batteries and the device can last longer years of service before they can be dumped as e-waste, thus aiding in the concept of circular economy supporting and enabling Sustainable Environment and Development Goals.

Commercialization Details:

The work is running on millions of phones with excellent performance.

46. Improved Greenhouse

Summary:

The present invention provides a low-cost light structural configuration for an aerodynamic greenhouse that can withstand wind forces and provide adequate ventilation. The greenhouse comprises a two-way ventilator system comprising raised ridge ventilator/s provided with openings formed by the outer side roof, inner side roof having reduced slope, and the raised ridge roof; an intermediate column provided along with strut; a tension member to reduce the deflection at the upper end of column; outer bay/s provided with corridors and side ventilator/s wherein one of the outer bays is provided with a corridor and side ventilator controlled by a rolling curtain; gutter/s provided between bay/s. The multiple bays are a combination of outer bays provided with one-way ventilators and the wider inner bays supplied with 2- way-raised ridge ventilators wherein the outer roof slope of the outer bays is substantially reduced.

Patent No: 371081

Date of Grant: 03/07/21

Applicant: Mahindra & Mahindra

Inventor(s): Subhash Gajanan Modak, Ashok Hiralal Sharma, Tejas Rameshbhai Joshi, Ramesh Narayan Nayak



Salient Features:

The present invention achieves the desired aerodynamics in greenhouses as follows:

- The outer bays have 2-way ventilators, and the inner bays are provided with one-way ventilators.
- The outer bays are provided with one-way ventilators, while the inner bays are supplied with 2-way ventilators.

The height of the outer sides of the greenhouse may also be reduced to improve the aerodynamics of the greenhouse further. Vertical sides at the front and rear ends of the bays may also be sloping to reduce the wind forces on the front and rear ends of the greenhouse.

Problems Addressed:

The prior greenhouses require heavy-duty, high-cost structures to withstand wind forces on their structural members. Further, existing greenhouses have actuators with moving parts that need to be operated manually or electronically to adjust the ventilation in the greenhouse. Such controls modulate the ventilation but do not help to reduce the impact of high wind forces on the greenhouse structure. Therefore, there is a need to provide low-cost structural configurations that reduce the impact of high wind loads on the greenhouse structure without needing constant maintenance and yet provide appropriate ventilation, temperature, and air volume inside the greenhouse required for plant growth.

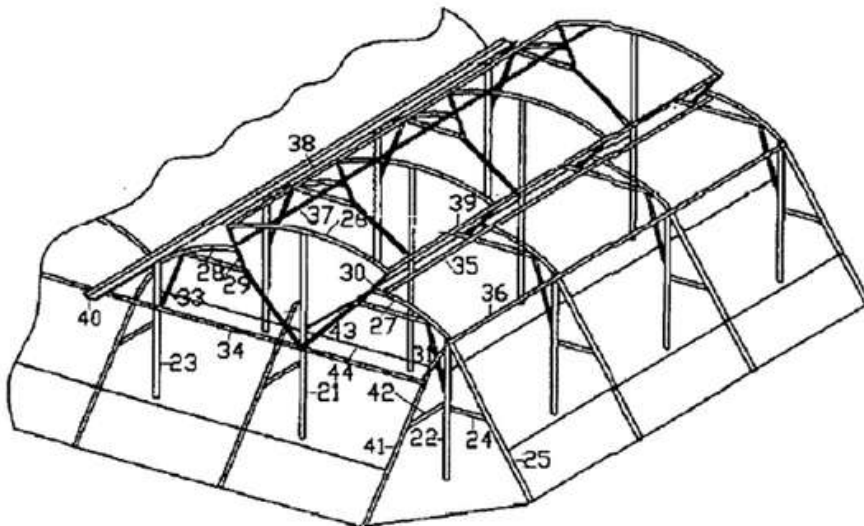
Salient Features:

This Improved greenhouse exhibits far less resistance to wind flow with the advantage of ensuring free airflow across the roof ventilator, thereby reducing wind loads on the structure, enabling such a configuration to use fewer and lighter members in the greenhouse for a given covered area as compared to the greenhouses of the prior art. While the reduction in the wind loads as above allows the use of fewer and/or lighter and low-cost members for the structure by a reduction in the cross-sectional area, preference may need to be to the use of thinner pipes or tubes of higher diameter in case of round-type, and height and width in case of rectangular or square pipes than thicker but slender pipes in order to optimize their capacity to withstand buckling, bending and torsional loads, and also to facilitate assembly and service personnel/ workmen to get better hold and support while climbing on the said pipes/ structures. However, prevalent joining/ jointing systems for the assembly of greenhouses are not appropriate for use with thin-walled pipes of standard diameter or height and width.

Commercialization Details:

It's been commercialized by Mahindra EPC Irrigation Ltd.

Photographs:



47. Method of Novel eSIM Remote SIM Provisioning in Multi-Profile Environment for Wearable Devices

Summary:

Providing cellular connectivity to a smart watch via e-SIM provisioning, thereby allowing the smart watch to send and receive calls, messages and internet connectivity even when user is not carrying phone.

Salient Features:

The smartwatch downloads the eSIM subscription profile information of a network provider (e.g., Airtel, Jio, etc.) via the smartphone. Once the eSIM is activated, the smart watch can function independently to send and receive calls, messages, and internet connectivity even when the user is not carrying a phone.

Problems Addressed:

An eSIM, or electronic SIM, is a digital SIM card that eliminates the need for a physical SIM card. It allows the activation of the mobile plan from your network provider without a physical SIM card. The “e” in eSIM stands for “embedded,” which indicates that it is a SIM card that stays inside your phone and can’t be removed. Activation of the eSIM profile on an electronic device (e.g., a smartphone) is performed using a process called Remote SIM provisioning (RSP). Remote Sim Provision is remotely activating the SIM profile over the air on the eSIM device. With the rise of wearable devices with similar capabilities to smartphones, a solution is required to provide eSIM profiles remotely on wearable devices.

Impact of the Invention:

This invention enabled a new infrastructure with network operators such as Jio, Airtel, etc., in India, which allows smartwatches to perform the functions of a smartphone independently with the help of a virtual SIM (i.e., e-SIM).

Commercialization Details:

This solution is deployed in 47 countries, including India, for 100+ Mobile Network Operators (MNOs). Samsung Galaxy watch 4 is the product in which the solution is commercialized.

Photographs:



Patent No: 505133

Date of Grant: 30/01/2024

Applicant: Samsung Electronics

Inventor(s): Satyajit Anand



48. System and Method for Street Lighting Optimization

Summary:

The street lighting optimization system and patent application method manages the lighting schedule of a plurality of lamps set up in an Area of Interest (AOI). The patent application method provides granular control by generating an optimized lighting schedule for every lamp of the plurality of lamps set up in the AOI using predictive and prescriptive analytics. Prescriptive analysis refers to optimization based on a set of constraints applied to an optimization objective function (objective function).

The AOI's objective function may be preset based on current lighting requirements and electrical energy availability. The set of constraints is generated from spatio-temporal predictions, which are derived by analyzing area data of the AOI. The area data may be obtained from a plurality of data sources. The constraints also include a plurality of regional factors associated with the AOI, such as climate conditions, climate data, city event calendar data, third-party automated data, etc. The area data comprises crime data providing crime rate, traffic density data, subject density data, and lamp map data corresponding to every lamp among the plurality of lamps set up in the AOI. Consideration of the area data along with the regional factors to generate the set of constraints enables authorities managing the light system to plan energy targets subject to the electricity budget. The patent application method applies to any AOI or environment, such as street lighting in an urban or semi-urban environment. It may be extended to corridor lighting in metro sub-stations, huge complexes, and the like by refining the constraints in accordance with the needs of the AOI considered. By addressing the critical issues of time and cost-efficient energy management associated with lighting optimization, the street lighting optimization system and method of the patent represents a significant step towards achieving the United Nations Sustainable Development Goal 7 of ensuring affordable and clean energy and SDG 12 of responsible consumption and production.

Salient Features:

The system and method of street lighting optimization are scalable. They may be easily expanded to manage the lighting of a plurality of AOIs that are included within the lighting system. The method is portable and may be implemented on any operating platform with minor modifications to adapt to the platform. Thus, portability and scalability make the technique and the patent application system easy to implement while providing time and cost-efficient energy management.

Problems Addressed:

Energy management is a challenge in every sector. Smart balancing between energy demand and availability of energy resources is a need of time considering the exponentially growing population—a similar scenario in lighting systems, typically for electrical energy management. Managing the lighting systems to provide more sustainable lighting solutions is critical to letting people live, work, and socialize in safe, secure, attractive cities. Many solutions exist for managing lighting systems to meet

Patent No: 470389

Date of Grant: 20/11/2023

Applicant: TCS

Inventor(s): Jun-Jang Jeng,

Charles Okey Njelita, Jay

Gupta, Sachin Gangwar,

Suman Mahalanabis



energy demands, aiming to save maximum energy. Apart from conventional techniques requiring manual monitoring, street light systems are currently utilizing predictive maintenance scheduling and methods of operation. Most solutions offer segmented approaches to controlling streetlights, such as real-time monitoring, energy prediction, or lighting schedule planning. Cities around the globe spend a huge percentage of their energy budget on street lighting. Efficient management or planning of lighting systems, not limited to street lighting, is required to utilize electrical energy in an optimized manner. This requires considering several other parameters such as crime data providing crime rate, traffic sensor data and people sensor data, climate data, and the like.

Many solutions exist and have been proposed for intelligent smart light management. An existing method controls street lighting over a group of road segments, wherein a road class is dynamically assigned to each road associated with each road segment, and traffic parameters are determined for each road segment for a current time period. However, the existing lighting system, even though dynamic, is responsive or reactive and changes its predefined lighting schedules based on real-time feedback of current traffic conditions.

Reactive lighting systems are slow and do not optimize energy management. Further, the existing method limits lighting control to higher levels (road segment levels) and does not provide granular control at lower levels, effectively not optimizing lighting control.

Another existing method utilizes clustering techniques to derive lighting requirements for the streetlights. The clusters are defined from the location-based data, and lighting requirements are defined for each of the clusters based on the analysis of the location-based data. However, the existing method is responsive or reactive. It changes its predefined lighting schedules based on real-time feedback on current traffic conditions; hence, it does not provide optimization in energy management. Further, the existing method limits providing lighting control at a higher level (cluster level), not granular control at further lower levels, effectively not providing an optimized lighting control.

Impact of the Invention:

The systems and methods of the patent overcome limitations of energy demand and availability of energy resources of conventional systems and granular control at further lower levels by generating revised optimized lighting schedules when real-time area data such as traffic density data or subject density data or the like are obtained from sensors at every lamp. The real-time data provides information on changes that occurred over time after implementing the current optimized lighting schedule. Thus, the revised optimized lighting schedule takes into account the changes to modify the lighting schedule accordingly. In scenarios when real-time feedback may not be obtained directly from sensors, the method repeats the generation of optimized lighting schedules at predefined intervals, wherein the area data is newly obtained or extracted before generating the revised optimized schedule, automatically capturing any recent changes in the area data that have been updated in the data sources of the AOI.

Commercialization Details:

- Analytics-driven insights for optimizing sustainable actions & recommendations.
- Administrator privilege to visualize, monitor, and analyze organization-wide events in real time.
- A proactive approach to water loss management with out-of-the-box capabilities, incorporating weather, event, outage, employee, and other real-time enterprise/campus data.
- Improves public & private transit operations and continuity.

49. A Fire Resistant Steel Product and a Method of Producing a Fire Resistant Steel

Summary:

The invention introduces a high-strength, fire-resistant steel with minimal variations in material quality, maintaining a yield strength at 600°C that is at least two-thirds of its yield strength at ambient temperature. The production method for this steel involves a composition with specific proportions by mass: C at 0.04 to 0.08%, Mn at 0.8 to 1.3%, Si at 0.2% or less, Mo at 0.1% or less, Ti at 0.005 to 0.03%

, N at 0.006% or less, Al at 0.05% or less, P at 0.03% or less, and S at 0.02% or less. The remainder of the composition is primarily iron, along with unavoidable impurities. This steel demonstrates a yield strength at 600°C that is 66% or greater compared to its yield strength at room temperature. The invention also details a method for producing fire-resistant structural steel with exceptional stability in strength when exposed to fire. The steel is a deformed low carbon sheet reinforced with Ti and Mo, which serve as the main elements for precipitation strengthening, ensuring the precipitates remain stable at elevated temperatures and thus offering superior performance compared to other similar structural steels in fire conditions.

Patent No: 436740

Date of Grant: 30/06/2023

Applicant: Tata Steel

Inventor(s): Arunansu

Haldar, Gajendra Jha, T.

Venugopalan



Salient Features:

This method is for manufacturing hot-rolled, high-strength steel specifically designed for fire-resistant structural purposes. This method aims to address and overcome the limitations found in existing production techniques. One of the key objectives is to enhance the steel's yield strength by incorporating hardening elements such as Titanium (Ti) and Molybdenum (Mo). This process is engineered to create stable (TiMo) carbide precipitates that maintain their integrity at high temperatures. Moreover, the method ensures that the steel retains at least 66% of its room temperature yield strength, approximately 600 MPa, even when subjected to elevated temperatures around 600 degrees Celsius. Alongside these improvements, the proposed technique also strongly emphasizes ensuring that the resulting steel exhibits superior weldability, making it ideal for construction use in fire-prone environments.

Problems Addressed:

In the event of a fire, the temperature increase causes the structural steel components of a building to elongate and deform. This can result in the compromise of the building's load-bearing framework. For example, in a framed structure, the expansion of beams can negatively impact the stability of the columns, making the entire structure prone to collapse. Countries such as Japan, China, and Germany have implemented fire-resistant steel in various constructions, including multi-level parking facilities, sports venues, train stations, and office complexes. While there is some information available on the performance and characteristics of fire-resistant steel, further research is imperative to fully understand its benefits and drawbacks, including the financial implications of its use. More studies are also needed to establish guidelines for the effective integration of such steels into structural design. Ensuring the integrity of load-bearing structures during a fire is crucial for the safety of individuals. The fire resistance

of a structure is a multifaceted issue that depends heavily on the properties of the materials used in construction, and it is significantly influenced by the choice of these materials.

Impact of the Invention:

The present invention pertains to a novel and enhanced method for producing and assessing hot-rolled high-strength steel (with a minimum yield strength of 600 MPa) for fire-resistant structural applications. Additionally, this invention encompasses a fire-resistant steel product manufactured via this advanced process. This product is designed for use in structures requiring fire resistance and involves a rolling process that produces steel in sheet or strip form. Key aspects of this invention include the strategic combination of the steel's composition and its treatment process, which collectively confer fire resistance to the material. The resultant steel exhibits superior weldability, precise thermomechanical properties, high resistance to softening at temperatures up to 600°C, and maintains ample toughness within the heat-affected zone (HAZ). An advantage of this product is its reduced reliance on protective coatings. Overall, the method ensures that the steel produced demonstrates high resistance to softening at elevated temperatures of 600°C and retains the necessary toughness in the HAZ, enhancing its suitability for fire-resistant applications.

Photographs:



50. Adjustable Breakdown Warning Alarm and Light Lantern

Summary:

The invention is a compact and foldable Breakdown Warning Alarm & Light Lantern designed to enhance safety during vehicle breakdowns, particularly on highways. The device includes a reflective warning triangle, recognized universally as a symbol for a broken-down vehicle, made of reflective material for improved visibility at night. The triangle is equipped with flashlights at the top and a diverting light system on both sides to guide oncoming vehicles. Parking lights are placed on either side of the breakdown vehicle to indicate its width. A proximity sensor in the warning triangle detects approaching vehicles and triggers a sound alarm via an Electronic Control Unit (EDC). The system is powered by a solar panel, with a 12-volt battery wiring system for energy storage and night-time use. The warning unit is fixed on a magnetic fixture for stability and can be packed into a weather-proof box for storage in the car.

Patent No: 348579

Date of Grant: 05/10/2020

Applicant: P. Jayakumar,

S.M. Seeni Mohaideen

Inventor(s): P. Jayakumar,

S.M. Seeni Mohaideen,

Muralikannan Rangarajan ,

Jeyalashmi Chellasamy,

Tamilselvi Rajendran ,

Jaikalam Rajendran



Salient Features:

- A reflective warning triangle with a universally recognized design, enhancing visibility during night-time breakdowns.
- Flashlights and a diverting light system to guide oncoming vehicles and indicate the width of the broken-down car.
- A proximity sensor that triggers a sound alarm when approaching vehicles is detected.
- A solar panel for power, with a 12-volt battery wiring system for energy storage and use during night-time.
- A magnetic fixture for stable placement and a weather-proof box for compact storage in the car.
- A foldable structure for easy handling and transportation.

Problems Addressed:

The invention addresses several problems associated with vehicle breakdowns on highways, including:

- **Poor visibility:** The reflective warning triangle, flashlights, and diverting light system enhance the visibility of the broken-down vehicle, reducing the risk of accidents.
- **Lack of warning:** The proximity sensor and sound alarm provide an early warning to approaching vehicles, allowing them to take appropriate action.
- **Power supply:** The solar panel and 12-volt battery wiring system ensure a reliable power source for the warning system, even during night-time breakdowns.
- **Portability and storage:** The warning unit's foldable structure and weather-proof box make it easy to store and transport in the car.
- **Stability:** The magnetic fixture provides a stable base for the warning unit, ensuring it remains in

place even in windy conditions.

By addressing these problems, the invention improves safety for brake-down vehicles and approaching vehicles on highways.

Impact of the Invention:

The impact of the invention is enhancing safety during vehicle breakdowns on highways. The improved visibility provided by the reflective warning triangle, flashlights, and diverting light system can reduce the risk of accidents and make it easier for approaching vehicles to take appropriate action. The proximity sensor and sound alarm provide an early warning to approaching vehicles, allowing them to adjust their speed and direction in a timely manner. The reliable power supply from the solar panel and 12-volt battery wiring system ensures that the warning system remains operational even during night-time breakdowns. The foldable structure and weather-proof box make storing and transporting the warning unit in the car easy, while the magnetic fixture provides a stable base for the warning unit. The present invention has the potential to save lives and reduce the number of accidents caused by vehicle breakdowns on highways.

Commercialization Details:

A prototype model has been developed.

Photographs:



51. Incinerator for Biological Waste

Summary:

One of the sustainable goals for developing countries, as well as developed ones, is to prevent or minimize air pollution and the dissemination of disease-causing organisms. Today, the prime challenge is the management of 'Biomedical Waste' without releasing disease-causing organisms into the environment. We are following the European guidelines for incineration of hazardous biomedical waste, which are implemented by the Central Pollution Control Board and the State Pollution Control Boards. The guidelines demand the construction of incinerators that burn biomedical waste, giving emphasis on

hazardous gases and chemicals. There is no consideration of the possible release of disease-causing organisms. It is scientifically proven that, due to biofilm formation and the presence of acidic amino acids in cellular structure, few pathogens get released during the incineration of 'Biomedical Waste'. Such pathogens are small in size and have low mol. Wt., remains in air in the form of 'Droplets' and 'Droplet Nuclei'. The administration is unaware of the fact that such 'Droplets' and 'Droplet Nuclei' remain suspended in the air for a long time (For a few pathogens, it is for 3 to 4 months), and those can travel a distance of 5 to 10 km. Present innovation has a unique filtration system for the removal of microorganisms, including bacteria, fungi, and viruses. The use of this 'Incinerator for Biological Waste' can revolutionize waste disposal and processing methods. It will prevent airborne transmission of diseases from biomedical waste. Our company 'Droplets Innovative Incinerators Pvt. Ltd., is located in Karad, Maharashtra, and registered under CIN U28299PN2023PTC220670. It is registered under the 'Startup Category' of 'Green Technology and Waste Management'. Government of India has supported our company through 'Biotechnology Ignition Grant of Rs. 50 lakhs in 2023. Our product, 'Biological Waste Incinerator,' is unique and patented, and it does not release disease-causing organisms during the burning of 'Biomedical Waste'.

Salient Features:

- Research-Based Patented Technology (PATENT NO. 394390)
- Two chambered incinerators. The primary chamber is operated at 850° C, and the Secondary chamber is operated at 1050° C.
- No emission of pathogens during incineration. Patented technology for curbing the release of pathogens. Unique in the category.
- Less emission of Carbon.
- TOC in the bottom ash is < 3%
- In-built APCD
- A quenching mechanism for Dioxins control
- Biofuel Blend Burners

Patent No: 394390

Date of Grant: 07/04/2022

Applicant: Droplets

Innovative Incinerators

Inventor(s): Bharat Bajaran

Ballal, Satish Ganapatrao

Patil, Renuka Bharat Ballal,

Shubhra Bharat Ballal



Problems Addressed:

It is estimated that 10 to 20 % of Biomedical waste generated through hospitals is hazardous, and such waste is the cause of a variety of health problems, including fatal upper & lower respiratory tract infections. On a global scale, about 64% of healthcare institutions have been reported as having unsatisfactory biomedical waste management facilities. Documented transmission through biomedical waste includes Tuberculosis (8.51%), HIV (74.47%), Pseudomonas sp. (29.4%), Proteus vulgaris (5.88%), Citrobacter sp. (2.20%), Staphylococci (8.82%), Enterococci (3.67%), Escherichia (22.79%), Hepatitis A (10.64%), Hepatitis B (56.19%). Common Biomedical Treatment Facility Centres have claimed for safe disposal of biomedical waste. Irrespective of following Central and State Pollution Control Board guidelines, such centers often spread pathogens in the air and adversely affect the health of nearby society.

The definition of biomedical waste vide Gazette of India Extraordinary part II Section III, Sub-section (i) Dated 28th March 2016, as amended in 2018 & 2019, is "Any waste, which get generated during the diagnosis, treatment or immunization of human beings or animals or research activities pertaining thereto or in the production or testing of biological or in health camps, including the categories mentioned in Schedule I appended to these rules".

As per the Central Pollution Control Board, there are 3,22,425 healthcare facilities, out of which 1,06,796 are bedded and 2,15,780 are non-bedded. 1,53,885 number of Health Care Facilities are granted authorization under the Biomedical Waste Rules. 2,35,571 Health Care facilities utilize Common Biomedical Waste Treatment Facility Centres, and 18,015 Health Care Facilities have captive bio-medical waste treatment and disposal facilities. There are 202 number of Common Bio-medical Waste Treatment Facility Centres in operation (35 under construction).

The total generation of biomedical waste is about 619 tonnes per day, out of which about 544 tonnes are treated in Common Biomedical Waste Treatment Facility Centres and captive treatment facilities. About 55 tonnes per day are treated by captive treatment facilities, and about 489 tonnes per day are treated by Common Bio-medical Waste Treatment Facility Centres. As reported, 29,062 healthcare facilities/Common Bio-medical Waste Treatment Facility Centres were observed to be violating the provisions of the Biomedical Waste Rules.

States, namely Assam, Maharashtra, Bihar, Karnataka, Kerala, Nagaland, Odisha, Chhattisgarh, Jammu & Kashmir, Madhya Pradesh, Manipur, and Rajasthan have observed gaps in the generation and treatment of biomedical waste. Hence, concerned State Boards should examine this issue and ensure that biomedical waste is disposed of in accordance with the provisions under the Biomedical Waste Management Rules, 2016.

States with Class I cities, namely New Delhi, Chennai, Mumbai, and Kolkata, generate a minimum of about 28 tons/day of biomedical waste. However, States, namely Kerala, Uttar Pradesh, Gujarat, Bihar, and Karnataka, also generate an enormous quantity of biomedical waste.

The states namely Andaman & Nicobar, Himachal Pradesh, Jharkhand, Assam, Chhattisgarh, Goa, J & K, Nagaland, Odisha, Puducherry, Karnataka, Kerala, Lakshadweep, Maharashtra, Meghalaya, Mizoram, Madhya Pradesh, Rajasthan, Sikkim, Tamil Nadu, Tripura and Uttarakhand use deep burial pits for disposal of Biomedical waste, however as per Biomedical waste Rules, 2016 use of deep burials is allowed only in remote or rural areas where there is no access of Common Bio-medical Waste Treatment Facility Centres (CBWTF).

Based on the above background, 'Droplets Innovative Incinerators Private Limited' has developed a unique research-based patented incinerator for the management of 'Biomedical Waste.'

Impact of the Invention:

The invention will revolutionize the present methods of biomedical waste management. In India and also in other countries, biomedical waste management methods release disease-causing organisms during their operational cycles. This always puts a tremendous burden on the healthcare sector, and it is the prime cause of economic burden on the respective nation. The present innovation will cease the spread of such disease-causing organisms during the incineration of biomedical waste.

Commercialization Details:

DROPLETS INNOVATIVE INCINERATORS PRIVATE LIMITED is located in Karad, Maharashtra, India. The company was founded on intense research, and the support team includes eminent scientists, microbiologists, aerobiologists, engineers, and furnace experts. As a collaborative activity, the company conducted extensive field research at and around 'Biomedical Waste Treatment Facility Centers (BWTFC) in selected cities.

Photographs:



52. Wind Augmentation and Air Purifying Unit

Summary:

The present invention relates to an air purification system and apparatus thereof. The air purification system and apparatus comprises filtration unit(s) which comprises filter(s) placed in a different position(s) to remove pollutants from ambient air around a polluted place; axial fan(s) connected to said filter(s) to generate a flow force to pass air through said filter(s); thermal oxidizer unit(s) connected to said filtration unit(s) to oxidize air at an outlet of said axial fan(s) and outlet unit connected to thermal oxidizer unit(s) to pass said oxidized air to atmosphere.

Patent No: 438248

Date of Grant: 11/07/2023

Applicant : IIT Bombay

Inventor(s): Vinayak Kishor

Padalkar, Rashmi

Sharashchandra Patil,

Rakesh Kumar, Satinder

Kaur



Salient Features:

The functionality of the air purification system is based on two principles viz., active pollutants removal and wind generation for dilution of air pollutants. The system includes filters through which the polluted air is passed through, wherein the pollutants are removed. The filters are able to remove the pollutants in the atmospheric air using a flow force, provided by the axial fans. The flow force is due to wind, which is generated by the axial fans. The filters perform dust filtration, in which dust particles of various sizes existing in the polluted air are filtered. The particulate matter (PM) in the atmospheric air can be of various sizes, and particularly PM having a size less than 10 μ m or lower are dangerous for health since it can be directly inhaled by the respiratory tract of humans. Thus PM and other pollutants in the atmospheric air are captured at the inlet of the filters.

The air purification system further includes a thermal oxidizer unit which oxidizes pollutants such as but not limited to carbon monoxide (CO), volatile organic compounds (VOCs), hydrocarbons, carbon dioxide (CO₂). The air which is passing through the filters, containing gaseous pollutants such as CO, VOCs, hydrocarbons or any other toxic pollutants, is subsequently passed through a thermal oxidizer unit. The air is heated inside this oxidizer unit with appropriate surface and retention time, which is typically three to four seconds. The retention time herein refers to the time taken by system to process the polluted air before ejecting it back into the atmosphere. The retention time depends on the volume of the air, wherein the density of the air remains constant. The velocities of the air at the inlet and outlet of the system are different, which result in atmospheric turbulence; thereby helping in bringing down the concentration of pollutants in the atmospheric air by dispersion and dilution.

The air purification system allows the integration and installation of sophisticated sensors, which can detect the concentration of the pollutants in the atmospheric air. Thus, the system starts when the pollution levels exceed safe limits and turns off when the pollution levels are within safe limits; thereby saving energy or reducing power consumption

Problems Addressed:

The air purification systems which are located in vehicles are insufficient to overall reduce of the contaminants released in the atmospheric air by the vehicles, stranded in the traffic at road junctions. Thus, there is a requirement of having an air purification system positioned at public places which can take in atmospheric air, having significant pollutant concentration, and eject purified air into the atmosphere. The air purification system as disclosed in the present invention can be placed at different locations to solve the problem of air pollutants can cause climate change, global warming and profound damage to human health

Impact of the Invention:

The impact of invention is reducing the harmful air pollutants that are responsible for adverse climate change effects and can cause diseases such as cardiovascular diseases, lung diseases, cancer or the like in humans. The air purification system of present invention can be positioned in a city in which a road junction is located. At such a junction, usually traffic congestion takes place, which leads to significant emission of air pollutants into the atmosphere from the vehicles caught in the traffic. The cause of such pollution is primarily due to burning of fossil fuel or combustion of engine from the vehicles which are stranded at the junction. The system aims at removal of such pollutants which are ejected by the vehicles in the traffic. The system allows reducing ambient air pollution levels at traffic

intersections, congested roads and other places, which have high concentration of pollutants. In an environment in which the concentration of air pollutants is higher than normal levels, a plurality of filtration units, which is composed of filter and axial fan, can be used. The system can reduce PM, CO, VOCs, hydrocarbons and carcinogenic compounds emitted in the atmosphere by the vehicles. The system can also remove resuspended particles already existing in the vicinity of the road junction.

Commercialization Details:

Technology is developed by Indian Institute of Technology (IIT)-Bombay and the National Environmental Engineering Research Institute (NEERI). This is an air purification device for air pollution control and tested in multiple locations. This has been licensed to one company and negotiations are on going with few more companies.

53. Synchronous Actuators with the Telescopic Shafts Feeding System for Sewage Cleaning.

Summary:

The present design introduces a “Synchronous actuators with the telescopic shafts feeding system for sewage cleaning, which is a part of HomoSEP product. The HomoSEP is a robotic system designed to assist manual scavengers in safely cleaning sludge from septic tanks and manholes. It effectively softens and vacuums hardened sludge, enhancing cleaning efficiency. Equipped with three IP67-rated low-light cameras, it provides clear visibility during homogenization and bucketing processes. Its

movable camera aids in manhole entries without the need to open doors, ensuring operator safety. Additionally, gas sensors detect hazardous gases swiftly, prioritizing safety. Vivid flood and focused lights ensure seamless operation in various lighting conditions. This innovative system aligns with UN SDG 6 goals by promoting both sustainability and safety in sanitation processes.

Salient Features:

- **Worker Safety:** The feeding mechanism addresses the dangers faced by workers in sewage cleaning processes, minimizing exposure to toxic and hazardous substances.
- **Rotational Motion:** It enables rotational motion at a certain distance, crucial for effective sewage cleaning procedures.
- **Accessibility:** Designed to operate in confined spaces, the mechanism can access areas where human intervention is challenging, enhancing efficiency and safety.
- **Actuator-driven:** Operated by two actuators, the mechanism ensures precise and controlled movement, optimizing the cleaning process.

Design No: 351677-001

Date of Grant: 17/12/2021

Applicant: IIT Madras

Inventor(s): Prabhu

Rajagopal, Divanshu

Kumar, Bhavesh Narayani,

Vrijesh Kunwar



Problem Address:

In sewage cleaning, mixing, and drilling processes conducted below ground level, workers face safety risks due to toxic gases and hazardous conditions. Traditional methods involving manual entry through manholes are unsafe and time-consuming. Existing feeding systems using chain, belt, or rope drives lack efficiency and safety. To address this, a synchronized feeding mechanism with two actuators and a telescopic shaft provides precise depth control and rotational motion below ground level. Actuators ensure reliability and endurance, while telescopic shafts offer customizable power transmission with minimal loss. This mechanism enhances safety, efficiency, and resource conservation, aligning with the SDG's goal of ensuring access to clean water and sanitation.

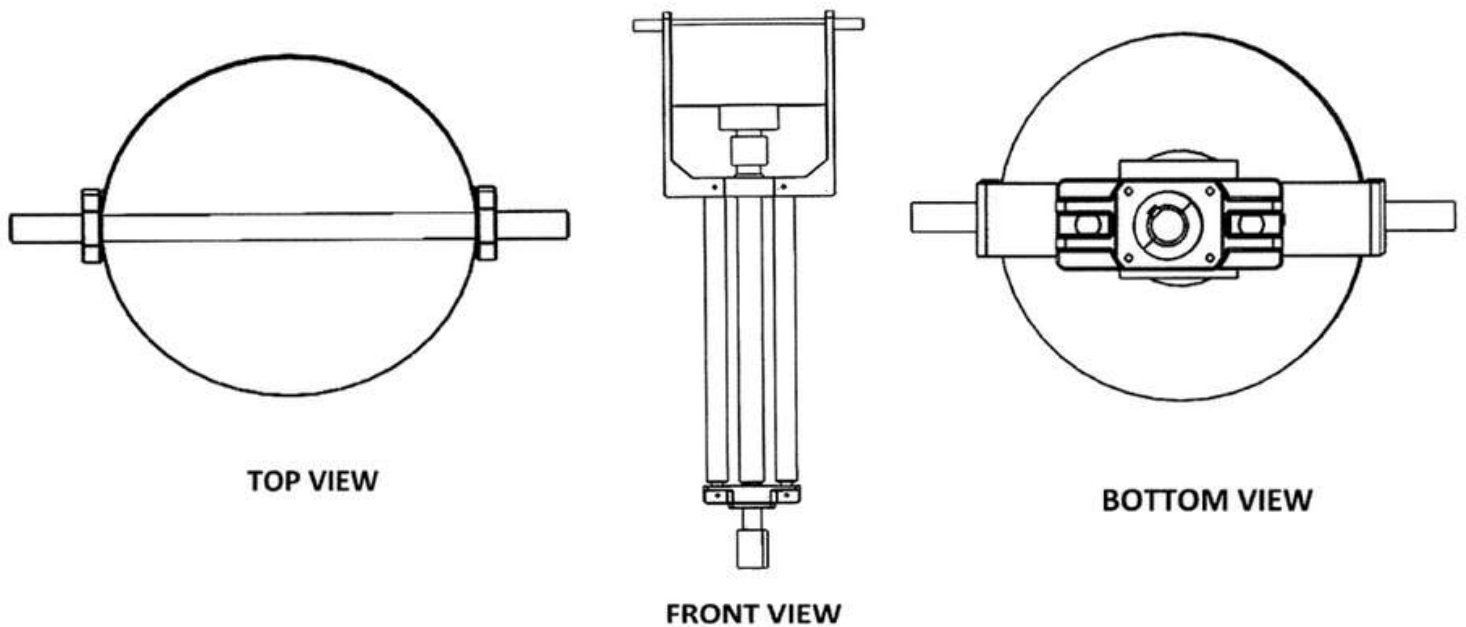
Commercialization Details:

LICENSOR: IIT MADRAS

LICENSEE: SOLINAS INTEGRITY PRIVATE LIMITED (<http://solinas.in/>)

COMMERCIAL PRODUCTS: HomoSEP (Septic tank cleaning robots)

Photographs:



54. A Feeding Mechanism for a Drilling System.

Summary:

The present disclosure introduces a feeding mechanism designed for connection to a drilling system, consisting of at least two actuators, a telescopic shaft, and a bearing assembly. Actuators enable synchronous linear movement to adjust the feed depth via the telescopic shaft. The upper and lower supports feature central seats to accommodate the telescopic shaft, and the bearing assembly supports its rotational motion. Each actuator integrates multiple sensors to determine speed and

load, while a control unit facilitates remote actuation and self-adjustment based on sensor feedback. This innovation enhances drilling precision and efficiency, especially in remote or hazardous environments.

Salient Features:

- **Dual Actuator Design:** The feeding mechanism incorporates at least two actuators, allowing for synchronous operation to precisely adjust the depth of feed.
- **Telescopic Shaft Configuration:** A telescopic shaft connects the upper and lower supports, providing flexibility and adaptability to varying drilling conditions.
- **Rotatable Bearing Assembly:** A bearing assembly mounted on the lower support facilitates the rotational motion of the telescopic shaft, enhancing drilling efficiency.
- **Sensor Integration:** Each actuator is equipped with multiple sensors to determine speed and load, ensuring accurate and safe operation.
- **Remote Control Capability:** A control unit enables remote actuation of the actuators, enhancing convenience and safety during drilling operations.

Problems Addressed:

The technical problem addressed relates to the hazardous and challenging nature of drilling and sewage cleaning processes, particularly in underground environments, posing risks to workers' health and safety. Existing drilling and feeding mechanisms, including manual and motorized augers, suffer from limitations in controlling depth, managing load, and ensuring worker safety during sewage cleaning operations. This scenario hampers progress in achieving SDG 6: Clean Water and Sanitation, as it impedes efficient and safe sewage treatment and drilling for water extraction. There is a crucial need for an improved feeding mechanism to enhance safety, efficiency, and sanitation in drilling and sewage cleaning operations.

Patent No: 454084

Date of Grant: 25/09/2023

Applicant: IIT Madras

Inventor(s): Prof. Prabhu

Rajagopal, Divanshu

Kumar, Bhavesh Narayani,

Vrijesh Kunwar



Photographs:



Impact of the Invention:

The innovative feeding mechanism presents a significant breakthrough in addressing the hazardous challenges faced in drilling and sewage cleaning processes, especially in underground environments. Its implementation offers a transformative solution, not only improving operational efficiency but also safeguarding the health and safety of workers. Enhancing control over depth and load management mitigates risks associated with toxic gases and hazardous substances encountered during sewage cleaning operations. This advancement fosters a safer working environment, reducing the likelihood of accidents and health hazards for workers. Furthermore, facilitating more efficient drilling and sewage cleaning procedures contributes to the broader goal of ensuring clean water and sanitation for all, as outlined in the Sustainable Development Goals.

Commercialization Details:

LICENSOR: IIT MADRAS

LICENSEE: SOLINAS INTEGRITY PRIVATE LIMITED (<http://solinas.in/>)

COMMERCIAL PRODUCTS: HomoSEP (Septic tank cleaning robots)

55. Method and System for Data Analysis for Generating Resource Optimization Recommendations During City Planning

Summary:

The method and system of the patent deal with generating recommendations for city planning. The system of the patent collects data pertaining to a current city model and references city models. The system of the patent then uses the current city model, the reference city models, and real-time data collected and generates recommendations for resource optimization. Processing incoming data further determines future demand for any or all of the resources. By addressing the critical issues of manual city planning and resource optimization, the method

and system of the patent represent a significant step towards achieving the United Nations Sustainable Development Goal 11 of ensuring sustainable cities and communities and SDG 15 of ensuring life on land.

Salient Features:

The method and system of the patent deal with generating optimization scenarios based on real-time analysis of 'current resource distribution' and one or more live data collected. Further, resource analysis is performed as part of the city planning, which includes using a dedicated analytics mechanism, predicting attractiveness, accessibility, and appropriation of each resource. Furthermore, an impact analysis of a resource part of planning (or a requirement) is performed to predict the impact of each resource (or a change to it) on the overall city model.

Patent No: 472958

Date of Grant: 24/11/2023

Applicant: TCS

**Inventor(s): Jyoti Sankar
Panda, Debiprasad Swain,
Saroj Kumar Choudhury,
Sachin Gangwar, Hemanta
Kumar Dash**



Problems Addressed:

City/urban planning is a term that broadly refers to processes concerned with the effective use of land and resources, which further involves effective planning and allocation of various resources/facilities so as to constitute a sustainable environment for people. A few examples of resources/facilities are transportation, healthcare, public welfare, water, infrastructure, communication networks, waste management, and so on. This process further involves the identification of resources/facilities that would constitute a city and the planning the distribution of the resources across the available land. City planning further involves planning the resources and aiming for the optimized use of resources with an eye on saving resources in the future.

An urban planner is a person who performs urban planning. Typically, an urban planner collects requirements during urban planning and decides how different resources/facilities can be placed in available land to meet the requirements. A disadvantage of this 'manual planning' is that the final result of planning (in terms of resource allocation, distribution, and so on) depends solely on the experience and skills of the urban planner. As this involves a lot of data processing, the final result is likely to be affected by possible human errors. Certain systems exist that help/assist urban planners with urban planning. Such systems use different mechanisms to process data and provide required assistance to the users. Further, the capability of the systems in terms of parameters being taken into consideration for generating the final result also varies, which in turn affects the final result.

Impact of the Invention:

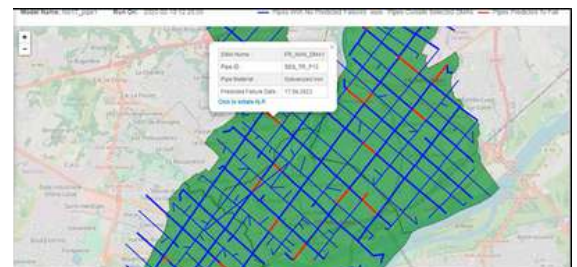
The methods and systems of the patent generate recommendations for resource optimization as part of city planning. The system of the patent predicts the impact of each resource in the city planning and the impact of change in each of the resources during the city planning from a resource conservation point of view, including environmental, social, and business impacts, which maps to SDG 11. Environmental impact refers to reporting the change (reduction/increase) of land area, green space, and pollution by generating a predictive analytic model using any known technique. Social impact highlights how citizens will be impacted, how they will benefit from the implementation of the action items, and what initial inconvenience they may have to face, which maps to SDG 15. Business impact indicates which government authorities can possibly fund the implementation, public partnership/sponsors' suggestion, etc.

Commercialization Details:

IUX is a digital spine for AI-ML-based sustainability decisions and helps enterprises simplify their net zero journeys in sustainability. It provides features like:

- Analytics-driven insights for optimizing sustainable actions & recommendations.
- Administrator privilege to visualize, monitor, and analyze organization-wide events in real time.
- A proactive approach to water loss management with out-of-the-box capabilities, incorporating weather, event, outage, employee, and other real-time enterprise/campus data.
- Improves public & private transit operations and continuity.

Photographs:



56. Product and Process for Manufacturing Superior Quality Complex Microstructure Reinforcement Rebars for Earthquake Resistance Applications

Summary:

This patented invention discloses a manufacturing process for steel rebar. The process involves several steps, including casting a billet/bloom with specific chemical composition percentages. This composition includes 0.05-0.3 wt.% carbon, 0.4-1.65 wt.% manganese, 0.1-0.8 wt.% silicon, up to 0.05 wt.% niobium, up to 0.05 wt.% vanadium, up to 0.05 wt.% titanium, up to 0.05 wt.% aluminum, up to 0.04 wt.% Sulphur and phosphorous, up to 0.012 wt.% of nitrogen, and 0.0005 to 0.01 wt.% boron, the remaining balance being iron and impurities. After casting, the billet/bloom is subjected to thermo-mechanical rolling, which involves heating the billet/bloom to a temperature range of 980-1100 deg. C for the final rolling temperature (FRT) and 600-680 deg. C for the equalization temperature. The FRT temperature range is suitable for 6-12mm diameter rebar, while the equalization temperature range is suitable for 16-40 mm diameter rebar.

Patent No: 373122

Date of Grant: 29/07/2021

Applicant: Tata Steel

Inventor(s): Shaumik

Lenka, Jayanta

Chakraborty, Diptak

Bhattacharya, Saurabh

Kundu, Kandala S

Ramakrishna, Ravinder

Singh Pathania, Sanjay

Chandra, T.Venugopalan



Salient Features:

A process for manufacturing earthquake-resistant steel rebar includes steps such as casting billet/bloom. The billet/bloom has a specific chemical composition consisting of carbon, manganese, silicon, niobium, vanadium, titanium, aluminum, sulfur, phosphorous, nitrogen, and boron, with iron and impurities remaining. The billet/bloom is then subjected to thermo-mechanical rolling to produce rebar with specific temperature ranges depending on the diameter. The invention also provides a steel rebar with the same chemical composition mentioned above. This steel rebar exhibits specific properties such as a yield strength of 500 Mpa, UTS/yield strength ratio of ≥ 1.25 , total elongation of $\geq 20\%$, uniform elongation of $\geq 8\%$, and improved resistance to corrosion. Moreover, the method is cost-effective and can be used in the manufacturing of steel rebar for seismic-resistant applications.

Problems Addressed:

Steel rebars are essential components in the construction industry as they provide structural support. To ensure their effectiveness, it is crucial for rebars to possess suitable mechanical properties that allow them to withstand various damaging forces experienced by building elements such as foundations, beams, columns, and slabs. These forces can include the dead load of the building, a live load of occupants and their belongings, wind/storm load, or earthquake loads, all of which act differently and at different times. Certain regions in the world, particularly those in seismic zones IV and V, face the challenge of earthquakes and require robust and damage-resistant rebars for construction purposes. The demand for strong and earthquake-resistant rebars has increased due to the ongoing climatic changes worldwide, particularly in high-risk earthquake zones. Steel rebars need to fulfill specific primary criteria to effectively serve earthquake-resistant applications. Firstly, they should possess

adequate yield strength to withstand significant loads without experiencing permanent deformation. Secondly, rebars should have a high ultimate tensile strength to yield strength ratio, enabling them to absorb substantial energy in the plastic region and handle the immense pressures exerted during an earthquake before entering the plastic instability zone. Lastly, rebars must exhibit good ductility (elongation values) and toughness to allow for effective deformation before failure occurs.

Impact of the Invention:

Recent advancements have been made in the production of rebars through the air-cooling method. This process involves the addition of small amounts of alloying elements, such as vanadium, which enhance strength through precipitation hardening and grain refinement. Unlike TMT rebars, micro-alloyed rebars have a uniform cross-section in terms of microstructure, strength, and ductility, with a ferrite-pearlite structure and fine precipitates of vanadium nitrides and carbo-nitrides. Moreover, these rebars exhibit a high strength ratio of $UTS/YS \geq 1.25$ and demonstrate excellent corrosion resistance. However, there are certain challenges associated with this process. Firstly, the production of high nitrogen heat becomes difficult due to the limitations of the existing LD technology. Secondly, the cost increases significantly because vanadium is an expensive alloying element. Lastly, handling these rebars on the cooling bed immediately after hot rolling poses some difficulties. The demand for rebars with suitable mechanical properties for earthquake resistance applications is substantial, considering the earthquake-prone zones encompassing North America, Japan, China, parts of Australia, and around 55% of India's land area. Micro alloyed rebars fulfill this requirement, albeit at a higher cost due to vanadium micro-alloying, and are accompanied by operational challenges during production.

Commercialization Details:

The rebar possesses the above-mentioned properties and has been successfully commercialized with a total steel volume of 8000 tonnes.

Photographs:



57. Axial Flux Rotor Assembly System

Summary:

One objective of the present invention is to provide an axial flux rotor assembly with optimum flux linking without saturation of a material with high magnetic permeability.

Another objective of the present invention is to provide an axial flux rotor assembly with reduced weight and inertia.

Another objective of the present invention is to provide an axial flux rotor assembly with increased air gap flux density.

Another objective of the present invention is to provide an axial flux rotor assembly that enables improvement in motor torque per ampere and efficiency.

Another objective of the present invention is to provide an axial flux rotor assembly that can be efficiently self-cooled.

In accordance with one of the above embodiments of the present invention, the magnets are periodically arranged in relation to annulation on the flux-linking plate, enabling optimum flux density across the plate.

Salient Features:

An axial flux rotor assembly is comprised of a rotor with a plurality of vents. The vents on the rotor and periodic annulation arrangement of the flux linking plate enable air circulation from and towards the air gap between the magnet and stator of the electric motor. The flux linking plate has front and rear sides; the front side is coupled with magnets, and the rear has periodic annulation. The flux linking plate has front and rear sides; the front side is coupled with magnets, and the rear side has wavy annulation. The flux linking plate is governed by the flux density in material and eventually increasing air gap flux density, which enables improvement in motor torque per ampere and efficiency.

Problems Addressed:

- **Flux Leakage:** Flux leakage occurs when the magnetic flux generated by the stator does not effectively link with the rotor, resulting in inefficiencies and reduced torque production. By minimizing flux leakage, more of the generated magnetic field interacts with the rotor, maximizing torque output and overall motor efficiency.
- **Lightweight Design:** Reducing the weight of the motor improves efficiency, reduces energy consumption, and enables easier integration into systems where space and weight constraints are significant considerations.
- **Dynamic Response:** Minimizing rotor inertia allows for quicker acceleration and deceleration, enabling precise control and responsiveness in applications requiring rapid changes in speed or direction.
- **Heat Dissipation:** Effective self-cooling mechanisms efficiently dissipate heat generated during operation, enhancing motor reliability, longevity, and overall performance.

Patent No: 438354

Date of Grant: 12/07/2023

Applicant: Tork Motors

Inventor(s): Sushant

Khade, Kapil Shelke



Impact of the Invention:

Improvement in the flux weight and reduction in inertia in the rotor assembly enhances the motor's efficiency and increases its torque density. This means you can achieve more torque output per unit of weight, which is incredibly valuable, especially in applications where weight is a critical factor.

Overall, a decrease in required raw materials due to improved efficiency and reduced inertia can lead to cost savings in motor production. Using fewer materials reduces manufacturing costs and decreases the motor's overall weight, potentially leading to additional savings in transportation and handling costs.

More efficient motors and reduced raw materials have positive environmental implications and contribute to lower energy consumption during operation, which can indirectly reduce greenhouse gas emissions.

More efficient and lightweight motors can extend the range of electric vehicles and improve their performance. In industrial machinery, they can enhance productivity and reduce energy costs. Moreover, these advancements can foster innovation in other fields, such as renewable energy systems, consumer electronics, and medical devices.

Commercialization Details:

The rotor assembly of the present innovation is installed on the 2W Kratos R model of Tork motors and in 3W for the L5N segment.

Date of commencement of Motor production Total No of motors produced 2W: ~4400 Cumulative kms covered on the road: ~ 19 million km

Photographs:



58. Innovations towards Advance Human Well Being using the One Health Approach

Summary:

At MicroGO, our purpose is to advance human well being using the One Health approach. The innovations we present align with our purpose and its goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment. Towards this, we focus on problems around food safety and security, water management and conservation, and antimicrobial resistance. We

present our platform innovations viz., Tubelet™. Tubelet™ is the platform for delivery of a pure form of the oxidizing agent without contamination of the outer bulk with unreacted reactants and disinfection by-products. Using this platform, we have developed and commercialized four products, and one is in progress. These products have applications ranging from surgical, water, fresh produce disinfection, and management.

Salient Features:

We cite the salient features of the commercially available products developed from these platforms for simplicity.

- **GOpure™ PW:** This water disinfection system requires no external power source. It utilizes a mini-generator to disinfect water and is designed to treat up to 400 liters of water.
- **GOpure™ inline:** This is an intelligent, automatic, and IoT-enabled water treatment system. It is specifically designed for water treatment applications where a high flow rate of 190 liters per minute is required. It assures that the antimicrobial dosage is always above the minimal inhibitory concentration.
- **GOfresh™:** GOfresh™ is a mini-generator that requires no power and disinfects fresh produce. It is designed to disinfect up to 2 tonnes of fresh produce at one time.
- **GOfresh™ inline:** Similar to GOfresh™, GOfresh™ inline is an IoT-enabled, intelligent, and automatic disinfection system. It is specifically designed for larger-scale disinfection of fresh produce, with a capacity of up to 5-50 tonnes at one time. Its primary purpose is to extend the shelf life of fresh produce and storage at ambient conditions.
- **GOsteri®:** GOsteri® is a medical device specifically designed for surgical sterilization anytime and anywhere. It doesn't require power or water for its operation.

These innovations directly align with United Nations Sustainable Development Goals 3, 6, and 11, which stand for Good health and well-being, Clean water and sanitation, and Sustainable cities and communities, and indirectly with SDG no. 1, i.e., no poverty.

Problems Addressed:

- **SDG 1—No Poverty:** SDG 1 seeks to end all types of poverty. While not directly related to food and water safety, SDG 1 is indirectly related. Poverty can reduce access to safe, nutritious food and clean water, increasing the risk of foodborne and waterborne infections. Poverty reduction and resource access are essential for food and water security.
- **SDG 3: Health and Well-being** SDG 3 promotes universal health. It aims to reduce maternal and

Patent No: 301737

Date of Grant: 01/10/2018

Applicant: Micro GO LLP

**Inventor(s): Rachna Dave,
Deepa Pitchaimani, Deepthi
Subbaraya**



SDG 3, address child mortality, combat communicable illnesses, provide critical healthcare, improve early warning and risk mitigation, and manage health risks. It also addresses food and water safety by preventing and managing foodborne and waterborne diseases, providing safe and nutritious food and clean water, and reducing health risks from dangerous food and water practices. SDG 3 also addresses antimicrobial resistance, which affects infectious illness treatment and antibiotic use.

- **SDG 6: Clean Water and Sanitation:** SDG 6 ensures universal access and sustainable management. It directly affects water security. SDG 6 covers clean water, sanitation, and water resource sustainability. Water safety requires preventing contamination, monitoring water quality, and treating water to remove germs and dangerous compounds. Proper cleanliness and infrastructure can prevent waterborne infections. Water safety is essential for food production, processing, and consumption, and SDG 6 helps achieve this.
- **Goal 11: Sustainable Communities and Cities** SDG 11 promotes inclusive, safe, resilient, and sustainable cities and human settlements. Although not directly related to food and water safety, SDG 11 is related to urban food and water security. Its goals include safe and affordable housing, urban planning, sustainable mobility, and disaster resilience. These variables foster food security, safe and nutritious food, and clean water. Sustainable and resilient infrastructure, encouraged by SDG 11, can indirectly improve food and water security.

A multi-SDG approach is needed to address food and water safety, security, and antimicrobial resistance. Governments, international organizations, the commercial sector, and civil society must work together to implement laws, regulations, and practices that preserve public health.

Impact of the Invention:

The innovation mentioned above, which focuses on reducing fresh produce wastage while enabling storage at ambient temperature and humidity, has several positive impacts:

- **Fresh Produce Wastage Reduction:** This innovation can reduce fresh produce wastage to as low as 10%. This is a significant improvement compared to traditional storage methods, which often result in higher spoilage rates. Reducing fresh produce wastage helps conserve resources, minimize food loss, and improve overall food security.
- **Ambient Storage Capability:** Fresh produce can be stored at ambient temperature and humidity, which is advantageous as it eliminates the need for energy-intensive refrigeration or controlled-environment storage. This can lead to energy savings and reduced greenhouse gas emissions associated with refrigeration systems.
- **Water Conservation:** Over the past two years, the innovation has saved approximately 58 lakh liters of water. This is an impressive achievement, considering the water-intensive nature of agricultural practices. The innovation contributes to water conservation and sustainable water management by reducing water usage in food production and processing.
- **Environmental Impact:** The conservation of approximately 263 trees over the past three years indicates the innovation's positive environmental impact. Minimizing fresh produce wastage and optimizing storage conditions can reduce the need for additional agricultural land and resources. This helps mitigate deforestation, land degradation, and other environmental challenges associated with expanding agricultural activities.
- **Antimicrobial Resistance Prevention:** The reduced occurrence of HAIs resulting from the innovation's implementation can also have positive implications for antimicrobial resistance. HAIs often require antibiotic treatment, and by preventing infections, the need for antibiotics can be reduced. This contributes to responsible antibiotic use and helps combat the growing threat of antimicrobial resistance. In addition, when the dosage of the anti-microbials is always above the MIC, the microbes do not get an opportunity to develop resistance.

Overall, the discussed innovation demonstrates a range of positive impacts, including reduced fresh produce wastage, water conservation, environmental sustainability, improved patient safety, and the potential to mitigate antimicrobial resistance. These achievements highlight the importance of innovative solutions in addressing critical challenges in food and water security, healthcare, and sustainability.

Commercialization Details:

- GOpure™ PW: Commercialised.
- GOpure™ inline: Commercialised.
- GOfresh™: Commercialised.
- GOfresh™ inline: Field pilot in progress.
- GOsteri®: Regulatory approvals in progress.

Photographs:



59. Particulate Matter Filter Assembly

Summary:

In today's world, the battle against air pollution looms large, with dire consequences for public health and the environment. Air pollution, driven by Particulate Matter (PM₁₀, PM_{2.5}) emissions, poses significant health risks, including respiratory diseases, cardiovascular ailments, cancer, and maternity complications. Diesel generators exacerbate this crisis, contributing a substantial share of PM_{2.5} emissions in urban areas. This not only intensifies health hazards but also escalates global warming due to PM's high global warming potential. ~16%, ~25%, and ~9% of PM_{2.5} in the Delhi- NCR region, Bangalore, and Chennai comes from Diesel Generators, respectively. These emissions in urban areas exacerbate health hazards and escalate global warming due to PM's high global warming potential.

The Particulate matter filter assembly (covered in Patent No. 429359) is developed for an exhaust after-treatment system in diesel generator (DG) sets to trap particulate matter (soot and unburnt carbon particles), which is harmful to the environment and human health. Common diesel traps, such as diesel particulate filters (DPFs) and partial flow filters (PFFs), can reduce emissions but may suffer from reduced efficiency and increased back pressure, especially in developing countries with lower-quality fuels and older engine technologies.

Patent No: 429359

Date of Grant: 19/4/2023

Applicant: Chakr

Innovation

Inventor(s): Avichal Mishra,

Sunil Reddy Konatham,

Tushar Batham, Parth

Sarathi



The assembly comprises a housing with inlet and outlet channels and multiple filter units arranged inside. These filter units are divided into two sets: a first set positioned closer to the inlet and a second set downstream. The ratio of the distance between these two sets to the length of the first set falls within a specific range, ensuring optimal performance. This assembly in our Chakr Shield product is primarily responsible for capturing the Particulate Matter, i.e., Carbon Black. It is a filter-type arrangement with the required mean pore size to ensure the entrapment of all the particles that have a size more than that, including PM 2.5 and PM 10.

Additionally, the assembly may include an oxidation catalyst positioned upstream of the filter units to enhance particulate matter's oxidation further. The disclosed design offers several advantages, including high particulate matter reduction efficiency (in the range of 70-80%), ultra-low back pressure, high ash carrying capacity, reduced thermal rundown risk, and more compact size compared to conventional filters.

The regeneration of the DPF by burning and oxidizing as conventionally, continuous, and intermittent regeneration techniques are used, which utilize expensive catalysts to reduce the carbon burning temperature between 400-600 °C depending on the type of catalyst used. In many instances where engines operate at very low loads or idle conditions, this high-temperature range is not achievable. Active Regeneration requires the addition of extra energy (such as heat) to the exhaust to increase the temperature of the soot to the point at which it will oxidize in the presence of excess oxygen in the exhaust. Our Patent No. 512849 (System and method for microwave-based intermittent regeneration for the particulate filter(s) of diesel engine) discloses a microwave-generating source that emits microwaves to initiate an active regeneration process for DPF by introducing sufficient heat to the DPF. The said invention overcomes these issues and works without any dependency on the temperature of the exhaust gases of the engine.

By addressing the critical issues of air pollution, air quality, and health risks associated with air pollution, the Chakr Shield represents a significant step towards achieving the United Nations Sustainable Development Goals (SDGs) 3 and 11 of ensuring access to clean air for all.

Salient Features:

Design and configuration of the particulate matter filter assembly (Patent No. 429359) aim to provide effective solution for diesel engine emissions control for the Indian Market. The ratio of the distance between the two sets of filters in the assembly to the length of the first set falls within a specific range, ensuring optimal performance. The particulate matter filter assembly facilitates achieving high particulate matter (soot and/or unburnt carbon particles) reduction efficiency within the range of 70-80%, maintaining ultra-low back pressures in line with the diesel engine at all times of operation, high ash carrying capacity of the particulate matter filter assembly, reducing the thermal rundown risk of the exhaust after treatment system, enhanced passive regeneration of the filter, high operation efficiency, increased service life, and compact assembly.

Additionally, the system and method for microwave based intermittent regeneration for particulate filter of diesel engine (PatentNo. 512849) provides an alternative which is cost-effective because the present system or process eliminates use of costly catalysts as generally be used in the conventional systems. The waveguides are designed in such a way that they transfer microwaves with the least losses and provide a path for the exhaust gases to travel without much restriction. Horn antenna designs have been used to increase the effectiveness of DPF cleaning by increasing the area directly exposed to microwaves. Blowers are also provided which increase the efficiency of regeneration by supplying fresh air for carbon burning process.

Problems Addressed:

Our product, Chakr Shield (protected with Patent Nos. 429359 and 512849), tackles pressing issues such as air pollution and global warming. It aligns seamlessly with SDG 3 (Good Health and Well-being) and SDG 11 (Sustainable Cities and Communities).

By curbing pollutants, enhancing public health, and fostering sustainable urban environments, Chakr Shield embodies a holistic approach to achieving these vital goals:-

SDG 3 (Good Health and Well-being): Chakr Shield directly addresses the issue of air pollution, particularly by reducing Particulate Matter (PM), Hydrocarbons, and Carbon monoxide emissions. By mitigating these harmful pollutants, our technology contributes to improving air quality, which is crucial for public health and well-being. Exposure to high levels of PM and other pollutants is linked to various respiratory and cardiovascular diseases, including asthma, lung cancer, and heart attacks. Therefore, our solution helps in creating healthier environments and reducing the burden of diseases associated with air pollution.

SDG 11 (Sustainable Cities and Communities): Air pollution is a significant challenge in urban areas, affecting the quality of life for residents and impacting the sustainability of cities and communities. Chakr Shield plays a vital role in addressing this challenge by offering a solution for reducing emissions from stationary diesel generators, which are commonly used in urban settings for backup power supply. By reducing emissions from these generators, our technology contributes to creating cleaner and more sustainable urban environments.

Impact of the Invention:

1. Air Quality Improvement:

- Particulate control filters, especially in vehicles and industrial processes, effectively reduce the emission of particulate matter (PM) into the atmosphere.
- PM, especially fine particles like PM_{2.5}, is known to be harmful to human health and the environment. It can penetrate deep into the lungs and even enter the bloodstream, leading to a range of health issues.
- By reducing PM emissions, particulate filters contribute to cleaner air, which is crucial for minimizing respiratory diseases, cardiovascular problems, and other health issues associated with poor air quality.

2. Health Benefits:

The improved air quality resulting from particulate control filters can lead to significant health benefits for individuals living in areas with high levels of pollution.

- Studies have shown that reducing PM levels can decrease the incidence of respiratory diseases such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD).
- Lower PM levels also reduce the risk of cardiovascular diseases, as PM exposure has been linked to an increased risk of heart attacks, strokes, and other heart-related issues.

3. Environmental Protection:

- Particulate control filters play a crucial role in reducing overall air pollution levels, which is beneficial for the environment.
- Lower levels of PM and other pollutants in the air can help protect ecosystems, including plants, animals, and aquatic life, from pollution's harmful effects.

- Reduced air pollution also contributes to the preservation of natural resources and promotes a healthier environment for future generations.

4. Regulatory Compliance and Social Responsibility:

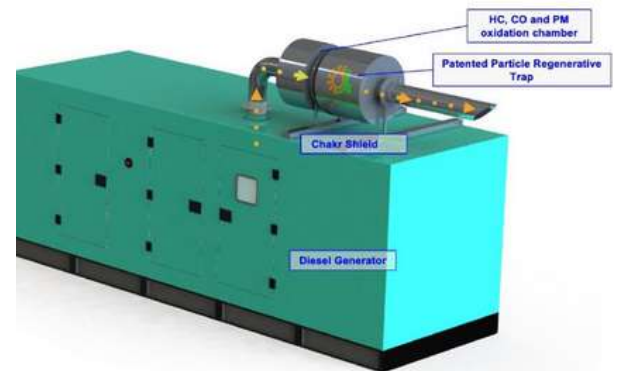
- The use of particulate control filters can help industries and vehicle manufacturers comply with environmental regulations and standards aimed at reducing air pollution.
- By implementing these filters, organizations demonstrate their commitment to environmental stewardship and public health, contributing to a more sustainable future.

Problems Addressed:

Technology was commercialized in 2019 for the targeting the in-use DG sets in Indian market i.e., CPCB 1 and CPCB 2. With the introduction of the regulatory compliance by the state authorities or the central authorities, implementation of the retrofit emission control device became mandatory for in-use DG sets running the market.

From 2019 till date, Chakr Innovation has installed around 1500 units across the India and secured around 200 crores of revenue till date.

Photographs:



60. Improved Battery Pack for Thermal Management

Summary:

The present disclosure pertains generally to field of the lithium-ion high energy density battery specifically to thermal management in such battery power supply systems.

A general object of the invention is to provide an improved battery pack of lithium batteries to increase the ambient temperature range at which the lithium battery pack can operate.

The general object of the invention can be attained, at least in part and in accordance with one embodiment of the invention, through a lithium-ion battery pack. The lithium-ion battery pack includes a plurality of cylindrical format cells. Each cell is surrounded by PCM material in two parts, which are separated by high thermal conductive material (such as but not limited to polymer, plastic, and/or metal) sheet. The cells are stacked and spot welded to copper connector plate, which is then sandwiched between copper clad under initial compression force for effective current and heat conduction.

Patent No: 474276

Date of Grant: 29/11/2023

Applicant: Tork Motors

Inventor(s): Sushant

Khade, Kapil Shelke



Salient Features:

An improved battery pack for thermal management in battery power supply systems comprising a plurality of cells connected in parallel through a copper connection plate to form a module, a plurality of modules are connected in series through copper clad to form a stack, the copper plate and copper clad are compressed to form a series connection and allows heat transfer from said plate to clad which enable uniform temperature and contact pressure thorough out the stack, the plurality of stack are connected to each other via a connector to form the battery pack, wherein the cells are of any shape /form and surrounded by phase change materials (PCM) in two parts which are separated by high thermal conductive material by means of close fit maintaining surface contact.

The cells in the battery pack are mechanically supported by plastic trays and PCM, which transfer the weight of modules to compression support.

Problems Addressed:

- **Reduced Hotspots:** Strategically placing PCM within the pack's structure can help maintain uniform temperature distribution across the cells, reducing the risk of hot spots and prolonging battery life. PCM absorbs and releases heat during its phase transition without temperature rise, which helps regulate temperature fluctuations within the battery pack.
- **Ambient Temperature Range:** Effective thermal management allows battery packs to function optimally in high—and low-temperature environments, improving overall performance and reliability.
- **Enhanced Safety:** A consistent temperature within the battery pack helps to mitigate the risk of thermal runaway and other safety issues associated with extreme temperature variations. PCM can act as a buffer against temperature spikes, providing additional safety protection for the battery cells.
- **Battery Lifespan:** PCM-enabled thermal management systems can help preserve battery capacity and performance over time by minimizing thermal stress and degradation, resulting in longer-lasting battery packs.

Impact of the Invention:

- **Prevention of catastrophic failure and safety:** This innovation effectively mitigates and minimizes the risk of thermal runaway by preventing hotspot formation in the battery pack and keeping the battery pack within a desirable temperature range. It can prevent or prolong the thermal runaway and associated catastrophe because of Li-ion cells going into thermal runaway and hence increases the safety level of the complete product.
- **Use of larger Battery Packs:** This innovation enables the utilization of larger battery power supplies in applications requiring higher energy storage capacity, such as electric vehicles. This is essential for meeting performance demands without compromising safety and reliability.

CommercializationDetails:

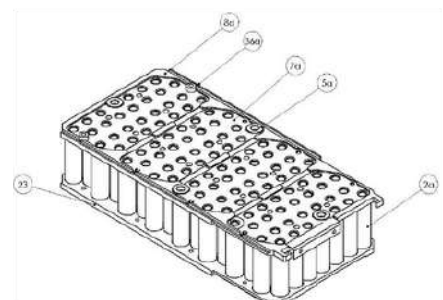
The battery packs of the present innovation are installed on the 2W Kratos R model of Tork motors.

No of vehicles on the road: 3375

Date of commencement of Battery Box production: 1 Nov 2021

Cumulative km covered on road: ~ 19 million km

Photographs:



61. Dark Coloured Cool Roof Coating

Summary:

The invention is basically to cool the roofs of houses, industrial sheds, rail compartments, bus roofs, etc., after the application of a specially created architecture coating on concrete or steel roofs. This coating helps reduce the roof's temperature by 10 to 20°C, depending upon the ambient temperature of the day. On a hot summer day when the ambient

temperature is 45°C, the roof temperature at peak hours would be about 65°C. On application of this coating, the roof temperature would drop to about 42-45°C.

Patent No: 322862

Date of Grant: 15/10/2019

Applicant: IIT Bombay

**Inventor Name: Prof. A S
Khanna**



Salient Features:

The coating for concrete roofs is eco-friendly. An acrylic base coating is modified with heat-reflective pigments and insulating pigments, which help absorb the IR component of the solar radiation and then immediately reflect it, making the surface cool thereafter.

The steel coating is solvent-borne with a Polyurethane base mixed with solar heat-reflecting pigments and insulating pigments.

The coatings are simple and applied by brush or airless gun to a thickness of 120 microns. The coatings can be pure white or any of RAL colors, especially yellow, dark red, blue, green, or camouflage colors.

Problems Addressed:

- Saving electricity for air conditioners creates a 25-30% drop in monthly electricity bills.
- Keep the water cool for overhead concrete, steel, or plastic tanks.
- Keep the temperature low for containers converted into site offices and temporary residences.
- Give comfort to corporate schools, hospitals, and dispensaries
- Enhance the life of air conditioners in buses for long-distance travel by reducing the temperature of the bus.
- Warehouses are a big requirement where materials need to be stored at lower temperatures.

Impact of the Invention:

The main impact of the technology is to fight global warming. Reduction in electricity consumption is directly related to the reduction in C-footprints, which in turn helps in reducing global warming, which is a global issue at present.

Commercialization Details:

Solar heat reflective coating marketed by Thermogreen Cool Coat Pvt. Ltd. Has been in the market for the last five years. Although there are a number of products under the name Cool Roof Coatings, they have a half-baked concept, are mostly modified with insulating materials, and depend upon the whole color reflection. None of the products is patented or has BIS compliance. Thermogreen has a series of products, including primer coatings. It has a product called Thermogreen 0.3C for concrete application

and a product called Thermogreen 0.3M for steel roof application. It also has a special product, developed for Railway Compartment Roofs, Thermogreen 0.3M FR is fire-resistant. In addition, it has a primer called WP51, which must be applied while applying 0.3C to the concrete surface. It also developed an STP primer, which is used on steel roofs where the existing surface is not sound. These products are approved by CPWD, Defense, TCIL, HPCL, Dairy Development Board, and many others. More than 3 lakh sqft of area has been coated with these coatings. The most prestigious application is the New Parliament building roof.

Photographs:



62. Soil Conditioning Composition for Improving Soil Fertility

Summary:

According to the invention, waste from iron ore slime is tested for its suitability to use as a substance to improve soil quality. These tests were carried out in four different stages. In the first stage, the waste material is converted by treating it with organic matter. In the second stage, tests are conducted under a simulated condition representing a soil phase necessary at the beginning of crop cultivation. Thus, soil is tested along with organic matter at high moisture levels for its soil characteristics. In the third phase, along with the organic waste matter, fertilizer enriched with Nitrogen (N), Phosphorus (P), and Potassium (K) was used in the waste material for its use as soil amendment. The produced (serial) Bora rice was then tested for its nutrient contents at different stages of crop growth. These tests indicate the suitability of the organically converted waste material in supplying nutrients to the crops at their different stages of growth. The fourth phase of tests was carried out following phase three. However, a crop used for these tests was cabbage. All these tests indicate that the waste material from iron is slime and soil at a ratio of 1:3 and 1:4, along with organic matter, and N, P, and K are suitable for the growth of crops such as serial (Bora rice) and vegetables such as (Cabbage).

Patent No: 352209

Date of Grant: 25/11/2020

Applicant: Tata Steel

Inventor(s): Asim Kumar

Mukherjee, PK Banerjee



Salient Features:

Slime has excellent water-holding capacity, which helps in improving soil pH, electrical conductivity, organic carbon%, available P%, available P%, available K%, and available iron%. This helped in the growth of crops such as salmon (Bora rice) and vegetables such as (Cabbage). The invention relates to the development of a new method of making soil amendments from the waste of iron ore beneficiation, thus making iron ore beneficiation a zero-waste technology. A mixture of soil, iron ore slime waste, and organic matter in the presence of NPK is beneficial to improving soil fertility and crop production.

Problems Addressed:

Iron ore is the major raw material in the iron and steel industry. Indian iron ore contains alumina (Al_2O_3) as the major impurity. Alumina in iron ore decreases hot metal productivity in Blast Furnace and adversely affects the cost of steel production. Therefore, alumina content in the iron ore is known to be lowered through beneficiation to an acceptable level of 2.2% from feed alumina level of 3.0-4.0% and more. The beneficiation process generates rejects in the form of iron ore slimes. Around 15-20% of the feed treated in beneficiation plants is rejected as iron ore slime. Iron ore slime also contains liberated iron ore particles. However, the present applicant has already disclosed and filed patent applications in India relating to the process for beneficiation of iron ore slime to recover iron values from an ultrafine fraction of iron ore slime, for example, of size 45 microns and below. This process recovers iron ore concentrate containing 2.2% alumina from a feed containing 7-10% alumina. The concentrate yield is around 45 - 50%. Reject generated from the beneficiation of iron ore slime can be treated as waste as the iron content in the reject is below 40%. Furthermore, the liberation characteristics of iron and associated gangue minerals are complex; hence, recovering iron values from this rejection through beneficiation is not feasible. Therefore, rejection of iron ore slime beneficiation is considered waste, and

effective utilization of this waste is required to make iron beneficiation a zero-waste technology.

Impact of the Invention:

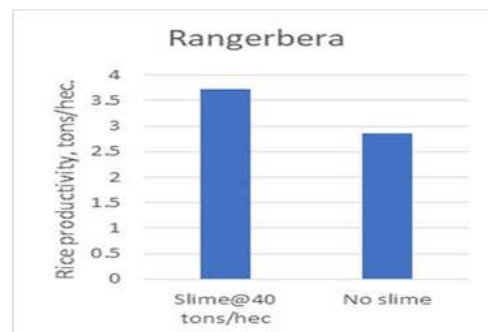
The invention enables a process of characterization and conversion of waste materials from iron-slimes beneficiation, which eliminates the huge amount of waste material produced in this method. Moreover, the invention enables the conversion of waste material into a substance to improve soil quality, leading to an agricultural revolution.

Commercialization Details:

Field trials have been carried out in farmers' fields at Noamundi iron ore mines for this patented invention. Results showed a 30% improvement in rice productivity using iron ore slime waste as a soil conditioner.

Photographs:

Rengerbera



63. A Soil Conditioner and Applications Related There to

Summary:

This patent pertains to a novel soil conditioner formulation that enhances soil quality, bolsters plant growth and yield and elevates the nutrient absorption capability of plants. Additionally, it outlines a process for creating this soil conditioner. This patent also encompasses methods for augmenting plant growth and yield, increasing nutrient assimilation in plants, and ameliorating soil conditions. When benchmarked against conventional gypsum and the recommended fertilizer dosage, this soil conditioner has been found to be markedly effective in stimulating plant growth and yield, facilitating nutrient uptake by plants, and upgrading soil properties.

Patent No: 450892

Date of Grant: 12/09/2023

Applicant: Tata Steel

**Inventor(s): Shrenivas
Ashrit, Supriya Sarkar,
Chikkaramappa**

Thimmarayappa,

Prabhudev Dhumgond,

Prakash Nagabovanalli,

Shruthi Venkatesh, Munish

Sudan



Salient Features:

This disclosure introduces a soil conditioning composition designed to enhance soil quality, stimulate plant growth, and increase yields by optimizing nutrient absorption by plants. It outlines a series of related methods, including a specific process for creating this soil conditioner through the acid treatment of LD slag. The disclosure also details the application of the soil conditioner, recommending the incorporation of 300 to 750 kilograms per hectare (kg/ha) into various soil types, such as acidic, neutral, and alkaline soils. Furthermore, the disclosure describes techniques to bolster nutrient uptake in crops like paddy, maize, and groundnut by blending 300 to 750 kg/ha of the conditioner with the soil. Similarly, it presents a method for boosting plant yields for these crops using the same quantity of soil conditioner. Additionally, the use of the soil conditioner at the specified rates is advocated for multiple purposes, including soil amelioration, improved nutrient uptake, and enhanced crop yields.

Problems Addressed:

Steel slag, the byproduct of the steel refining process in a conversion furnace, presents a significant waste management challenge for the industry. With India's steel production capacity projected to more than double, increasing from approximately 140 million tonnes (Mt) to 300 Mt by 2030, the consequent generation of blast furnace slag and Linz-Donawitz (LD) slag is expected to surge to 27 Mt and 12 Mt, respectively, as highlighted in the 2019 FICCI report. LD slag, a predominant waste product from steel manufacturing, is characterized by its high basicity, enriched with calcium-rich minerals such as mono, di, and tricalcium silicates, alongside free lime and traces of metallic iron. This iron content is salvaged at a Waste Recycling Plant (WRP) through a multi-step process that includes water quenching, solidifying, and employing a sequence of magnetic separators. The steel industry faces a critical challenge in disposing of and repurposing its waste. Large quantities of iron and steel slag are routinely stored in the yards of production facilities, leading to detrimental impacts on agricultural lands and contributing to environmental pollution. There is an urgent need for effective strategies to address these issues and promote sustainable waste management practices.

Impact of the Invention:

This patented invention unveils a transformative soil conditioner composition designed to enhance soil conditioning, boost plant growth and yield, and increase plant nutrient absorption. Additionally, the invention encompasses a suite of methods for creating this potent soil conditioner, optimizing plant growth and yield, elevating plant nutrient uptake, and effectively conditioning the soil. It also details the application of this innovative soil conditioner.

Commercialization Details:

“Dhurvi Gold is a one-of-a-kind quality product based on this patented invention that improves soil's physical and chemical properties, making it ideal for plant growth and thereby boosting crop yield. The product derives value from its composition, a mix of highly useful and scarcely available nutrients. As a one-stop solution to multiple nutrient needs, Dhurvi Gold is the farmer's friend for a sustainable and successful future”. This product can be used by farmers across the country in any soil type and any climatic condition. To date, 10,000 tons of Dhurvi Gold have been sold, which signifies the market value of this product.

Photographs:



6.4. Multi-layered Device with Self-Adhering film

Summary:

The invention is a pioneering, self-adhering multi-layered device designed for effortless transfer onto various substrates without the need for solvents or extensive surface preparation. This device presents an environmentally friendly alternative to conventional paints, wallpapers, and vinyl products. The device comprises at least four layers: a base layer, a release layer, a pressure-sensitive adhesive (PSA) layer, and

and a top coat layer. This composition allows the device to eliminate long drying times and minimize health and environmental risks typically associated with Volatile Organic Compounds (VOCs). By integrating these layers into a single, user-friendly format, the invention not only simplifies the application process but also enhances safety and sustainability.

Salient Features:

The standout features of this invention are its self-adhering nature and multi-layered construction. The device is environmentally friendly, free from PVC and VOCs, ensuring it poses no harm to users or the environment. Its ability to transfer onto diverse surfaces enhances its versatility. The device can be printed with various inks, allowing for a wide range of aesthetic and functional customizations. The incorporation of pigmented and abrasion-resistant films ensures durability and vibrant visual appeal. Additionally, the device is water-resistant and washable, making it practical for long-term use. It conforms to EN-71 Part 3 standards, highlighting its safety and suitability for various applications. Designed for DIY enthusiasts and professional users alike, the device supports commercial-scale production, making it a versatile solution for numerous markets.

Problems Addressed:

This invention effectively addresses multiple problems associated with traditional surface covering methods. Firstly, it eliminates the need for extensive surface preparation and long drying times required for conventional painting. This reduction in preparation and drying time streamlines the application process, saving time and effort for users. Secondly, it significantly reduces health and environmental hazards caused by VOCs found in liquid paints. VOCs are known to contribute to indoor air pollution and pose health risks such as respiratory issues and allergic reactions. By avoiding the use of VOCs, this device mitigates these risks and ensures a healthier environment. Additionally, the device prevents allergic reactions and unpleasant odors that are commonly experienced with freshly painted surfaces. It also offers a viable alternative to wallpapers, which are often limited in application and sensitive to humidity.

Impact of the Invention:

The impact of this invention is profound, offering significant improvements in efficiency, convenience, and sustainability for surface covering applications across various industries. By providing an easy-to-apply, environmentally friendly solution, the invention addresses the limitations of traditional painting, wallpapering, and vinyl applications. The device's versatility in adhering to multiple surfaces, coupled with its water resistance and durability, makes it a practical and sustainable choice for both commercial and residential use.

Patent No: 539295

Date of Grant: 27/05/2024

**Applicant: Can Image Media
Tech**

**Inventor(s): Ketan Arvind
Desai, Karunesh Mishra**



65. Methods and Systems for Automated Identification of Agro-Climatic Zones

Summary:

The methods and systems for automated identification of agro-climatic zones of the patent deal with receiving parameters pertaining to ambiance and soil from various external systems for a geographical region via one or more interaction methods. The parameters may be raw or derived from raw data, homogenized, and stored in a generic and hierarchical format for easy consumption. Inference is drawn from the parameters and associated attributes by comparing them with historic attributes available in a knowledge base module for a

corresponding agro-climatic zone. Inferences may also be made from parameters available in encoded form, such as images, videos, and ontological knowledge. Based on the comparison, a score is generated that reflects the degree of compliance with pre-defined agro-climatic zones. The patent enables real-time, intelligent inferencing of the classification of a geographical region based on micro-climatic parameters that are available directly or in an encoded format. Addressing the critical impact of global warming and unforeseen changes in climatic conditions on agro-climatic zone identification, the methods and systems provided in this patent specification represent a significant step towards achieving the United Nations Sustainable Development Goal (SDG) 13 of climate action.

Salient Features:

The patent's methods and systems for automated identification of agroclimatic zones involve technological interventions that help in this process and provide smart insights from time to time on zone information relative to the state of the art, which can aid crop planning activities. This can help create real-time agroclimatic zones that help plan agricultural activities better on a smaller scale to improve crop yield.

The methods and systems for automated identification of agro-climatic zones of the patent provide a technological framework that can be used to conveniently and flexibly collect data from a plurality of external systems and derive attributes of parameters pertaining to ambiance such as temperature, rainfall, and the like and soil characteristics such as type of soil, pH (potential of hydrogen) value, and the like, which are used to define and ascertain agro-climatic zones. The patent system comprises a machine-interpretable knowledge base module. The parameters obtained from the geographical region of interest are compared with parameters associated with pre-defined agro-climatic zones. The outcome is a score indicating whether the geographical region of interest conforms to the characteristics of the agro-climatic zone defined for it. Such an inference can inform if there is a need to create further subdivisions in the form of agro-climatic subzones. The systems of the patent may source information in real time from various sources and streams and combine this information with existing knowledge bases to arrive at decisions that can be presented as services for consumption by external systems. Effectively, the systems create a common configurable digital middleware fabric to connect all possible data sources, streams, and sinks.

Patent No: 523266

Date of Grant: 11/03/2024

Applicant: TCS

**Inventor(s): Sarangi Sanat,
Vazhayil Praneet**

Padinchare, Ramanath

Saranya, Chandrasenan

Gopu, Pappula Srinivasu



Problems Addressed:

A geographical region is divided into agro-climatic zones, indicating possible crops that can be grown in the zones. Based on various parameters pertaining to ambiance such as temperature, rainfall, and the like and soil characteristics like type of soil, pH (potential of hydrogen) value, and the like, numerous agro-climatic zone classifications have been proposed for many geographical regions across the globe. As agro-climatic zone-based classifications were done quite early in history based on broad trends and primitive measurement equipment, the validity of such classifications may be questionable in terms of precision. Also, with global warming and unforeseen changes in climatic conditions, the classifications based on historical climatic conditions may be erroneous. Hence, validating in real-time whether a particular geographical region of interest should belong to an agro-climatic zone defined traditionally would help uncover anomalies or hotspots so that only suitable crops are grown in that geographical region of interest region. However, it is a challenge to not only automate this process end to end, beginning with data acquisition from various non-homogenous sources, but also to identify compliance of the agro-climatic zones for growing suitable crops in real-time based on micro-climatic parameter values.

The development of relevant agro-climatic zones is closely dependent on the accurate availability of ambient and soil parameters. This information has historically not been easily available due to the sheer number of sources, lack of appropriate technology, and changing environmental conditions. Therefore, various authorized bodies have proposed a large number of agro-climatic zone configurations. Again, the size of these zones keeps reducing with time, and new micro-zones are continuously being formed.

Impact of the Invention:

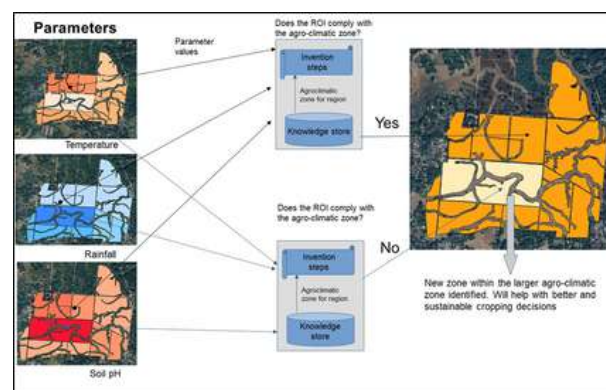
The systems and methods of the patent overcome the limitations of conventional systems by (a) providing an automated and intelligent generic framework that remains adaptive to all kinds of interaction mechanisms with external sources (producers and consumers) of data and (b) maintaining data in a generic format to comply with the different data structure requirements of the interacting systems. The systems and methods of the present disclosure are embodied with intelligence to infer encoded information from images, videos, and ontologies, thereby enabling the classification of a geographical region of interest even in the absence of relevant information.

The embodied intelligence in the systems of the patent also generates and supports smart inferences on agro-climatic zones, such as generating a score that represents the degree of conformance of a given zone to a pre-defined agro-climatic zone and receiving a geographical region of any size as input and compare it with a reference agro-climatic zone to identify potential deviations.

Commercialization Details:

The TCS Digital Platform for Next Generation Agriculture (DNA) is a state-of-the-art, cloud-based decision intelligence and crop monitoring system that provides customized, site-specific predictive advisory services to farmers and other players in the food value chain.

Photographs:



66. Naturally Aspirated Common Rail Diesel Engine Meeting Ultra Low PM Emission by Passive Exhaust after Treatment

Summary:

A system for controlling emissions of exhaust gases in said naturally aspirated engine is disclosed. The system includes an open loop exhaust gas recirculation flow. The system further includes a catalyst mounted at the engine's exhaust manifold. Furthermore, the system consists of an exhaust gas mixing tube inserted into the intake elbow (mixing tube). The system further includes an exhaust gas recirculation valve mounted on the cold side of the EGR cooler. Furthermore, the system consists of an electronic control unit to control the exhaust gas recirculation valve along with various other engine calibration parameters.

Salient Features:

The features of the invention are to provide an emission control system for a naturally aspirated common rail diesel engine with a diesel oxidation catalyst in the exhaust gas flow path, to provide an open loop Exhaust Gas Recirculation system for a controlled supply of exhaust gas to an intake of the naturally aspirated diesel engine, to provide an emission control system which will provide more accurate control over the exhaust gas re-circulation

Problems Addressed:

Exhaust gas re-circulation is a technique commonly used to control the generation of undesirable pollutant gases in the operation of internal combustion engines. This technique has proven particularly useful in internal combustion engines used in motor vehicles such as passenger cars, light-duty trucks, and other on-road motor equipment. The exhaust gas re-circulation technique primarily involves the re-circulation of exhaust gas by-products into the intake air supply of the internal combustion engine. This exhaust gas, thus reintroduced to the engine cylinder, reduces the concentration of oxygen therein, lowering the maximum combustion temperature within the cylinder and slowing the combustion process's chemical reaction, decreasing the formation of nitrous oxide. Furthermore, the exhaust gases typically contain a portion of unburned hydrocarbon, which is burned on its reintroduction into the engine cylinder, which further reduces the emission of exhaust gas by-products, which would be emitted as undesirable pollutants from the internal combustion engine.

Further, few exhaust gas-treating systems containing a plurality of catalysts have been proposed. The operations often involve the use of one catalyst under reducing conditions to maximize the conversion of nitrogen oxides to nitrogen. A separate catalyst is employed under oxidizing conditions to maximize the conversion of carbon monoxide and hydrocarbons to carbon dioxide and water. Such systems are expensive and, therefore, undesirable, particularly where the amount of space available for containing the catalytic equipment is limited, as is usually the case with Off-Highway Vehicles. However, as time passes, the levels of pollutants that may be charged acceptably into the atmosphere are being lowered to the extent that both the oxidation of carbon monoxide and hydrocarbons and the reduction of

Patent No: 420502

Date of Grant: 06/02/2023

Applicant: Mahindra & Mahindra

Inventor(s): Velusamy R,

Dipankar Ray, Bhosale

Sadanand, Hiranandani

Pravesh, Rane Santosh,

Suresh R, Dalvi Atmaram,

Deepak S



nitrogen oxides must be accomplished to a high degree of government regulations are to be satisfied. It is, therefore, quite important to develop catalytic systems for treating such gases most effectively and under economically attractive conditions.

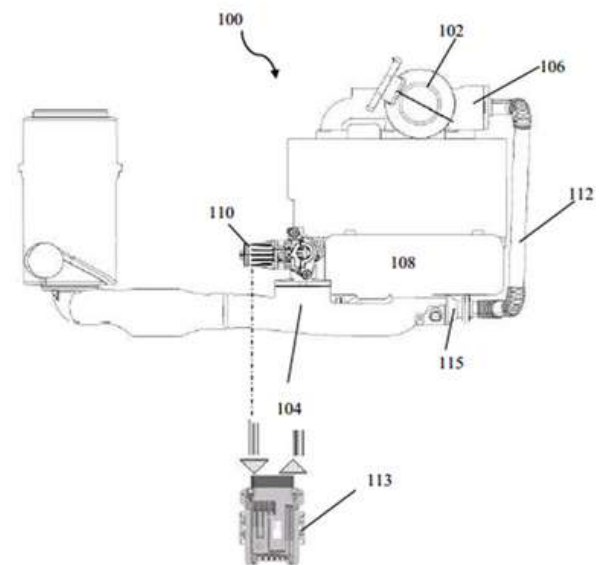
Impact of the Invention:

The invention provides numerous advantages, including a quick transient response of the engine on dynamometer tests as well as in field operations. An additional advantage is a superior control of the emission of undesirable exhaust gas byproducts from the exhaust gas discharge. Further, this configuration can be adapted easily to existing vehicle layouts, which reduces substantial investment in vehicle development. The optimum selection of piston bowl shape, Injector, EGR valve, EGR cooler, and DOC with optimum rail pressure, main injection timing & EGR maps over the entire engine operation are the key factors for achieving this invention.

Commercialization Details:

It's been implemented in our Tractor engines.

Photographs:



67. Method and System for Assessing Soil Carbon Sequestration of a Farm Based on Remote Sensing

Summary:

The methods and systems of the patent deal with assessing soil carbon sequestration of farms based on remote sensing. One of the 5 driving factors for climate change and global warming is the emission of greenhouse gas emissions. Of the possible ways to reduce climate change and global warming adoption, sustainable agricultural practices will enable efficient soil carbon sequestration, thereby reducing greenhouse gases as well as increasing crop yield. The system of the patent assesses the soil carbon sequestration of the farm by continuously monitoring the farm in real-time based on remote sensing using a plurality of satellite data and a plurality of farming

data using several techniques. The system and method of the patent utilize several techniques, such as machine learning, a carbon sequestration estimation technique, estimating a crop health index and an adoption index, and computing a set of carbon sequestration parameters for assessing soil carbon

Patent No: 522161

Date of Grant: 08/03/2024

Applicant: TCS

Inventor(s): Sakkan

Mariappan, Mohite

Jayantrao, Sivalingam

Ravinkumar, Sawant

Suryakant Ashok, Sarangi

Sanat, Pappula Srinivasu



sequestration. By addressing the critical issues of climate change and global warming associated with assessment of soil carbon sequestration of farm, the system and method of the patent represent a significant step towards achieving the United Nations Sustainable Development Goal 13 of climate action, and SDG 2 of ensuring zero hunger.

Salient Features:

The methods and systems of the patent deal with remote sensing to acquire real-time data and monitor and assess soil carbon sequestration of farmland, thus eliminating the need for physical presence in the field. Therefore, by remotely monitoring the farm and evaluating the carbon sequestration of the farmland, the frequent visits to the farm for assessment will be greatly reduced while also providing an accurate and effective technique to increase the carbon levels in soil (by recommending the set of agricultural practices).

Problems Addressed:

Climate change and global warming are critical issues facing the world today. One of the driving factors for climate change and global warming is greenhouse gas emissions. A greenhouse gas (GHG or GHG) is a gas that absorbs and emits radiant energy (heat) within the thermal infrared range, causing the greenhouse effect. The primary greenhouse gases in Earth's atmosphere are water vapor (), carbon dioxide (), methane (), nitrous oxide (), and ozone ().

The greenhouse gases, especially carbon dioxide (, can be removed from the Earth's atmosphere by various processes, including biological, chemical, and physical processes. Of the biological processes for removal, agricultural fields can act as a carbon sink, wherein the carbon sink is a reservoir that accumulates and stores carbon-containing chemical compounds for an indefinite period, lowering the concentration from the atmosphere. The agricultural lands are excellent natural carbon sinks as they are stored in biomass and soil as a result of photosynthesis in crops. The process through which the atmosphere is absorbed naturally through photosynthesis and stored as carbon in biomass & soils is called soil carbon sequestration.

Agricultural practices can directly affect the levels in the soil. Hence, it is recommended that agricultural practices be followed to aid in better absorption in the soil, which would also enable increased crop yield while reducing greenhouse gases in the atmosphere. Adopting sustainable agricultural management practices enables efficient soil carbon sequestration, reducing greenhouse gases and increasing crop yield. Based on the adoption of sustainable agricultural management practices, the farm needs to be continuously monitored to assess the carbon levels and enable an analysis of carbon sequestration in real-time.

The existing legacy state-of-the-art techniques for monitoring carbon levels in agricultural farms focus on crops and various practices followed by land attributes. However, carbon levels need to be estimated using accurate recommendations of sustainable agricultural practices, considering various environmental factors, and constantly monitoring the farm in real time using modern technologies.

Impact of the Invention:

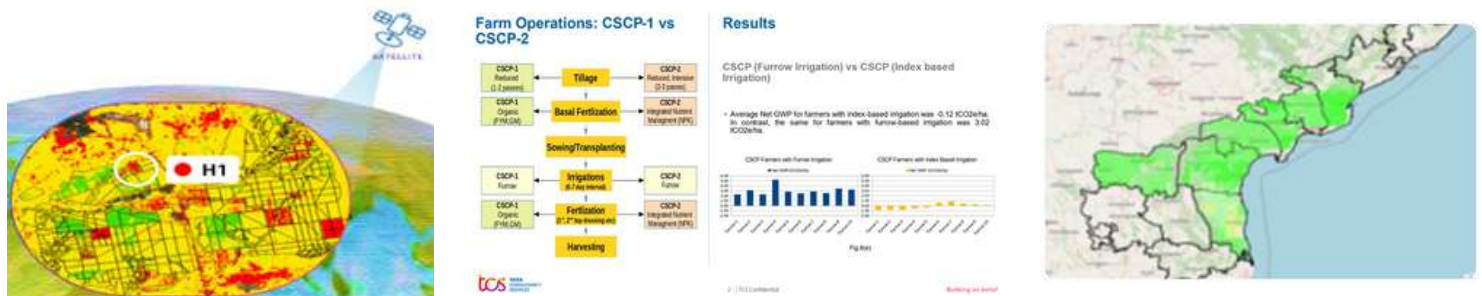
The methods and systems of the patent recommend a set of agricultural practices for effective crop production in farming during the crop life cycle of the suitable crop. The agricultural practices are also aligned to ensure effective carbon sequestration in the soil. The recommended set of agricultural practices includes (a) conservation tillage practices like direct seeding systems, (b) elimination of summer fallow, (c) extending crop rotations to include perennial forage crops for hay or pasture,(d)

Management of crop residue and application of 5 organic materials and manures; (e) Soil fertility optimization through improved fertilizer placement and site-specific management, (f) Reductions in the use of chemicals, (g) Other techniques that may improve crop yields, and reduce on-site and off-site production risks.

Commercialization Details:

The TCS Digital Platform for Next Generation Agriculture (DNA) is a state-of-the-art, cloud-based decision intelligence and crop monitoring system that provides customized, site-specific predictive advisory services to farmers and other players in the food value chain.

Photographs:



68. Air Pollution Control System

Summary:

The air pollution control system described herein comprises several key components working in tandem to purify air in a given area. It includes an air quality monitoring device and a wind direction monitoring device to assess air quality and wind direction respectively. The system features an air purification device, automatically activated based on measured air quality, which consists of an air suction tower and a baffled cyclone separator. The suction tower utilizes rotating inlets to draw air from all directions, filtering coarse particles and directing the air to the cyclone separator. Here, dust particles larger than 5 microns are removed, with finer particles further filtered by a pulse jet bag house. The purified air is then released in the determined wind direction. Additionally, the system integrates solar panels for power, ensuring sustainable operation. This innovative design promises effective air pollution control while considering energy efficiency and environmental impact. The proposed invention belongs to the sustainable development goal (SDG) 7 category: affordable and clean energy.

Patent No: 516534

Date of Grant: 28/02/2024

Applicant: IIT Madras

Inventor(s): S.M. Shiva

Nagendra, Dheeraj Alshetty

V, Sruthi Jayaraj



Salient Features:

The air pollution control system presented here addresses urban air quality issues by combining wireless sensor networks for real-time monitoring with an innovative purification system. It comprises an air quality and wind direction monitor to assess and respond to environmental conditions. The purification system includes an air suction tower and baffled cyclone separator to remove dust particles, followed by a pulse jet bag house for finer particle removal. Notably, the system's design enhances particle collection efficiency, particularly for particles larger than 5 microns, and it can be powered by solar panels for sustainability. Additionally, the system features automated operation and adjustable air discharge direction based on monitored data, offering a comprehensive solution for urban air pollution hotspots.

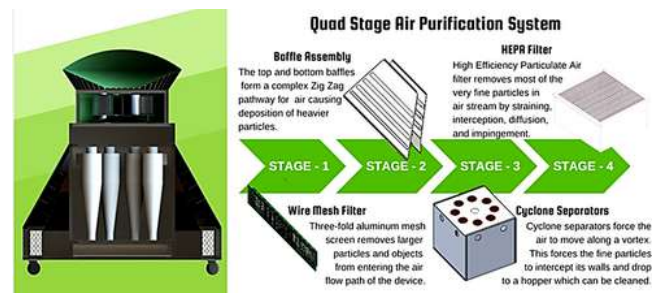
Problems Addressed:

- The invention targets areas within urban environments characterized by high concentrations of air pollutants, addressing the specific challenge of combating pollution hotspots.
- Existing control measures primarily focus on reducing emissions at the source, neglecting the direct treatment of ambient air pollutants present in the environment.
- Conventional purification methods, such as normal cyclone separators, struggle to effectively remove smaller particles, highlighting the need for more efficient air purification technologies.

Impact of the Invention:

The Homogenizing Device for Septic Tank Sludge emerges as a beacon of progress in the critical realm of sanitation management. Its introduction marks a pivotal step forward, addressing the challenge of sludge accumulation and safeguarding public health, enhancing living standards, and fostering sustainable development. Effectively mixing and managing septic tank sludge reduces the risk of overflow and the spread of diseases, thus promoting healthier environments and reducing mortality rates, particularly among vulnerable populations. Furthermore, offering a safer alternative to manual reducing the concentration of pollutants in the air. Moreover, the system's ability to adjust air discharge direction based on environmental conditions ensures optimal dispersion of purified air, further enhancing its effectiveness. With the integration of solar panels for power, the system also promotes sustainability, offering a long-term solution to urban air pollution challenges. Overall, this invention has the potential to significantly improve public health and quality of life in urban areas by mitigating the harmful effects of air pollution. The subject invention belongs to SDG 7: affordable and clean energy.

Photographs:



69. A System for Recovering Heat from Industrial Paint Cooling Operation and Heating Chemicals in Pretreatment Process Tanks

Summary:

A system is proposed that would harness heat otherwise rejected to the atmosphere from industrial processes involving chiller condensers and recycle it back into other industrial processes. The system uses different types of equipment such as a heat pump and heat exchangers and also a hot water generator in an inventive combination to recover the heat from the condensers of the chillers that are used for cooling paints or any other systems of industrial process and provide the recovered heat to pretreatment operations that take place at the upstream end of said industrial processes. The heat

The pump used for recovering heat from the chiller condenser preferably works on the 'vapor absorption' principle, and the heat exchangers used to transfer the recovered heat preferably work on a liquid-to-liquid heat transfer principle.

Salient Features:

The present invention recovers the rejected heat from the chiller condenser, uses the recovered heat in industrial processes, and provides a source of heating in the form of heat recovered from the chiller condenser, which would reduce operational costs and adverse environmental impact.

Problems Addressed:

As a part of the automobile painting process, the painted articles are baked and then cooled down. The liquid paint itself is heated and cooled down during the process. Liquid chemicals are heated & paints are cooled during the process. Paint shops conventionally use electrically operated chillers to cool the paints used in painting operations in manufacturing plants. Typical chillers run on the vapor compression principle. These chillers perform the function of chilling through their evaporators, whereupon heat is rejected to the atmosphere at the condenser end of a chiller via a cooling tower. The amount of heat rejected to the atmosphere through this process is significant, for example a 100 ton chiller rejects heat to the order of 300k Kcal/hr.

On the other hand, the pretreatment processes in a typical paint shop associated with manufacturing require heating at the pretreatment process stage. This is conventionally achieved through a hot water generator, which is energized by liquefied petroleum gas (LPG), High-Speed Diesel (HSD), or even electricity. This incurs a huge cost and adds to CO2 emissions.

As there are already operations involving heat rejection taking place in the paint shop, it makes all the sense to recover the heat and use it elsewhere. Although there are systems in use where such heat recovery is made possible, these systems are not recommended for large operations such as the paint shop units of manufacturing plants. There is, therefore, a need to provide systems to recover heat from various sources of waste of heat energy in a paint shop and reuse it in processes that need heating.

Patent No: 308475

Date of Grant: 04/03/19

Applicant: Mahindra & Mahindra

Inventor(s): Piyush Thakar, Anand D. Patil, Ramdas Nair, Umesh Joshi, Anant Khond, Nitin Pate, George Joseph



thereby the cost of manufacturing and damage to the environment, especially in large manufacturing facilities.

Impact of the Invention:

It provides a system of heat recovery whereby the recovered heat may be used in large-scale industrial applications.

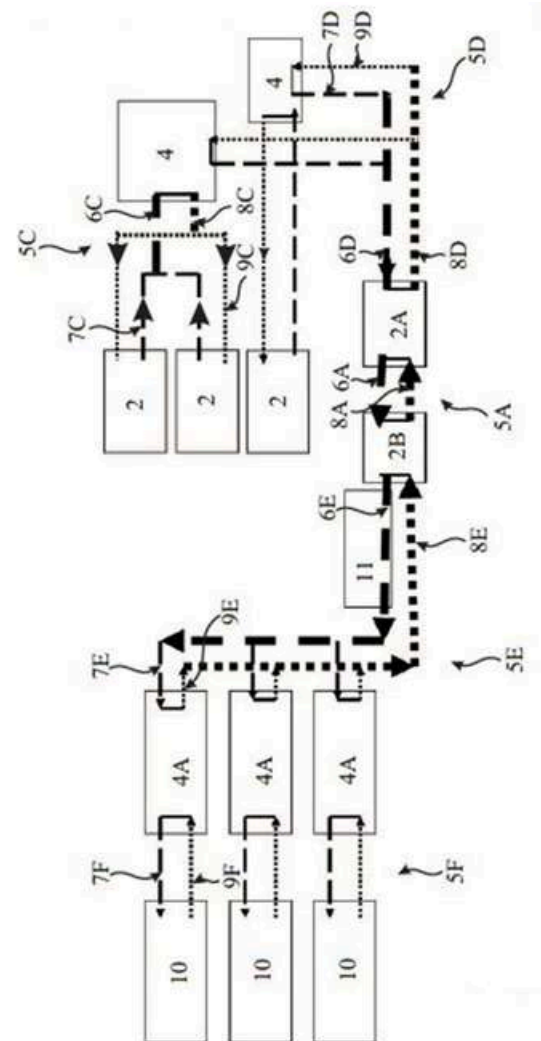
It provides a system whereby recovered heat may be used even during the startup phases of the pretreatment processes (where the recovered heat is used) without halting the operations.

The amount of heat recovered is so substantial that it significantly compensates for the reduced performance of the chillers.

Commercialization Details:

The invention was deployed in two separate paint shop installations located adjacent to each other. The first paint shop had an overall physical plan with dimensions of 330m x 116m. The second paint shop had plan dimensions of 200m x 50m. The length of piping involved in the condenser heat recovery process was approximately 300m. A pipe size of 300NB was laid for this purpose. The water was circulated through the first closed water loop at a 400 m³/hr rate. Each of the two paint shops had two paint systems containing liquids that needed cooling (one for the electro-deposition process and one for the painting process). Corresponding to each tank was provided a heat exchanger. A total of two chillers (each with a 154-ton capacity) were used in a parallel configuration for both paint shops together. A single heat pump was provided to service both chillers. At the pretreatment end, five tanks were used in one paint shop and three in the other. A single hot water generator was used to supply heat to all tanks in the start-up phase. The pretreatment lines in the two paint shops were stretched over the length of 200m & 70m, respectively. The size of the piping used for this purpose was 200NB to carry water at a capacity of 185m³/Hr and then further distribute it to 8 heat exchangers (5 locations in one paint shop & 3 locations in another paint shop). The 5 heated pretreatment process tanks in the first paint shop were of the following capacities – 1)13 m³, 2) 20 m³, 3) 160 m³, 4)160 m³, and 267 m³. The three heated pretreatment process tanks in the second paint shop were of following capacities 1) 15 m³, 2) 60 m³, 3)60 m³.

Photographs:



70. Emission Control System for Spraying a Mixture of Coldwater and Compressed Air Over an Exhaust Gas Line

Summary:

The invention is designed to reduce emissions in internal combustion engine vehicles, such as cars and buses. The internal combustion engine powers the vehicle, and an alternator generates electric power stored in a battery (12V for light vehicles, 24V for heavy vehicles). If needed, an inverter connected to the battery can convert DC power to AC power. The system uniquely addresses exhaust emissions by

spraying a cold water and air mixture on the exhaust gas to reduce pollutants like CO_x, NO_x, and Hydrocarbons. A water tank, pump, and an air compressor facilitate this process, with the pump operated by the battery and the compressor connected to the inverter for DC or AC operation. An electronically operated control valve regulates the water and air mixture based on vehicle speed. In contrast, a solenoid valve controls the pressure of the mixture sprayed on the exhaust gas according to the engine's load condition. The system includes an exhaust central processing unit collecting particulate matter and spraying water droplets on the exhaust gas. The unit contains a collection tank for the mixture of water, air, and particulate matter and an outlet that releases smoke with reduced levels of hydrocarbon, carbon monoxide, and nitrogen oxide into the atmosphere.

Patent No: 273670

Date of Grant: 22/06/2016

Applicant: S.M.

Seenimohideen

Inventor(s): S.M.

Seenimohideen



Salient Features:

The salient features of this invention are various aspects of its design, functionality, and adaptability, making it an innovative solution for reducing emissions in internal combustion engine vehicles.

- **Power Generation and Storage:** The system harnesses power from an alternator connected to the internal combustion engine, storing the generated energy in a battery (12V for light vehicles, 24V for heavy vehicles). An inverter is also included to convert DC power to AC power when needed, ensuring a reliable and versatile power supply for the system's components.
- **Cold Water and Air Mixture:** The invention utilizes a unique approach to emission reduction by spraying a cold water and air mixture on the exhaust gas. This method effectively reduces the levels of harmful pollutants like CO_x, NO_x, and Hydrocarbons.
- **Water and Air Supply System:** A water tank, pump, and air compressor facilitate the supply of cold water and air for the mixture. The water pump is battery-operated, while the air compressor can function with DC or AC power through the inverter, providing flexibility in power usage.
- **Electronically Operated Valves:** An electronically operated control valve regulates the water and air mixture percentage based on vehicle speed. In contrast, a solenoid valve controls the pressure of the mixture sprayed on the exhaust gas according to the engine's load condition. These valves ensure optimal emission reduction across different driving conditions.
- **Exhaust Central Processing Unit:** This unit collects particulate matter, sprays water droplets on the exhaust gas, and contains a collection tank for the mixture of water, air, and particulate matter. An outlet releases smoke with reduced levels of hydrocarbon, carbon monoxide, and nitrogen oxide into the atmosphere.

Problems Addressed:

The invention addresses several problems associated with internal combustion engine vehicles. One of the primary concerns is the emission of harmful pollutants, such as CO_x, NO_x, and Hydrocarbons, which contribute to air pollution and negatively impact public health and the environment. The system tackles this issue by spraying a cold water and air mixture on the exhaust gas, effectively reducing the levels of these pollutants.

Another problem addressed is the presence of particulate matter (PM) in the exhaust emissions. These particles, including hydrocarbon particles, carbon oxide, and nitrogen oxide, can accumulate under the exhaust pipe and pose additional environmental and health risks. The invention's exhaust central processing unit helps mitigate this issue by collecting debris and spraying water droplets on the exhaust gas to facilitate the removal of particulate matter. The system takes into account varying vehicle speeds and engine load conditions. An electronically operated control and solenoid valve can adjust the water and air mixture's percentage and pressure accordingly. This adaptability ensures optimal emission reduction across different driving conditions.

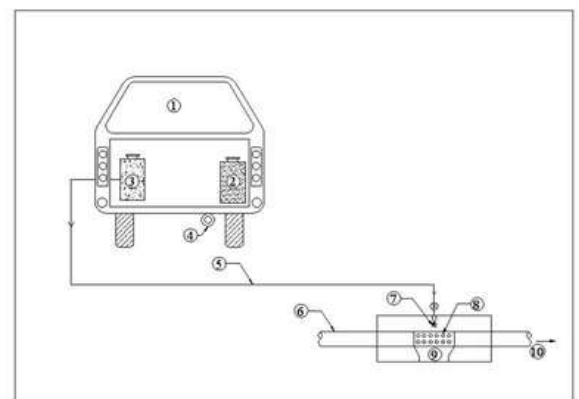
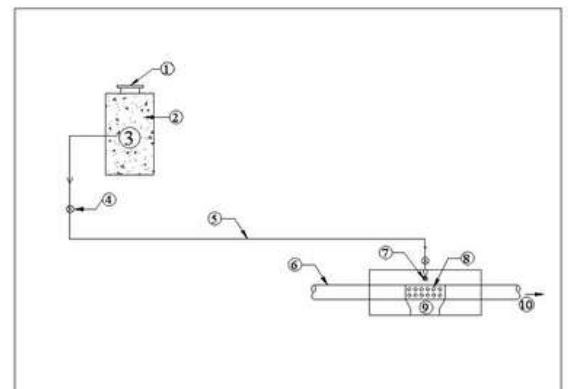
Impact of the Invention:

The impact of this invention in several aspects, primarily related to environmental protection, public health, and energy efficiency. Environmentally, the system's ability to reduce harmful emissions, such as CO_x, NO_x, and Hydrocarbons, can substantially decrease air pollution caused by internal combustion engine vehicles. By spraying a cold water and air mixture on the exhaust gas and collecting particulate matter, the invention helps minimize the release of pollutants into the atmosphere, ultimately contributing to cleaner air and a healthier environment. In terms of public health, the reduction of harmful emissions translates to lower exposure risks for individuals, particularly in urban areas with high traffic density. Lower pollutant levels can help decrease respiratory issues, allergies, and other health problems associated with poor air quality. The invention promotes energy efficiency by utilizing an alternator, battery, and inverter setup to power the system's components. This design allows for the effective use and storage of generated power, accommodating both DC and AC power needs. Consequently, the system can operate in various vehicles, from light cars to heavy buses, without compromising performance or energy consumption. This invention can encourage broader adoption of the technology across the automotive industry, leading to a more substantial collective impact on air quality, public health, and energy efficiency.

Commercialization Details:

Prototype model has been developed.

Photographs:



71. Development of novel green technology-based biologicals for bioremediation of municipal solid waste into bio-fertilizers as soil conditioners and commercialization of the same.

Summary:

- A formulation of biological consortium for bioremediation of municipal solid waste (MSW) into bio fertilizer as a soil conditioner, said formulation comprising a microbial consortium of bacterial strains of *Bacillus cereus* MTCC25342 and *Bacillus cereus* MTCC25343 and fungal strains strains of *Saccharomyces cerevisiae* MTCC 25341 and *Pichiakudriavzevii* MTCC-25340, and preservatives
- Said formulation has a viable cell count of a minimum of 2×10^8 CFU/ml and a maximum of 2×10^{10} CFU/ml, and –
- The product has a shelf life of 12 months to 24 months.
- The formulation, as claimed, wherein said bioremediation utilizes a dosage of 1L of liquid form or 4kg of solid form of the formulation mixed with 10L of drinking water and sprayed over 1 ton of segregated waste.

Patent No: 498017

Date of Grant: 14/12/2018

Applicant: IPL Biologicals

Inventor(s): Vimala Prakash



Salient Features:

- Reduces the volume of solid waste and increases the capacity of landfill sites (70% volume reduction).
- A maximum volume reduction of about 70 ± 3 % has been observed using the developed microbial consortium in segregated and shredded waste. About 39 ± 3 % volume reduction was observed in non-segregated and non-shredded conditions.
- The product successfully reduced cellulose by 88% for dosage T2 (2.5ml/kg) compared to 29% for untreated after 12-35 days, as the consortium consists of four cellulose-degrading strains.
- Reduce environmental contamination from landfills and remove odor.
- Cost-effective method for solid waste management.
- Microbial degradation of segregated MSW will yield compost suitable for biofertilizer, and in-house studies have shown that the application of enriched compost helps plant growth.
- Our product has some attractive benefits in treating MSW, such as reducing the volume of waste material, adjusting the waste and economic aspects, obliterating microorganisms in the waste material, and creating biogas for energy use.

Problems Addressed:

- India, the second-largest populated and one of the fastest urbanizing countries is a land of climatic, social, and cultural diversity. India generates about 62 million tonnes (MT) of municipal solid waste per annum. Only 43 MT of the waste is collected, 11.9 MT is treated, and 31.1 MT is dumped in landfill sites.
- Wastes generation varies from villages to cities, 0.1 to 0.6 kg per head.
- 23 metro cities generate 30,000 tons per day, class I cities generate 50,000 per day, and twenty-eight percent of the urban population produces approximately 1 76,530 T.
- It is well known that the impact of MSW landfills can cause pollution of all environmental components. By 2031, the MSW generation is projected to increase to 170 million tonnes, and 436 million tons by 2050.

- Natural degradation of municipal solid waste (MSW) is a time-consuming process, accompanied by the generation of toxic fumes, greenhouse gases, and leachate, which further lead to air, soil, and groundwater contamination. Immense amounts of MSW are generated daily, and their dumping has led to overflowing landfills.
- These sites act as breeding grounds for pathogens, insects, and pests, which further cause diseases in humans, animals, and plants. The overall effect is the degeneration of the immediate environment, making it inhabitable for living organisms.
- Physical and chemical interventions for waste treatment are problematic and unsustainable.
- Technologies like sanitary municipal landfill processes and Municipal solid incineration have limitations, such as the high cost of operation and the generation of environmentally toxic by-products.
- The developed microbial product, containing novel microorganisms specialized in the rapid degradation of MSW, overcomes most of the difficulties in implementation.
- It is estimated that about 50% of solid waste is biodegradable, and proper handling of biodegradable waste alone could reduce the challenges by half.
- Our product aims to convert the biodegradable fraction of solid waste to compost as organic fertilizer using a microbial consortium.
- The developed microbial consortium hastens the composting process. Using the above methodology, organic waste can be treated at the site, which ultimately reduces the cost of transport.
- Small-scale windrow composting with periodic addition of the developed microbial consortium will improve the rate of biodegradation and generate high-quality compost.
- Growing concerns about environmental and ecological impacts associated with agriculture activities have created the need for more sustainable agriculture practices. Biological fertilizers derived from biowaste as a potential alternative source of fertilization

Impact of the Invention:

- The management of solid waste presents a challenge for developing countries as the generation of waste is increasing at a rapid and alarming rate.
- It can be managed by separating and segregating biodegradable products from plastic waste, either via separation or by consumers segregating their waste in separate bins. Recycling this waste with a developed microbial consortium is being applied to produce valuable organic matter, which can be used as fertilizers or amendments to improve the soil structure.
- Swachh Bharat Mission demands processing waste either into compost or energy.
- Ministry of environment and forests indicates waste processing options which includes standard for composting.
- The product developed will have a huge potential in bio-remediating solid waste landfills and converting them into a usable bio-fertilizer
- Demand of compost/organic fertilizer in India is approximately 1200-1500 Tons per day.
- The compost, obtained as a byproduct of the microbial processes is a rich source of plant growth promoting nutrients such as nitrogen and phosphorus and can be made available to the farmers for agronomic practices at a fraction of cost.
- This will reduce the dependency on chemical fertilizers, further preventing accumulation of recalcitrant compounds.
- Composting is simple and quick to implement, in addition to its lower environmental and social costs, compared to other organic waste disposal methods such as landfilling and incineration.

CommercializationDetails:

- The product is under process for commercialization.
- Demonstration and trials are being conducted and once it is successfully completed, the product has a huge scope of commercialization.
- The product not only fulfills the solid waste management through microbial consortium but also generate organic fertilizer through decomposition and can be used successfully in sustainable agriculture practices.

Photographs:



Figure: Schematic presentation of IPL biological solution for municipal solid waste decomposition and waste generation into Sustainable Organic Fertilizers

72. An Improved Water Soluble Active Microbial Formulation and a Process for the Production.

Summary:

An improved water-soluble active microbial formulation said that the formulation comprises microbial ingredients comprising Vesicular Arbuscular Mycorrhiza and Sporulating antagonistic Bacteria deposited with Deposition No. MTCC 5728, organic nutrient ingredients comprising Seaweed Extract and Potassium Humate, and other active ingredients comprising Sodium Bicarbonate, Sucrose and Citric Acid

Patent No: 391190

Date of Grant: 04/03/2022

Applicant: IPL Biologicals

Inventor(s): Vimala

Prakash, Kaushik Basu



Salient Features:

The present invention provides an improved water-soluble active microbial formulation of Vesicular Arbuscular Mycorrhiza (VAM) and sporulating antagonistic bacteria and a process for the production thereof from agriculturally important microorganisms, ingredients, and organic nutrient enhancers, wherein all the ingredients are working synergistically together to result in said microbial formulation, such that the resulting formulation provides a total organic solution in agriculture, provides high crop yield, imparts nutrient supply for better growth, and enhances plant metabolic activities for interaction in the rhizosphere, resulting in increased root uptake capacity; said formulation also imparts antagonistic activity and disease control.

Problems Addressed:

- The present invention relates to the field of plants and agriculture.

- More particularly, the invention relates to the field of novel microbial formulation for better growth and disease control of plants.
- More particularly, the invention provides a microbial consortium that comprises microorganisms and organic nutrient enhancers for plants.
- Even more particularly, the invention provides a microbial consortium that is completely organic in nature, environment friendly, and very effective with no side effects to plants.

Impact of the Invention:

Advantages of the invention: The advantages of this invention are:

- The present invention, microbial consortium, which is organic in nature
- Applying the present invention results in better plant growth.
- Enhances the plant's metabolic activities
- The invention imparts antagonistic activity and disease-control properties to plants.
- The invention enhances the slow release of nutrients to plants.
- The invention is effective immediately.
- The invention does not cause any hazardous effects on anyone in the surroundings.
- The invention is cost-effective in nature.
- It is easy to use
- User-friendly application.
- The invention aims to reduce the dosage.
- Applying the consortium of the present invention results in better field performance due to stress-tolerant formulations

Impact of the Invention:

The product has been commercialized under the brand name VAMLET, and it is in the tablet formulation supplying nutrition to Plant and replacing harmful Chemical phosphate fertilizers

Vamlet is an eco-friendly bio fertilizer in tablet form that contains Mycorrhizal fungi. These fungi facilitate nutrient transfer from soil to plants, enhance phosphate uptake, and mobilize immobile micronutrients such as Fe, Mn, Zn, Cu, Bo, and Mo.

Photographs :



73. *Verticillium Lecanii* as Bio-Insecticide in a Viable Liquid & Powder and a Method for Development thereof

Summary:

- A liquid bioformulation for the effective control of insects and pests by utilizing biocontrol agents for sustainable agriculture, said bio-formulation comprising *Verticillium lecanii* MTCC5730 as one of the main constituents having viable cell count in the range from 2×10^8 CFU/g to 2×10^{10}

CFU/g; an optimized media for the growth of the *Verticillium lecanii* under submerged fermentation; and optimum preservatives to obtain a shelf life of up to two years, all the ingredients working together in a synergistic manner to obtain the desired efficacy.

- The liquid bioformulation is highly effective in controlling damage to crops by waxy skin insects and sucking pests in both agricultural and non-agricultural crops when applied via foliar spray
- Harvesting the fermented broth wherein selected media components work together in a synergistic manner under optimized process parameters, such that the process yields & bio-formulation of a shelf life ranging from 12 months to 24 months
- Microbial method of pest control
- Process of manufacturing the said microbe in fermenters
- Parameters optimized to achieve high cell density in fermenters
- Different methods of Formulation for commercialization and adoption by the farming community.
- Manufacturing and commercialization have been done for this patent.

Patent No: 504714

Date of Grant: 30/01/2024

Applicant: IPL Biologicals

Inventor(s): Vimala

Prakash, Kaushik Babu



Salient Features:

- This product is formulated as 2% AS and 1.15% WP formulation with high-density technology.
- The USP of the present invention lies in its superior and novel submerged fermentation, capable of producing highly viable active ingredients with a viable extended shelf life of more than two years in liquid formulation.
- The formulation is suitable for foliar application.
- The bio-formulation proliferates throughout the insect's body, draining the insect of nutrients and eventually killing it in around 48-72 hours via the production of several toxins like brassinolide and dipicolinic acid, which infect aphids, whiteflies, and scale insects and cause mortality.
- Process parameters are optimized for growing in submerged fermentation to achieve increased sporulation and batch harvesting criteria within 24-72 hours of fermentation against 6-7 days, as reported in the literature.
- This formulation is microbial-based, highly stable, nontoxic, and environment-friendly bio-formulation for effective pest control, and a process of manufacturing the same on a pilot scale and commercial scale,
- This product, under field conditions, was able to reduce the incidence of pest infestation and improve the product quality and export value of the produce.
- *Verticillium lecanii* effectively controls all soft-bodied sucking pests like Brown plant hoppers, Leaf hoppers, Scale insects, White flies, Aphids, Jassids, whitefly, and mealy bugs for a wide range of economic crops like bananas, grapes, guava, citrus, mango, spot, and apple, coconut, paddy, cotton, and tomato, chilly, aromatic and medicinal crops.

- Registered in CIB/RCAs as a bio insecticide.
- Our Product is formulated in such a way that the product is classified as organic under various organic certifications like IMO, INDOCERT, and Canadian Organic Registration.

Problems Addressed:

- The rapeseed-mustard crop basket is highly vulnerable to an umbrella of insect pests at different phases of plant growth. These pests are known to cause a 15–30% loss in yield in different oilseed crops in India and other parts of the world.
- India accounts for approximately 23 percent of the world's cotton area, but the average productivity of cotton is markedly low at about 521 kg/ha as compared to the world average of 765 kg/ha. The total loss due to cotton pests (Aphid, Whitefly, Thrips, Cotton Leaf Hopper or Jassid and bollworm complex) are the major sucking pests of cotton and limiting the profitable cultivation.
- To protect the crops from these pests, extensive use of synthetic chemicals has led to the disruption of ecosystems, such as the death of non-target species, accumulation of pesticide residues in the environment and food, and buildup of pesticide resistance in the target species.
- *Verticillium lecanii* is EPF of the order Hypocreales that can successfully act as a biocontrol agent against many plant-damaging insects and provide opportunities to use these fungi in integrated pest management (IPM) strategies.
- The effectiveness of this bio-control agent has been proved also in soil against the soil-borne stages of the western flower thrips.

Impact of the Invention:

- Meets the vision of 2030, i.e., Self-sufficiency in food production and producing food in the most organic way. Meets the following Sustainable Development Goals
- Goal no 3: Good health and well-being. The product shall replace the harmful pesticides used for pest control
- Goal no 15: Protects Life on land as this product usage shall replace harmful pesticides used for pest control
- Goal no 06: Helps in providing clean and safe water as it helps in the prevention of groundwater contamination due to chemical pesticides
- Goal no. 09: This product has great potential for export as it can replace banned chemicals in the European market.

Commercialization Details:

Varunastra is an eco-friendly biological insecticide made from a fungus called *Verticillium lecanii*. It is effective in controlling sucking pests and lepidopterous pests such as *Spodoptera* and *Helicoverpa*. Varunastra is a safe and natural way to control pests without harming the environment or beneficial insects. Varunastra is an eco-friendly biological insecticide made from a fungus called *Verticillium lecanii*. It is effective in controlling sucking pests and lepidopterous pests such as *Spodoptera* and *Helicoverpa*. Varunastra is a safe and natural way to control pests without harming the environment or beneficial insects.

Photographs:



74. An Improved Fertilizer for Augmenting Soil Quality and Crop Productivity for Light Texture Acidic Soil

Summary:

This patent discloses a novel sustainable technology to make the iron ore slime beneficiation process a 'Zero Waste Technology.' The reject generated from the beneficiation of iron ore slime is treated as waste as the iron content in the reject is below 45%. Effective utilization of this slime waste (<10 microns) is essential due to land and water conservation. According to the invention, texture acidic soil is treated through iron ore slime waste in combination with organic matter. Full factorial design of the experiment was chosen, and experiments were carried out to optimize the process condition by varying the dosage of iron ore slime waste and organic matter. Rice and wheat crops were tested to analyze soil and plant properties at different crop growth stages. Nitrogen, Phosphorus, and Potassium (NPK) dosage was kept constant in all experiments. Soil properties such as pH, organic carbon, water holding capacity, available N, available P, available K, exchangeable Ca, exchangeable Mg, micronutrient Fe, Mn, Zn, Cu concentrations, and heavy metal Cd, and Pb concentration were analyzed for all the experiments. Plant growth parameters such as height and number of tillers and yield attributing parameters such as number of spikes, spike length, grain yield, and dry plant yield were recorded. Finally, produce (grain and straw) was analyzed for its harmful elements, such as Pb and Cd. Test results indicate that the interaction of iron ore slime waste (30 t ha⁻¹) with organic matter in the presence of NPK is suitable for improving soil quality and productivity of crops such as rice and wheat growing on light texture acidic soil within the toxic limit of heavy elements in the produce.

Patent No: 352241

Date of Grant: 25/11/2020

Applicant: Tata Steel

Inventor(s): Prashant Dixit,

Asim Kumar Mukherjee,

Dilip Makhija, Tamal Kanti

Ghosh, R K Rath



Salient Features:

Iron ore slime as soil conditioner helps in improving the water-holding capacity of soil as its ultrafine particles (<10 microns) mixing with soil in a certain proportion decreases the permeability of the mixture and helps in retaining the nutrients in the soil. It also helps increase the pH of acidic soils due to the consumption of proton in the reduction of Fe³⁺ to Fe²⁺ under the anaerobic environment of soil. The application of slime as a soil conditioner is effective in areas where soils are iron-deficient in nature. The use of iron ore slimes not only improves crop yield but also improves the absorption of micro-nutrients like Fe, S, and Mn in crops. This would improve the quality of produce, enabling the farmers to sell the produce at a higher price.

Problems Addressed:

The impurities in iron ore are alumina and silica, which are separated through a process known as beneficiation. Approximately 15-20% of the total beneficiation plant input is discarded as slime. This slime is stored at the mine site in slime ponds. This slime, apart from having some amount of iron values and high impurities, contaminates land and water and poses a threat to the environment. Due to the increase in steel production over the past decades, millions of tons of slime were generated, thereby occupying more and more land and making the situation worse. The slime issue is not only to Tata Steel

but rather a global concern for iron ore beneficiation plants worldwide. To date, there is no sustainable solution that can utilize iron ore slimes in bulk. By addressing these interrelated challenges comprehensively, the use of slime waste as an oil conditioner can play a crucial role in sustainable development for the mining community.

Impact of the Invention:

The use of iron ore slime waste as soil conditioner improves the productivity of crops such as rice and wheat by enhancing the water-holding capacity of soil and adjusting the pH level of the soil. It increases the presence of all nutrients (N, P, K, Ca, S, Mg, Zn, Fe, Mn, Cu) in soil and crops. The invention also reduces the requirement for water and organic manure. The risk associated with land and water pollution could be eliminated. This will impact sustainable mining. Moreover, a new business development could be established if this product will boost the agricultural yield.

Commercialization Details:

Presently, this project is under demonstration scale at a farmer's field (7000 sqft area). Some field trials have been carried out in the farmer's field at Noamundi iron ore mines. Results showed a 30% improvement in rice productivity using iron ore slime waste as a soil conditioner.

Photographs:

Mahudi



75. Ampelomyces quisqualis based Bio Pesticide and a Method for Development

Summary:

A bio formulation for effective plant disease management said bio formulation comprising Ampelomyces quisqualis MTCC 25015 with preservatives.

- The bio formulation, as claimed, wherein said formulation is preferably in the liquid form.
- Selected media components work together in a synergistic manner under said optimized process parameters, such that the process yields said bio-formulation of a shelf life of more than 2 years high

Patent No: 498681

Date of Grant: 12/01/2024

Applicant: International

Panaacea Limited

Inventor(s): Vimala

Prakash, Kaushik Basu



CFU count of *Ampelomyces quisqualis* in the formulation in a range of a minimum of 2×10^8 CFU/ml and a maximum of 2×10^9 CFU/ml., said predetermined optimized process parameters of said submerged fermentation

- Microbial method of disease control and can be used against mildew infestation as Bio fungicide
- Process of manufacturing the said microbe in fermenters
- Parameters optimized to achieve high cell density in fermenters
- Different methods of Formulation for commercialization and adoption by the farming community.
- Manufacturing and commercialization have been done for this patent.

Salient Features:

- This product is formulated as 2% AS formulation with high-density technology.
- The product is formulated for a shelf life of 18 months, and it is user-friendly for foliar applications.
- *Ampelomyces quisqualis* liquid formulation is highly effective in controlling diseases like powdery mildew (*Erysiphe cichoracearum*) but is also parasitic on *Botrytis cinerea*, *Alternaria solani*, *Colletotrichum*, *Coccodes*, and *Cladosporium cucumerinum*.
- Process parameters are optimized for growing in submerged fermentation to achieve increased sporulation and batch harvesting criteria within 72 hrs. of fermentation, as opposed to 10-12 days, as reported in the literature.
- Under field conditions, this product reduced the incidence of pest infestation and improved the product quality and export value.
- These can be applied to a wide range of powdery mildew-affected crops, such as Cucurbits, Grapes, Apples, Peas, Beans, Tomatoes, Pulses, Cumin, Chilies, Coriander, Mango, ber, Peas, Strawberries, Medicinal and Aromatic crops, and Roses.
- Registered in CIB/RCas a bio fungicide.
- Our Product is formulated in such a way that the product is classified as organic under various organic certifications like IMO, INDOCERTand, and Canadian OrganicRegistration.
- It is Compatible with Organic manures, Bio-fertilizers, and Bio fungicides.

Problems Addressed:

- Powdery mildew is one of the most critical diseases on many different crops and is an obligate biotrophic pathogen of over 10,000 host plant species.
- Reports represent powdery mildews, which attack 256 plant species within 172 genera in 59 families and occur in 28 countries worldwide.
- Powdery mildew is one of the most damaging pathogens that reduces crop yields. It is among the most prevalent crop diseases, and yield losses of 10% to 15% resulting from powdery mildew in barley are common, but losses can be as large as 40%.
- Powdery mildew is a major disease in India and is emerging as a major problem of Indian mustard (*Brassica juncea*). It is caused by *Erysiphe cruciferarum*. All the Indian mustard cultivars presently grown in India are highly susceptible to powdery mildew, and so far, no resistance source has been reported.
- Fungicides are regularly applied to control powdery mildew. Frequent and inadequate use of fungicides may lead to the emergence of fungicide resistance in some powdery mildew fungi.
- Injudicious use of fungicides leads to residue, resurgence & resistance in the control measures in the long run.

- *Ampelomyces quisqualis* is a highly effective solution for controlling crop powdery mildew infection, resulting in increased yield. Its rapid growth enables it to colonize the plant's surface quickly, providing effective protection against the disease.
- This product can replace harmful synthetic chemicals and be the best alternative for Powdery Mildew management against a broad range of hosts. Incorporating *Ampelomyces quisqualate*-based biopesticides in IPM programs promotes a holistic approach to PowderyMildew Disease management.
- By integrating biological, cultural, and chemical control, farmers can optimize Powdery mildew control while minimizing environmental impacts and input costs

Photographs:



Impact of the Invention:

- Meets the vision of 2030, i.e., Self-sufficiency in food production and producing food in a most organic way. Meets the following Sustainable Development Goals
- Goal no 3: Good health and well-being. The product shall replace the harmful fungicide used to control powdery mildew disease.
- Goal no 15: Protect life on land as this product usage shall replace harmful fungicides used for disease control and play a major role in the organic method of disease control.
- Goal no. 06: It helps provide clean and safe water by preventing groundwater contamination due to chemical fungicides.
- Goal no 09: Has a great potential for export as this product has scope to replace banned chemicals in the European market. There is huge scope for exporting this product globally in Europe and other markets.
- This product's impact beyond disease management encompasses environmental sustainability, integrated pest management, and economic viability in agriculture.

Commercialization Details:

The product has been commercialised with the brand name MILGO and has been widely used in Grape cultivation in Maharashtra

76. Biological Control of Cockroaches by Entomopathogenic Fungi

Summary:

- An improved microbial composition in the form of gel for effective biocontrol of pests, especially cockroaches, in an environment-friendly way, said composition comprising active microbial and biodegradable based insecticidal ingredients *Metarhizium anisopliae* (MTCC5956), agar, jaggery, dimethyl sulfoxide, fish meal, sorbitol, water, yeast extract, and trace elements working in a synergistic way so as to achieve bio control up to 75% within 2-3 days
- The improved microbial composition comprises the immobilization of *Metarhizium anisopliae* spores for the preparation of the gel
- Microbial method of pest control
- Process of manufacturing the said microbe in fermenters
- Parameters optimized to achieve high cell density in fermenters

Patent No: 376502

Date of Grant: 06/09/2021

Applicant: International

Panaacea Limited

Inventor(s): Vimala

Prakash, Kaushik Basu



Salient Features:

The invention provides biological control of cockroaches.

- The invention does not comprise any harmful chemicals.
- The invention increases the mortality rate of the cockroaches.
- The invention is effective immediately and provides control over cockroaches, with a mortality rate of 75% within 48 to 72 hours.
- The invention provides no hazardous effects on anyone or on the surroundings.
- The invention is cost-effective.
- The invention, which is the gel-based formulation, is user-friendly.

Problems Addressed:

Heavy pesticide usage in the urban environment is a serious concern. Pesticide use in urban agriculture is a potential threat to food safety, and pesticide residues in the urban environment affect human and ecological health.

The German cockroach, *Blattella germanica* (L.), is an indoor sanitary pest worldwide and seriously threatens human health. With the rapid development of insecticide resistance, biological control has gradually become the most promising strategy for cockroach control.

Cockroaches have proven to be potential carriers of opportunistic pathogens that cause food poisoning, nosocomial infections, and diseases and play a role as a major source of allergens causing asthma or other allergic diseases. *B. germanica* species is one of the most important hygienic urban pests associated with human public health. At present, environmental problems and insecticide resistance associated with the massive use of chemical pesticides have increasing concern

Impact of the Invention:

Pesticide residues contaminate not only the application site but also offsite. Possible ways of contamination include dispersal of pesticides from application sites, washing waters from clean-up

sites, leaks from storage sites, and improper disposal of pesticides and their containers. Offsite contamination occurs in various ways, including surface runoff water, leaching into groundwater, plant uptake, volatilization, and drift of pesticides through the air.

Pesticides have been applied injudiciously and indiscriminately in agriculture/horticulture and non-agricultural settings to control a wide array of pests in the urban environment worldwide. While applying pesticides on a small scale, particularly in homestead areas, homeowners ignore the doses of pesticides used. Thus, very high doses of pesticides applied unintentionally leave residues that pose a threat to various sections of the urban areas. Also, due to their general use in residential areas.

In this invention, we have developed a gel formulation containing spores of *Metarhizium anisopliae* var *acridium*. When applied to cockroaches, this gel formulation stopped their feeding, leading to mortality within 48 hours.

Insect pathogenic microorganisms are important factors in the biological control of cockroaches because they can cause a wide range of infections in insect populations. Microbial control has many advantages, such as strong host specificity and harmlessness to people and livestock. It is also beneficial for the protection of pests' natural enemies. The pathogenic microorganisms of the cockroach mainly include bacteria, fungi, and viruses.

They enter the insect cuticle directly by infiltrating the hemocoel using a contact mode. Gut symbiotic bacteria play a critical role in defense against pathogens, enhancing the difficulty of biological control. The facultative endosymbionts have the potential to protect against adversaries, including parasitoids, pathogens, and predators.

The present invention provides a novel composition for biological control of cockroaches, and it also increases the mortality rate of cockroaches. The present invention provides the mechanism for controlling cockroaches biologically without any interference from chemicals. The invention relates to the biological control of most commonly found cockroaches. The present invention deals with innovative thought processes with well-documented experimental evidence of controlling cockroaches and other most common household insects. The composition under the present invention comprises Entomopathogenic Fungi and other attractants for the biological control and mortality of the cockroaches.

Commercialization Details:

The product has a huge scope for commercialization. The product is in the process of data generation for commercialization as a Biopesticide for Cockroach control

Photographs:



77. Novel microbial formulation for endosulfan bioremediation and process of manufacturing

Summary:

- Endosulfan is one of the most toxic pesticides and has been widely considered a Persistent Organic Pollutant (POP).
- Endosulfan is acutely neurotoxic to both insects and mammals, including humans.
- In, Kerala, India, Endosulphan spraying became suspect when linked to a series of abnormalities noted in local children's.
- To address this issue, endosulfan-degrading bacteria were isolated from the soil of Kasaragod, Kerala, and a liquid microbial formulation was developed using Burkholderia anything (MTCC 25118) as an active ingredient for degrading endosulfan in soil.
- The developed formulation can degrade alpha and beta endosulfan up to 85%- 95% within 25 days into nontoxic metabolites. It also shows the capacity to bioremediate the soil up to 99% in 30 days after application.
- The developed formulation contains up to 2.0×10^{10} cfu/ml of the endosulfan-degrading bacteria.
- The physiological inducement of isolated bacteria is carried out with several generations of transfer of the Burkholderia, anything from a lower concentration of 100 ppm to a higher concentration of 2500 ppm of endosulfan.

Patent No: 404587

Date of Grant: 25/08/2022

Applicant: International

Panaacea Limited

Inventor(s): Vimala

Prakash, Kaushik Basu



Salient Features:

- The developed formulation can degrade alpha and beta endosulfan up to 85%-95% within 25 days into nontoxic metabolites. It shows the capacity to bio-remediate the soil up to 99% in 30 days after application of the formulation.
- The developed formulation contains up to 2.0×10^{10} cfu/ml of the endosulfan-degrading bacteria.

Problems Addressed:

- Endosulfan is highly neurotoxic to both insects and mammals. Its toxicity causes hyperactivity, convulsions, tremors, staggering, lack of coordination, nausea, vomiting, breathing difficulty, diarrhea, and unconsciousness.
- Endosulfan is believed to be an endocrine disruptor & causes hormone disruption, and reproductive and developmental toxicity.
- Endosulfan adversely affects reproductive and developmental effects on human development.
- Many villages in Kasargod District of Kerala have been severely affected by the exclusive use of endosulfan as a pesticide for almost twenty years.
- Endosulfan was applied to cashew plantations in these villages.
- The boys from the villages had high levels of endosulfan in their bodies, lower levels of testosterone, and delayed sexual maturity & which can promote the proliferation of human breast cancer cells.

Impact of the Invention:

- Endosulfan strongly adsorbs microorganisms, with the majority of the insecticide being associated with the cell membrane rather than the growth medium. Hence, degradation of endosulfan

presumably leads to an accumulation of products within the cell, facilitating further degradation.

- So, we can apply a developed microbial formulation to contaminated sites of Endosulphan to degrade and convert it into nontoxic metabolites.
- Endosulfan degradation by microbes and the commercialization of such products shall help meet the sustainability development goal of 06, which is clean water and sanitization.
- The product shall work on the contaminated soils and convert the toxic form to a nontoxic form.
- This shall further avoid water and soil contamination, which will allow us to achieve sustainable development goals 14 and 15, which are life below water and life on land, respectively.

Photographs:

Different sets of experiment done in preliminary work



Commercialization Details:

The product has a vast scope for commercialization. The product is in the process of data generation for commercialization as a Bio formulation for Endosulphan degradation.

78. A Novel Composite Catalyst System for Eco-Friendly Synthesis of Menthol from Citronellal Rich Essential Oil

Summary:

The present invention is related to the synthesis of menthol from citronellal-rich essential oils. The common citronellal-rich essential oils, such as citronella oil and eucalyptus oil, fetched low prices due to their limited application in household products. Now, the present claim is related to an eco-friendly process for the selective conversion of citronellal compounds of these essential oils to menthol without affecting the other major compounds in a two-step reaction. In this process, the high-value menthol is obtained, and further, it can be purified using column chromatography or fractional distillation. Alternatively, the menthol-rich essential oil is slowly freezing to obtain menthol crystals. Besides, we claim new catalysts such as b-zeolite-Boric acid-Al or g-zeolite-Boric acid-Al or g-Na-zeolite-Boric acid-Al or Ag-zeolite-Boric acid-Al or b-zeolite-Boric acid-Sn or g-zeolite-Boric acid-Sn or g-Na-zeolite-Boric acid-Sn or Ag-zeolite-Boric acid-Sn. All these catalysts are prepared easily through the impregnation method, which effectively converts the citronellal to isopulegol. Similarly, the syntheses of reduced metals (1%Pd or 1%Ru) in activated charcoal or graphene are prepared. These synthesized

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Applicant: CSIR

Inventor(s): Chanotiya

Chandan, Rout Prasanta,

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Kumar



metal catalysts are effective for the conversion of isopulegol to menthol under external hydrogen pressure (10 psi). This reduction is equally efficient using metal catalysts with catalytic amounts of alkali or alkaline earth metal hydrides without external hydrogen pressure. Finally, L-menthol is enriched through esterification of menthol enantiomers followed by hydrolysis.

Salient Features:

We have developed a novel low-cost composite catalytic system comprising zeolite-boric acid-metal chloride catalyst in the ratio ranging from 1:1.5:5 to 1:2:6 and 1% Pd or Ru in activated charcoal or graphene, a reducing metal-based catalyst for complete conversion of the substrate. The process has two steps, starting from the cyclization of substrate molecules into first cyclic monoterpenes alcohol followed by reduction into pharmaceutical importance (1R,2S,5R)-(-)-menthol as the product of interest. Furthermore, in terms of the origin of carbon atoms, we claimed the end product as completely biobased where all ten carbons showed their origin from the present day's photosynthesis process with high ^{14}C content.

Problems Addressed:

(1R,2S,5R)-(-)-Menthol is isolated naturally from the *Mentha arvensis* or *Mentha piperita* (Family Lamiaceae) essential oil through a repeated crystallization process at low-temperature cooling. To date, there are numerous menthol-based consumer products such as food products, chewing gums, mouth fresheners, medicine and syrup, etc. Menthol is also used for the synthesis of menthyl lactate, which has a cooling effect and cosmeceutical application. Unlike (1R,2S,5R)-(-)-menthol, menthyl lactate is a liquid at room temperature, so this property helps it to be used as an ingredient in many household products. So far, the increasing demand has been met by promoting the cultivation of mint such as menthol rich *Mentha arvensis* within the country. Besides the mint plant as a natural source of menthol, various synthesis processes for the preparation of menthol from citronellal and thymol as starting materials have been available in the literature. The commercial production of (-)-isopulegol from (+)-citronellal (synthetic citronellal) with an annual production of more than 1100 tons was reported by Takasago Co. using ZnBr_2 catalyst. Recently, a tris(2, 6-diarylphenoxy) aluminum catalyst for cyclization of (+)-citronellal to (-)-isopulegol is reported by the same company.

In the hitherto known processes, a precious metal catalyst is required to carry out the reaction at a high operating reaction temperature. The present invention overcomes such limitations by using inexpensive catalysts and low operating temperature conditions for the synthesis of menthol. Similarly, most works have been reported using citrals, citronellal, or thymol as starting material. Hence, the reported processes in the present invention might make it easier to convert menthol. As per the knowledge available to date, no research group in India or abroad is working on the semi-synthesis approach. A few papers and patents published by different groups are available, but their process is based on the pure chiral specific (+)-citronellal as the substrate. However, the present process is based on natural, abundantly available citronellal-rich essential oils as the substrate. Therefore, the present process leads to a semi-synthesis of sustainable, natural, identical menthol with the highest purity.

Impact of the Invention:

The industry demand for (1R,2S,5R)-(-)-menthol is increasing because of its multiple usages in food, flavor, and pharmaceutical preparations. Since mint cultivation is governed by various biotic and abiotic factors, it results in stagnation in its production. In addition, the crop is highly water intensive and prone to pests and diseases. Keeping the industry demand for (1R,2S,5R)-(-)-menthol in view, many international chemical

producing companies like BASF, Symrise, and Takasago, etc., have increased menthol production severalfold using petrochemicals as a substrate.

Under the CSIR-Aroma mission, the production of citronellal-containing essential oils (Eucalyptus and Citronella spp.) has increased drastically. Due to the availability of starting low-cost citronellal-rich essential oils, the value addition of these oils is of utmost importance for providing high agro income to our farm communities. Based on the demand and supply gap, we have addressed the production of semi-synthesized menthol from biobased oils or components such as citronellal.

The major challenge arises when this conversion is attempted in essential oils rich in citronellal. The catalytic conversion of the target compound in the essential oil is influenced by the other compounds (present in the essential oil). As a result, either the catalytic active sites have been reduced, or constituents other than the target compound are chemically transformed. Therefore, effective catalysts with selective conversion are of utmost importance in this process for getting better economic returns. The present invention reports the development of effective catalysts for menthol conversion within a complex liquid medium.

Thus, keeping in view the drawbacks of the hitherto reported prior art, we have realized that there exists a dire need to provide a reasonably low-cost composite catalytic system for the conversion of citronellal to obtain (1R,2S,5R)-(-)-menthol. The proposed process is very selective and effective in the case of citronellal-rich essential oils. The endeavor is to develop a catalyst system that effectively converts natural citronellal essential oils into high-quality menthol for sustainable supply to the pharmaceutical industries.

Commercialization Details:

The invention is currently under discussion and deliberation with industries for licensing.

79. A Method for Producing Concrete Using Bottom Ash of Thermal Power Plants

Summary:

The method of concrete production from the bottom ash of the thermal power plant is an innovative solution designed to tackle the global challenge of unregulated and unscientific quarrying of sands from riverbeds for using natural river sand as “fine aggregate” in the production of concrete. Such unregulated and unscientific quarrying of sand further causes unexcepted changes in the river course; increased river erosion, riverbed deepening, and widening; accelerated groundwater depletion; habitat loss for flora, fauna, and communities; reduced

protection against storms; increased flooding, impact on tourism and economic activities, etc.

The patented method offers a sustainable and reliable technique for producing concrete using the bottom ash of thermal power plants. The patented method is the production of high-strength concrete

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**Applicant: CESC Limited,
SDG Consultants**

**Inventor(s): Surajit Basu,
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ParthaGhosh**



from “as available bottom ash” in its entirety, without leaving behind any further residue. Hence, the industrial waste or by-products of coal-based thermal power plants can be 100% recycled and kept confined within the mass of the concrete without the scope of any further environmental implications. By addressing the critical environmental issues, the sustainable, patented method represents a significant step towards achieving the United Nations Sustainable Development Goals 12, 13, 9, and 15 of ensuring sustainable management and efficient use of natural resources; reduction in deep, rapid, and sustained Green House Gas (GHG) emission to Net Zero; increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes; and achieving a land degradation-neutral world.

Salient Features:

The concrete for structural and non-structural applications is produced from the bottom ash of thermal power plants by -

- Using “as available bottom ash, a by-product of coal-based power generation as an alternative for river sand/crushed sand/M-Sand.
- Determine a maximum extent of using the obtained bottom ash as a partial replacement material for natural river sand and/or supplementary cementitious material to prepare a blended material for producing bottom ash concrete based on material characteristics of the obtained bottom ash and zonation of the blended material with respect to natural river sand of a specific zone.
- Prepare the bottom ash concrete mix by including other raw materials based on a mix design derived from material characteristics and the maximum extent of use as available bottom ash. The material characteristics of bottom ash include Particle size distribution, Chemical composition, and Pozzolanic reactivity
- Utilization of coarser particle sizes of the obtained bottom ash as partial replacement of sand/crushed sand/M-Sand and the finer particle sizes of said bottom ash having pozzolanic characteristics as a supplementary cementitious material for partial replacement of cement, where the finer particle sizes contribute towards pore refinement of concrete making the concrete densified, strong, stable and durable.
- The maximum extent of using the obtained bottom ash is determined to be in a range of 15% to 50% to replace the natural sand by volume of the natural sand.
- Based on the pozzolanic properties of the obtained bottom ash, the maximum extent of using the obtained bottom ash to replace cementitious materials was determined to be between 10% and 15% by weight of the cementitious material.
- The novel process uses a specialized admixture to deliver high compressive strength > 50 MPa of the bottom ash concrete, suited to diverse applications of structural concrete or Pavement Quality Concrete (PQC). This technique ensures proper hydration of the coal bottom ash from which the concrete is produced, addressing the other two challenges of high water demand and workability.
- Therefore, the novel process aids in gainfully utilizing the different particle size distribution of “as available bottom ash” during concrete production.
- Coarser particles were suitable for replacing natural sand/crushed sand/M-Sand,
- Finer particles having pozzolanic characteristics aid in reducing cement content and contribute to the pore refinement of concrete, making it densified, strong, stable, and durable.
- Further, specialized admixture is used in the novel process to deliver high compressive strength > 50 MPa of the bottom ash concrete to suit diverse applications of structural concrete or Pavement Quality Concrete (PQC) by ensuring proper hydration of coal bottom ash from which the concrete is produced. Such a technique addresses the other two challenges of high water demand and workability.

Problems Addressed:

The method of concrete production from the bottom ash of thermal power plants tackles several pressing issues outlined in Sustainable Development Goal 12: Responsible Consumption and Production. Firstly, it addresses the sustainable management and efficient use of natural resources by facilitating the use of coal bottom ash in concrete production to reduce sand consumption by up to 50% and provide a sustainable alternative, thereby conserving river sand, which helps in maintaining the river course; groundwater recharging; protection against erosion, storms, and floods; preventing habitat loss of flora, fauna, and communities. Further, the method aids in reducing cement consumption during concrete production as the coal bottom ash possesses pozzolanic properties and reduces demand for crushed/manufactured sand, which is energy-intensive and highly polluting. Furthermore, the method aids in reducing consumption of natural resources, can lower material footprint, and promotes a circular economy.

Additionally, the method's utilization of bottom ash, an industrial waste or by-product of coal-based thermal power plants, aligns with Sustainable Development Goal 13: Climate Action by reducing consumption of cement and/or crushed/manufactured sand, lowering carbon dioxide emissions. By addressing these interrelated challenges comprehensively, the patented method plays a crucial role in advancing the global agenda for sustainable development and ensuring the reduction of Greenhouse Gas (GHG) emissions.

Moreover, the method's utilization of bottom ash aligns with Sustainable Development Goal 9: Industry, Innovation & Infrastructure by reducing the use of sand and/or cement in concrete production using coal bottom ash, which leads to attractive cost savings and ensures enhanced life cycle cost of bottom ash concrete with respect to normal concrete.

Furthermore, the method of producing concrete from the bottom ash of thermal power plants addresses a number of critical issues mentioned in Sustainable Development Goal 15: Life on Land by dispensing with the need to block valuable land in close proximity to thermal power plants for storing unutilized ashes and reduce air, water, and surface pollution of such localities, positively impacting the overall environment, improving human health, and preventing land degradation.

Impact of the Invention:

- In the foregoing background, bottom ash may be used as a partial replacement of sand for concrete production. The illegal extraction of natural sand to fulfill the demand of the construction industry may lead to a man-made disaster. Hence, there is a great opportunity to produce concrete from coal bottom ash as a partial replacement for sand, which may be treated as an alternative and suitable building material. In other words, bottom ash-based concrete may turn out to be one of the green construction materials in the near future.
- The Indian cement industry has been working on its GHG emissions and is trying to bring down the CO₂ emission factor considerably to achieve the goals of the Cement and Concrete Roadmap 2050 for Net Zero Concrete. In that direction, the production of concrete from coal bottom ash will provide the impetus for the industry's journey towards the Nation's carbon net zero journey.
- Our innovative process technology will be one of the most cost-effective, eco-friendly, and sustainable concrete production techniques. This may lead to substantial use of such concrete in road construction, real estate, infrastructure, and Ready-Mix Concrete (RMC). This technology will not only offer an alternative construction raw material but also provide a cost optimization technique that will directly benefit the country.

Through its multifaceted impact, this invention embodies a tangible commitment to several Sustainable Development Goals, including the fundamental goal of protecting the environment.

Commercialization Details:

- We have demonstrated the patented process on the field through successful execution of trial stretches on State Highways of Public Works Department (PWD), Chandrapur Division, Government of Maharashtra. These trial stretches are the country's first public roads laid with bottom ash – concrete. Such trial demonstrates that concrete's compressive strength > 50 MPa is achievable using coal bottom ash, sand consumption in concrete can be reduced up to 50 percent, cement consumption can be reduced by 10 – 15 percent, and the overall cost can be reduced by at least 8 – 10 percent.
- The Respected Director, New Technology for Highway Development, Ministry of Road Transport and Highways (MoRTH), New Delhi, assured that consent would be granted through the appropriate Authority to Concessionaires/Contractors interested in constructing concrete roads using coal bottom ash and the patented process technology as per MoRTH circular dated 30 August 2022.

Photographs:



80. Bio-Degradable Angstrom Voids Polymer (AVP) Matrix and its formulation for a Slow and Sustained Release of Pheromone

Summary:

Bio-degradable Angstrom Void Polymer (AVP) Matrix Gel is a new, unique, and novel organo-inorganic amalgamated matrix formulation developed for the slow and sustained release of pheromones. This innovative formulation leverages the unique properties of microporous and mesoporous zeolites of type 4A, imbued with z-9-triclosan, integrated with a pH-modified Carbopol 940 aqueous gel. This results in a robust sustained-release matrix that acts as an efficient pheromone lure specifically tailored for the entrapment of houseflies, which are notorious vectors disseminating over 60 diseases affecting both livestock and humans. Marketed under the name "Barrix Catch Housefly Trap and Lure," this product

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Applicant: Barrix Agro

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leverages this unique formulation to enhance its efficacy in attracting and capturing houseflies, thus mitigating the health hazards they pose. This device is exceptionally suited for application in environments susceptible to fly infestations, such as Poultry, Cowsheds, Sheep farms, Food process units, Eateries, Hotels, Juice centers, Sweet Shops, Meat Shops, Hospitals, and Surrounding areas of Garbage dump yards, providing an effective means to control fly populations without the need for chemical agents. The "Barrix Catch Housefly Trap and Lure" operates autonomously without the need for electrical power, requiring minimal maintenance while being cost-effective, eco-friendly, and non-polluting. This makes it an invaluable tool in efforts to reduce reliance on chemical pest control methods, promoting a safer and more sustainable approach to pest management in both agricultural and urban settings. The "Barrix Catch Housefly Trap and Lure" not only serves as an innovative and efficient solution for pest management but also aligns closely with the United Nations Sustainable Development Goals (SDGs), particularly targeting SDG 3 (Good Health and Well-being) and SDG 15 (Life on Land). By drastically reducing the spread of diseases and enhancing the health of livestock and human populations, this product contributes significantly to global health security. Moreover, its environmentally friendly and sustainable design supports the achievement of SDG 12 (Responsible Consumption and Production) by promoting eco-conscious pest control solutions. Thus, the Barrix Catch Housefly trap and lure system exemplifies a sustainable, health-preserving innovation that helps forge a path toward a more sustainable and equitable world.

Salient Features:

The eco-friendly pheromone-based housefly trap is a patented innovation offering many environmental and public health benefits. This product efficiently traps houseflies using pheromones instead of chemical sprays, eliminating the need for pesticides and preventing land, water, and air contamination. Its use significantly reduces the reliance on antibiotics in livestock and humans by curtailing the spread of infections transmitted by houseflies. It prevents disease transmission, particularly advantageous in sensitive settings like hospitals and areas near waste processing facilities. Designed for simplicity, the trap requires no power, involves minimal maintenance, and is easy to use.

It is cost-effective compared to traditional pest control methods, providing long-term savings and reducing the need for frequent interventions. Additionally, the trap is safe for humans, animals, and the environment, made from biodegradable materials, and is recyclable, embodying principles of sustainability and safety while offering prolonged efficacy in controlling pests and associated diseases.

Problems Addressed:

The Barrix Catch House Fly Trap is a pioneering solution that directly contributes to the advancement of several Sustainable Development Goals (SDGs). It significantly improves public health and well-being (SDG 3) by effectively reducing housefly populations, known vectors of disease, in various settings, including hospitals, livestock farms, and residential areas. This reduction lessens the need for antibiotics in treating infections, thereby fostering healthier communities. In terms of environmental impact, the trap eliminates the need for chemical pesticides, thus supporting clean water and sanitation (SDG 6) by preventing pesticide runoff into water sources.

Additionally, the Barrix trap indirectly aids in promoting affordable and clean energy (SDG 7) by reducing the energy used in producing and applying chemical pesticides. Its innovative design represents a technological leap in pest control, aligning with industry, innovation, and infrastructure goals (SDG 9). The trap also enhances urban living conditions, contributing to sustainable cities and communities (SDG 11) by controlling pests without the use of harmful chemicals.

Responsible consumption and production (SDG 12) are furthered by the trap's eco-friendly design and recyclability, encouraging sustainable practices in pest management. By avoiding chemical sprays, it helps protect land ecosystems and biodiversity (SDG 15), preventing habitat destruction and pollution. The Barrix trap also plays a role in climate action (SDG 13) by reducing greenhouse gas emissions associated with conventional pest control methods.

Lastly, the Barrix Catch House Fly Trap's development and widespread adoption exemplify the power of partnerships for the goals (SDG 17). It demonstrates how collaboration between businesses, research institutions, and communities can lead to innovative solutions that address multiple sustainability challenges, driving forward the global agenda for a more sustainable and pest-free world.

Impact of the Invention:

The Barrix Catch House Fly Trap and lure developed from this technology has revolutionized pest control with profound benefits for both the environment and public health, significantly enhancing the health of livestock and human populations while protecting land, water, and air quality. By effectively trapping houseflies, known vectors of disease, the trap reduces the reliance on antibiotics in livestock, thus improving animal health and productivity without the adverse effects of chemical resistance. This is especially vital in environments like hospitals and densely populated areas, where reducing disease transmission is crucial for community health.

Furthermore, the trap's avoidance of chemical pesticides prevents contamination of soil and water bodies, maintaining the integrity of ecosystems and ensuring clean drinking water. It also contributes to cleaner air by eliminating the need for aerosol pesticide sprays, which typically release harmful pollutants. Overall, the Barrix trap not only controls pests but also supports sustainable agricultural practices, enhances biodiversity, and fosters healthier living conditions, making it an indispensable tool in modern ecological management and public health strategies.

Commercialization Details:

The Barrix Catch House Fly Trap has successfully transitioned from technological innovation to commercial products, achieving significant market penetration. As of the latest update, over 1.25 lakh units of the trap have been sold, reaching an extensive clientele of approximately 15,000 clients in India and globally across diverse sectors.

These sectors include Livestock segments like poultry, cowsheds, horse stables, piggeries, Food Processing industries, hospitality, healthcare, and residential management, indicating the product's broad applicability and effectiveness in various settings. The trap's widespread adoption by multiple industries underscores its versatility and appeal as a sustainable alternative to traditional pest control methods.

This level of commercial success also highlights the scalability and production capabilities of the technology behind the Barrix Catch Housefly trap system.

Photographs:



Glimpses of WIPO DG Visit





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