



Compendium of Technologies
and Products Towards

SWACHH BHARAT MISSION



एक कदम स्वच्छता की ओर



Department of Scientific and Industrial Research
Ministry of Science and Technology
Government of India
May 2018

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Ministry of Science and Technology
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Disclaimer

All efforts have been made to provide information as accurate as possible. The information is based on the responses received from companies and institutions. Department of Scientific and Industrial Research (DSIR) is not responsible for the accuracy of the same. Although, all possible care has been exercised for its correctness and procedure, however, the DSIR and TERI are not responsible for any inadvertence or any typographical error.

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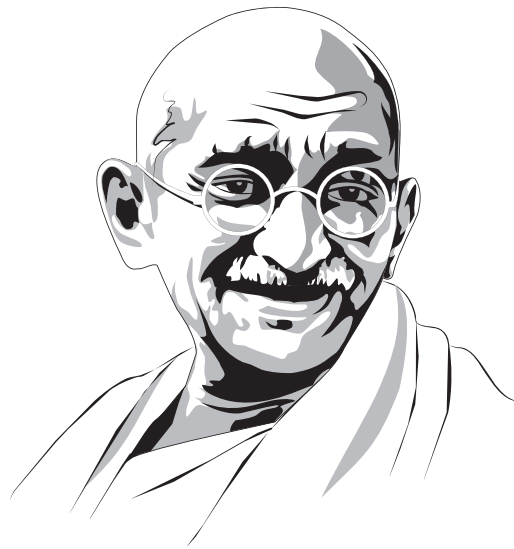
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Swachhta Pledge



Mahatma Gandhi dreamt of an India which was not only free but also clean and developed.

Mahatma Gandhi secured freedom for Mother India.

Now it is our duty to serve Mother India by keeping the country neat and clean.

I take this pledge that I will remain committed towards cleanliness and devote time for this.

I will devote 100 hours per year, that is two hours per week, to voluntarily work for cleanliness.

I will neither litter nor let others litter.

I will initiate the quest for cleanliness with myself, my family, my locality, my village and my work place.

I believe that the countries of the world that appear clean are so because their citizens don't indulge in littering nor do they allow it to happen.

With this firm belief, I will propagate the message of Swachh Bharat Mission in villages and towns.

I will encourage 100 other persons to take this pledge which I am taking today.

I will endeavour to make them devote their 100 hours for cleanliness.

I am confident that every step I take towards cleanliness will help in making my country clean.





Foreword



The Nation under the leadership of Shri Narendra Modi, Hon'ble Prime Minister took a pledge on 2nd October, 2014 to make our country clean and open defecation free by 2nd October, 2019. This transformational journey of cleanliness across the nation requires mass awareness amongst all people, participation, construction/redesign and provision of household toilets, municipal and commercial waste management, zero liquid discharge facilities and waste to wealth interventions.

Above targets can only be achieved by sensitizing and mobilizing every citizen of the nation towards the goals of Swachh Bharat Mission. Under its commitment to Swachhta Mission, DSIR urges to all its stakeholders, in-house R&D units of Industries, not for profit research organizations and CSIR labs/Instts towards intensive participation in all aspects of Swachhta Abhiyan with emphasis on bringing out novel processes and green technologies to achieve the goals of waste management and zero liquid discharge regime at industrial and municipal level.

It gives me immense pleasure to launch Compendium of

Technologies and Products towards Swachh Bharat Mission which brings altogether endeavours of DSIR recognized industries, research organizations and CSIR laboratories towards cleaner technological solutions, those holding potential to be scaled up, disseminated and adopted by various stakeholders and facilitators of Swachhta Abhiyan.

I look forward to many more success stories from our stakeholders that would inspire us to enable and facilitate them to accelerate their R&D and innovative efforts towards Swachh Bharat Mission.

(Girish Sahni)
Secretary, DSIR



Preface



Swachh Bharat Mission was launched on 2nd October, 2014, by the Hon'ble Prime Minister Shri Narendra Modi, to achieve the vision of "Swachh Bharat" by 2nd October 2019, the 150th birth anniversary of Shri Mahatma Gandhi, Father of the Nation.

Since the announcement of the Swachh Bharat Mission (SBM), there has been an increased emphasis on both the current and future possible involvement of the industries and institutions as key partners. The Department of Scientific and Industrial Research (DSIR) has been associated with industries and institutions by way of granting recognition to research and development (R&D) centers of industries and institutions. DSIR and many of its stakeholders have responded strongly to the call for the industries and institutions to act and undertake effective interventions towards SBM.

Some of the industries, institutions, and innovators have brought out innovative products and technologies, which have been implemented at various scales to bring out an impact on the mission of the SBM. Therefore, it gives me immense pleasure to bring out the Compendium of Technologies and Products towards Swachh Bharat Mission, which has been compiled through a questionnaire survey and brings together select innovative products and technologies developed by industries, scientific industrial research organisations (SIROs), and DSIR-supported innovators.

DSIR is delighted to bring out this compendium aimed at being an early attempt to comprehend scope and scale of the sanitation sector from the industry perspective. The report is organized into two sections. The first section showcases the technologies and products developed and implemented by the select companies and SIROs by appropriate use of technology in sanitation; overcome open defecation; effluent water treatment; and waste reuse and recycling and the second section documents innovative profiles and success stories of two organizations in creating zero effluent and clean energy facilities or implementing unique and new models for improved sanitation. The attempt also aims at understanding the current and possible future role of the private sector industry engagement in sanitation service delivery in India, with a view to scaling-up the engagement of the private sector industry.

We sincerely thank the organizations for providing information of technologies developed by them for this compendium. Without their support, this exercise would



not have been possible. The profiles for the 37 technologies/products by private sector industries and not-for-profit agencies that have been documented are based on responses received from these organizations. We are also thankful to the TERI team and TERI Press

for co-editing, designing, and printing of the compendium in a short period of time.

I look forward to many more success stories from our stakeholders that would inspire us to effect change in near future.

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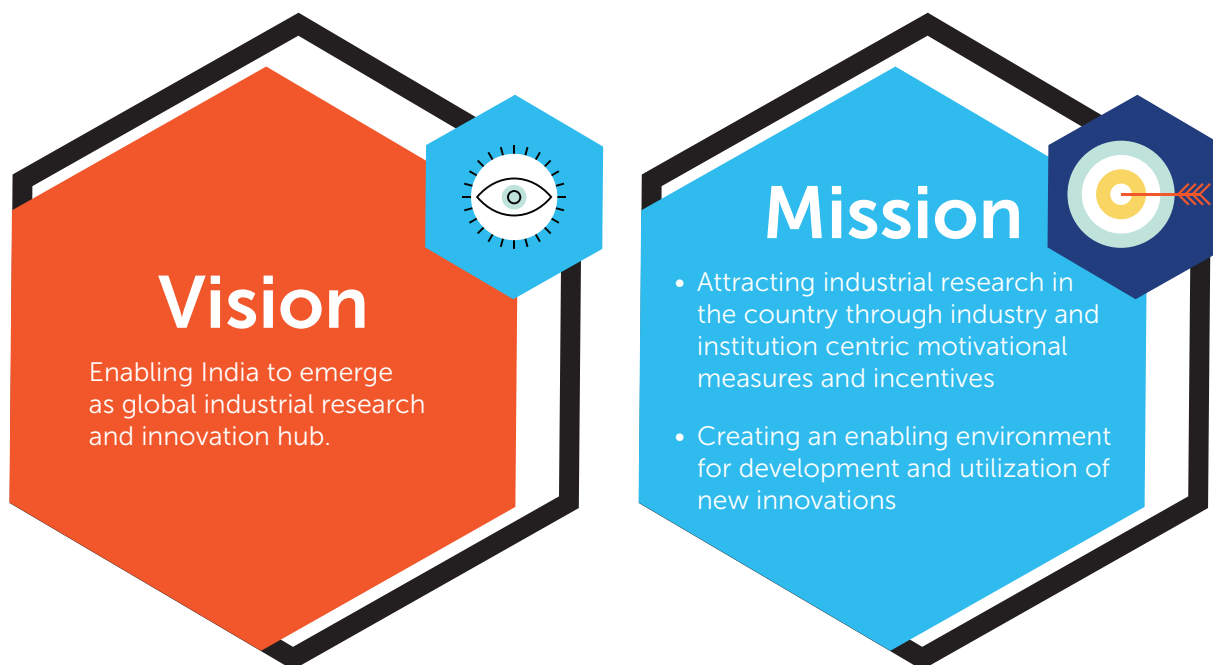


Department of Scientific and Industrial Research: An Overview



The Department under the Scientific and Industrial Research (DSIR), is a department of the Ministry of Science and Technology, Government of India.

The mandate of the department is to promote and facilitate Innovations, industrial research, and technology development.



DSIR has been supporting innovative research projects directed towards improving technological and industrial competitiveness of industries. DSIR Programmes entitled Promoting Innovations in Individuals Start-ups and MSME (PRISM); Access to Knowledge (A2K); Patent Acquisition and Collaborative Research and Technology Development (PACE); and Building Industrial Research and Development-Common Research & Technology Development Hub (BIRD-CRTDH) have been catering to all aspects, concerned with transformation of research to take innovation from mind to market such as:

- Assisting policy makers, researchers, technocrats, and entrepreneurs with innovative research ideas towards setting up of potentially successful knowledge-based companies,
- Supporting and up-scaling of technologies, products, and processes at the proof of concept stage, up to pre-commercialization and providing support for marketing of such technologies for commercial applications.
- Encouraging research and development (R&D) initiatives by the industry and private sector, enhancing industrial R&D activities, and increasing their share and output in national R&D expenditure from the current level.

Further to promote R&D investment and contribution of the private sector in India, the Industrial R&D Promotion Programme (IRDPP), under BIRD-CRTDH scheme of DSIR, grants recognition and



registration to in-house R&D units established by the corporate organizations and industries for boosting the industrial R&D by availing various direct and indirect tax benefits. DSIR supports the industries through implementation of various fiscal incentives like weighted income tax exemption, customs & central excise duty exemption on R&D inputs for scientific research, as announced by Ministry of Finance, Government of India, from time to time.

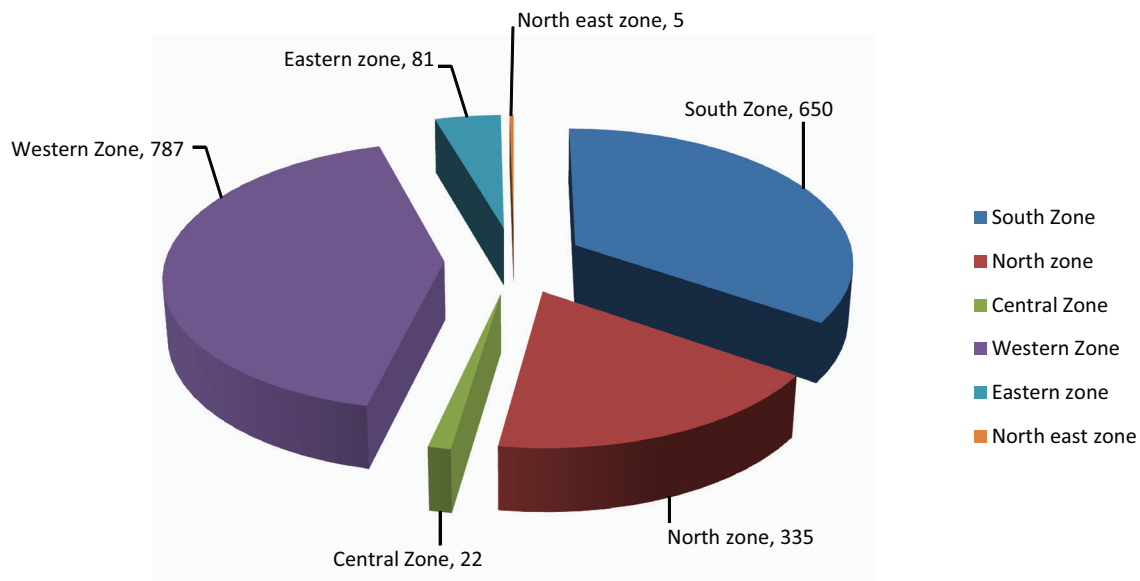
The scientific and industrial research organizations (SIROs) that include functional Societies, Trusts, Section-25 Companies, Universities/Colleges in the areas of medical; agriculture; natural and applied sciences and social sciences are also eligible to avail DSIR recognition and registration. DSIR recognition makes these eligible for availing customs duty exemption on imports and central excise duty exemption on indigenous purchase of essential scientific and technical instruments, apparatus, equipment (including computers), accessories, spare parts thereof and consumables, required for R&D activities.

Thus, a strong science and technology (S&T) infrastructure has been created under IRDPP of DSIR in the country. This covers a chain of national laboratories, specialized R&D centres established by the private and public sector, various academic institutions and training centres. At present, there are 1,880 industries with in-house R&D units and 661 SIROs duly recognized by DSIR with pan-India presence as depicted in the R&D Statistics section.

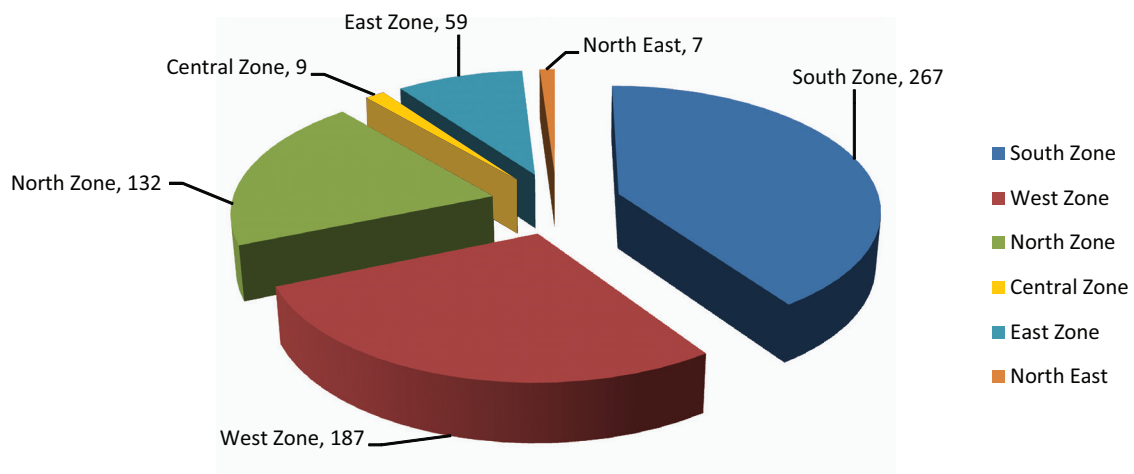
Brief Analysis



Zone-wise distribution DSIR recognized in house R&D units of companies (2016)



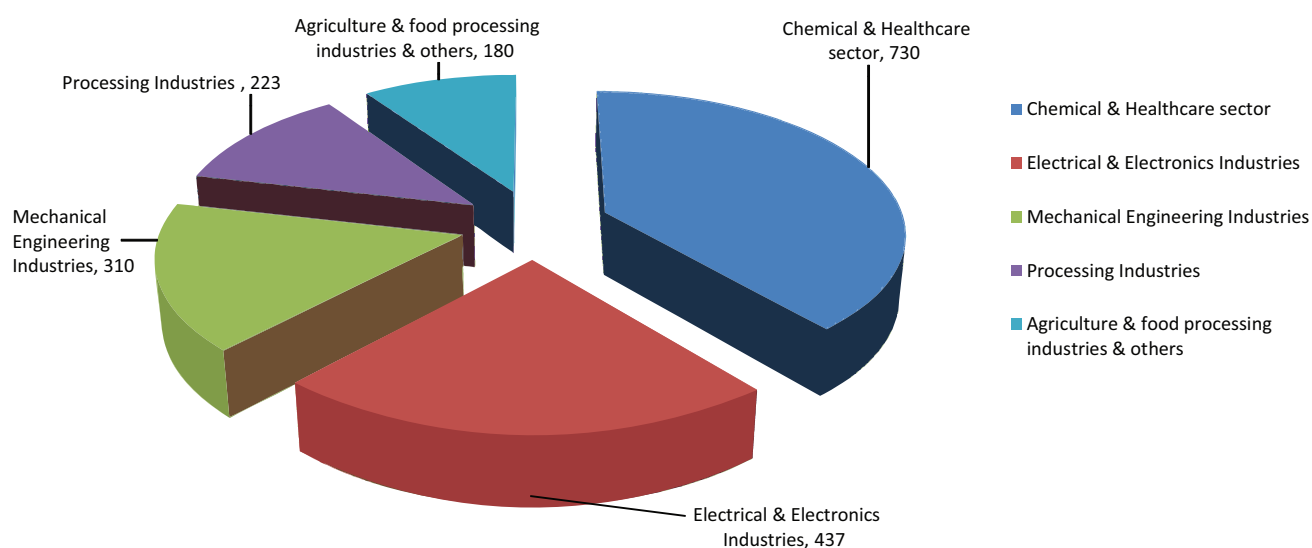
Zone-wise distribution of DSIR recognized SIROs (2016)



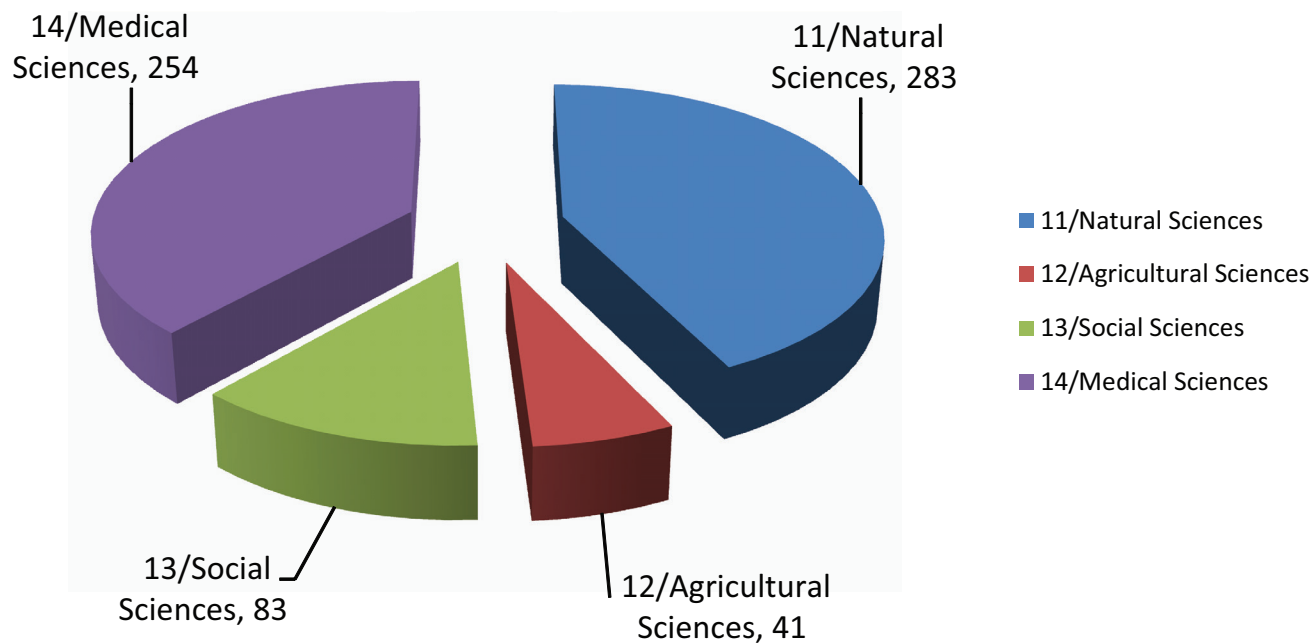
*Description of Zones

- South Zone : Karnataka, Telangana, Andhra Pradesh, Kerala, Tamil Nadu, Andaman & Nicobar, Pondicherry
- West Zone : Maharashtra, Gujarat, Goa, Rajasthan, Daman & Diu
- North Zone : J&K, Himachal Pradesh, Punjab, Haryana, Chandigarh, Uttar Pradesh, Uttarakhand, Delhi.
- Central Zone : Madhya Pradesh, Chhattisgarh.
- East Zone : Odisha, West Bengal, Bihar, Jharkhand
- North East Zone : Arunachal Pradesh, Assam, Sikkim, Manipur, Nagaland, Mizoram, Tripura, Meghalaya

Sector-wise distribution of DSIR recognized in house R&D units of companies (2016)



Sector-wise distribution of DSIR recognized SIROs (2016)



Introduction



The Swachh Bharat Mission was launched on 2 October, 2014 to fulfill the vision of clean India by 2 October 2019 as a tribute to Mahatma Gandhi on his 150th birth anniversary. The Mission is a concerted approach and one of the biggest ever drives to accelerate the efforts towards achieving universal sanitation coverage, improving cleanliness, and eliminating open defecation in the country.

With a vision that Swachhta (cleanliness) is everyone's responsibility and Ministries/Departments of the Union Government can play a substantial role in facilitating it, the Hon'ble Prime Minister, Shri Narendra Modi called upon all Ministries/Departments to bring Swachhta as an element in their schemes and activities so that each of them including the institutions, corporations, and offices under them and their stakeholders can contribute to make this initiative truly effective and real in its objective.

Acting on the Prime Minister's vision, the Ministry of Drinking Water and Sanitation (MoDWS), Government of India, being the nodal Ministry, coordinated with all Ministries/Departments to finalize and collate their Swachhta Action Plans (SAPs). During the financial year 2017–18, 76 Ministries/Departments earmarked funds worth 5248 crore rupees for their Swachhta Plans. Each Ministry/Department has started implementing its SAP from 1 April 2017.

The Department of Scientific and Industrial Research (DSIR) is the nodal department to promote and facilitate innovations, industrial research, and technology development. With an objective to enhance private sector investment in national research and development (R&D), DSIR under its flagship programme, Industrial R&D Promotion Programme (IRDPP), grants recognition to in-house R&D centres of industry and not-for-profit Scientific and Industrial Research Organizations (SIROs). DSIR, under its Swachhta Action Plan, committed to undertake awareness programmes and other campaigns to sensitize and mobilize its associated bodies and stakeholders to participate in the Swachh Bharat Abhiyan.

While observing Swachhta Pakhwada fortnightly from 1–15 November, 2017, as part of the effort of the Government of India to accelerate Swachh Bharat Mission, the Department called upon all its stakeholders, recognized R&D centers of companies, and research organizations (SIROs) to undertake well-planned activities during the Pakhwada. During the process, it was observed that DSIR-recognized research organizations have developed and adopted various technologies that contribute or have the potential to accelerate the endeavours of the Swachh Bharat Mission. It was envisaged that the significant outcomes of their research activities brought out as a compendium will provide useful information for all those working to make the Swachhta initiative a success.

The Energy and Resources Institute (TERI), New Delhi, was requested to take up the job of bringing out the compendium of technologies/ products developed or adopted by DSIR-recognized research organizations (Industry & SIRO) aiming to achieve universal cleanliness under the Swachh Bharat Mission. The main objectives of the compendium are enumerated as follows:

1. To compile the details of innovative technologies and products developed and adopted by DSIR-recognized research organizations
2. To design and develop print ready form of compendium-based technology details for dissemination to a wider audience for adoption and scaling up.

Methodology

The following methodology was adopted keeping in view the approach:

Step I : Primary Survey by DSIR



(i) Survey questionnaire

A survey questionnaire was designed comprising of 7 questions to capture the technological specifications, key features/advantages of the technologies, and their role in the cleanliness drive/roadmap ahead (Annexure I).

(ii) Coverage of Institutions for Data Collection

The target groups for data collection was in-house R&D units of Industries and SIROs recognized by DSIR and solicited to participate in Swachhta Pakhwada from 1–14 November, 2017.

Online survey-For the collection of information collection, questionnaire was also sent to all the concerned organization through email and was also published in an Indian Drug Manufacturing Association (IDMA) Newsletter.

Regular follow-up with the R&D personnel of Industry and organizations was done to collect the information in right format for compilation. No desk research was conducted.

(iii) Categorization of Technologies and Products

The Compendium has been developed based on the survey questionnaire received from DSIR-recognized research organizations and Industry. The responses to survey questionnaire received from DSIR recognized organizations and industries were categorized under the following broad sectors:

1. Information Technology Interventions
2. Open Defecation Free Models
3. Effluent/Water Management
4. Waste-to-Wealth Technologies
5. Energy Efficient Green Processes
6. General Products towards Swachhta

Step II: Constitution of broad-based Project Advisory Committee comprising members from DSIR, TERI, and other departments

Step III: Preparation of Compendium based on the Primary Survey

Conclusion

This compilation of value added knowledge products depicting the various innovative and frugal technologies developed by DSIR stakeholders could be reference point for offering solutions towards the Clean India Mission and will also facilitate translation and scaling up of technology innovations into tenable processes and outcomes. This compendium is an attempt to contribute to the on-going Swachh Bharat Mission of Government of India.

It is imperative for Companies, NGOs, and social organizations to adopt sustainable practices, promote and diffuse similar technologies and products to rural areas, unorganized sectors and small and medium enterprises (SMEs) for enhancing the Swachhta quotient of the nation. In response to a questionnaire survey conducted during Swachhta Pakhwada, 2017, many DSIR-recognized organizations shared their success stories on being a zero liquid discharge (ZLD) facility and in dissemination of Swachhta approaches. Many organizations also shared the strategies adopted to eliminate liquid waste and maximize water usage efficiency. They have also worked on minimization of the building's service energy demand, local production, and the efficient utilization of energy. Two such success stories are being shared in the compendium as a beginning.

As DSIR prepares to implement its strategy based on the output of the compendium, it seeks the active cooperation and contribution by all stakeholders in the Swachh Bharat endeavour of Government of India to make our cities & villages clean, green, hygienic, and open defecation free.

INFORMATION TECHNOLOGY INTERVENTIONS



—“

It is our social responsibility as
citizens of India to help fulfill
Gandhiji's vision of Clean India.

—**Shri Narendra Modi**

”—

An Innovative Smart Garbage Monitoring System



Technical Specifications

Inspired by the concept of 'The Internet of Things (IoT)', researchers at Sri Aurobindo Ashram Trust, Puducherry, have developed an innovative Smart Garbage Monitoring System. It works with an ultrasonic distance sensor that is placed on the interior side of the lid, facing the solid waste. The sensor estimates the amount of trash being disposed in the can. The live data is sent to a micro-controller that processes the data and through the help of a 3G/4G SIM card or WiFi, sends the information to a Mobile App.



Advantages/Key Features

- Provides real-time indication of the garbage level in a trash can at any given time, thus optimizing waste collection.
- Allows trash collectors to plan their daily/weekly pick-up schedule in real-time resulting in maximizing resources.
- The technology provides an automated solution towards detection, monitoring, and management of waste.

Roadmap/Role in Cleanliness Drive

The App visually represents the amount of trash in the bin with a small animation and indicates those bins which have crossed a pre-set threshold limit, thus requiring attention. Once this information is collated through the App, using the GPS locations of each trash can and a third-party web mapping service (such as Google Maps), the shortest and most efficient route to clear all the trash cans, which require attention, can be generated for the garbage truck driver. This will result in better efficiency and significant savings in time, fuel, and on-road traffic, thus contributing to the Government of India's commendable Swachh Bharat initiative.



The Garbage Monitoring System attached to the lid of a small trash can. It can be attached to trash cans of various shapes and sizes.

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BC-300, an IoT-enabled BinConnect Solution



Technical Specifications

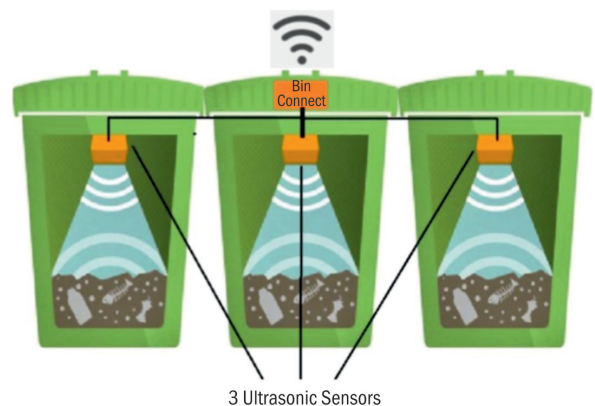
BinConnect is an intelligent product fulfilling the requirements of a Smart City Solid Waste Management. The BinConnect, a battery operated device, has an in-built GPS module that can be used to track the position of mobile bins. Additionally, it has an in-built temperature sensor and an optional RS-485 port that can be used for integrating weighing scale data. All these parameters are made available on the cloud. Frequency of data transmission to the cloud is user configurable. Whenever the bin is 100% full, data is immediately transmitted. BinConnect comes with IP65 grade enclosure, thus making its operation waterproof.

Advantages/Key Features

- Ultrasonic fill level sensor for garbage bins
- GPRS/GPS based-communication gateway
- Application software to provide garbage bin location and garbage level details on cloud /central server
- 24X7 access through BinConnect cloud services
- 3.6 V high performance primary lithium battery

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Automation of Hygienic Drinking Water Supply Using Wireless Sensor Networks



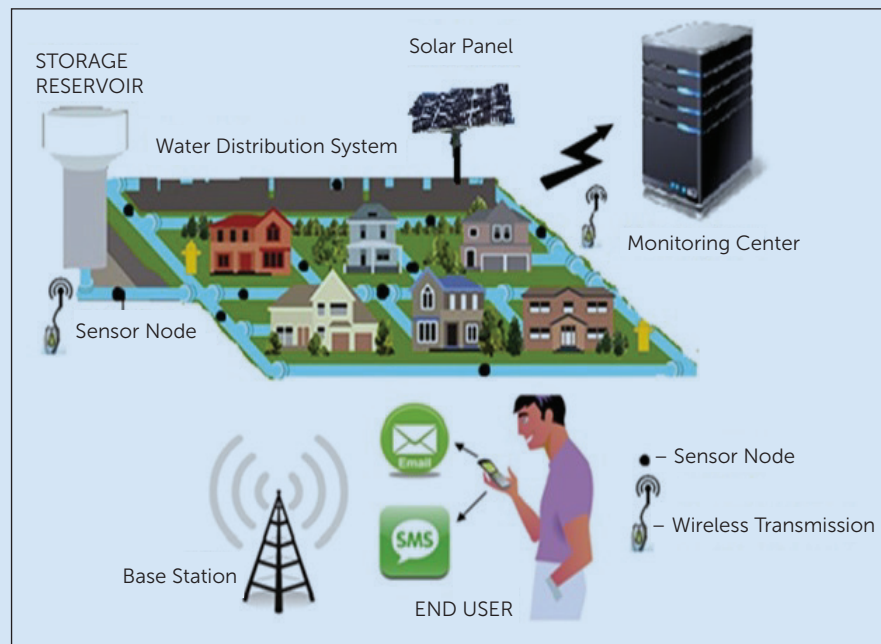
Technical Specifications

Determining the consequences of a water contamination event is an important concern in the field of water systems security and in drinking water distribution systems. MEPCO's Drinking Water Distribution System/s facilitate the transportation of portable water from water resources, such as reservoirs, rivers, and water tanks to industrial, commercial, and residential consumers through complex buried pipe networks. As the water distribution network is in a remote location, the lifetime of the wireless sensor networks is a major concern. An energy harvesting sensor network is also used wherein sensors are powered by solar energy for energy scavenging of the nodes deployed inside the water pipelines. This supports the additional energy consumption and balance the network connectivity in order to improve the network lifetime. Besides, an Energy Aware Multipath Routing Protocol has been proposed to prevent the water flow when contamination is detected in a particular pipeline region without interrupting the other water supply regions in the water distribution network.

A patent has been filed on the title *"Real Time Water Quality Monitoring in Water Distribution Mains using Wireless Sensor Networks"*

Advantages/Key Features

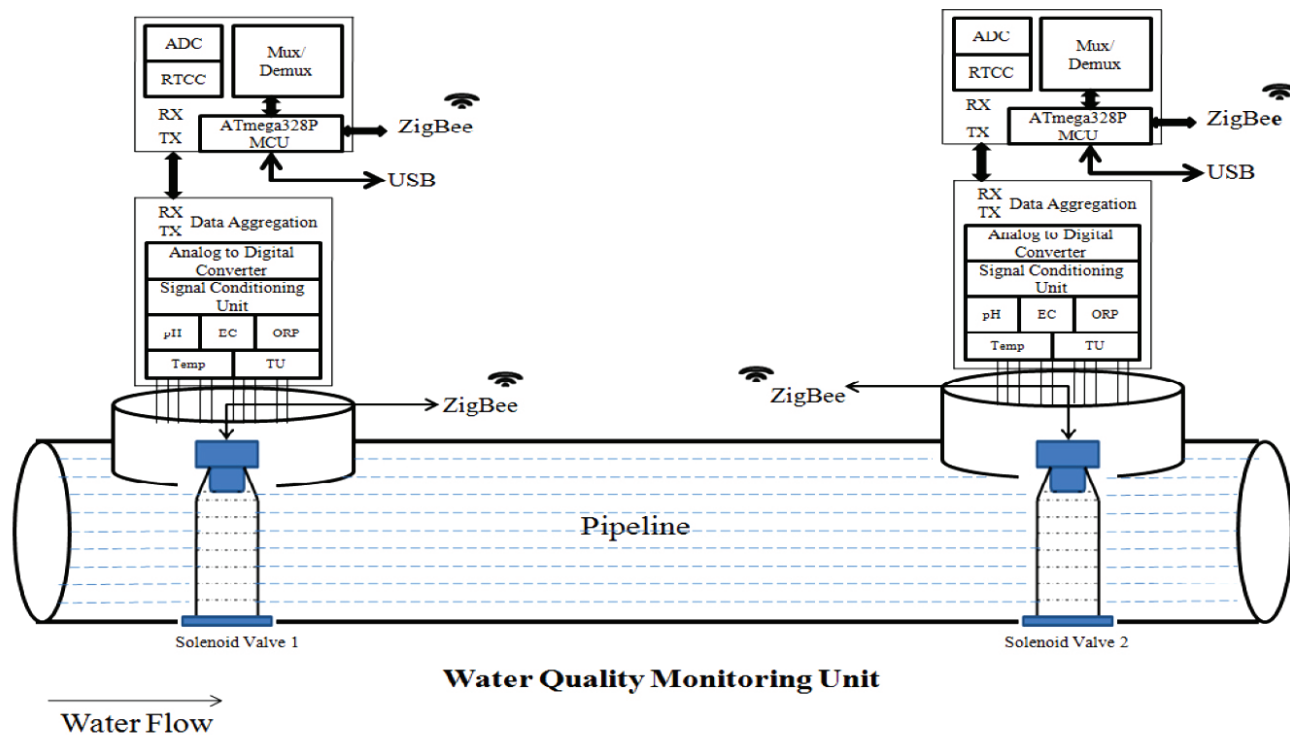
- An Energy Aware Topology Control Algorithm aims to construct energy efficient networks
- The approximation algorithm maximizes the spatial data correlation among sensors
- The fuzzy rule descriptors are applied to predict the water quality as desirable/acceptable/rejected for drinking with better accuracy.
- Shortest path routing and fast data transmission algorithm will report the water quality to the users quickly
- The use of event detection algorithms will assess the water contamination risks when anomalies are detected in the water supply pipes and alert the consumers/houses in the water-contaminated regions
- The (proposed) water quality monitoring system checks for water quality parameters, such as pH, temperature, turbidity, oxidation-reduction potential, electrical conductivity, *E. coli*, and dissolved oxygen in the drinking water supplied through pipes by the municipality in a fast and efficient manner.



Role in Cleanliness Drive

MEPCO's automation of the drinking water supply system is aimed at achieving the objectives of the Swachh Bharat Abhiyan and bringing about an improvement in the general quality of life of the people. As is well-known, around 20% of communicable diseases are spread by drinking unhealthy water. The main cause of the waterborne diseases is the pathogenic microorganisms that are directly transmitted upon consumption of the contaminated water. Hence, a novel Internet-of-Things (IoT)-based technique to monitor the water quality of drinking water distribution systems at consumer sites is the broad idea behind MEPCO's automation process.

MEPCO has forwarded proposal to local corporation office to deploy the proposed system in the local distribution tank in the Amathur region of southern Tamilnadu.



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OPEN DEFECATION FREE MODELS



“

Swachh Bharat Mission-Gramin:
Committed to Make India
Open Defecation free by 2019.

”

Low Cost, Affordable, and Hands-free Flushing Technology



Technical Specifications

In order to address the issue of open defaecation, especially in rural India, CSIR-National Environmental Engineering Research Institute (NEERI) developed an 'Automatic Mechanical Urinal-Toilet Flusher' actuated mechanically without any electronic/electrical part. It consists of a bulged portion acting as a temporary water reservoir with the cross-section of inlet and outlet of the pipe, in conformance with the shape mutually connected inlet and outlet. When a person stands for using the urinal toilet, the pre-specified quantity of water automatically gets loaded in the temporary water reservoir and when the person leaves, the water collected in the reservoir automatically dispenses the water into urinal toilet, that is, flushes specified quantity of water in the urinal toilet.

Advantages/Key Features

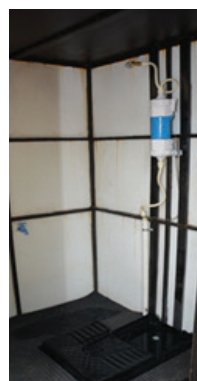
- Automatic, regular, compulsory and unintentional flushing
- Customized and retrofitted in existing and new urinals
- Needs 'NO' electronic/electrical operation/components
- Low cost and affordable for rural areas
- Helps in water conservation

Roadmap/Role in Cleanliness Drive

Dirty, stinky, and unhygienic urinals in rural and urban areas in the absence of regular cleaning and flushing leads to reluctance of people towards public toilet usage and is one of the major reasons for open defaecation in areas even with toilet facilities. This technology addresses these problems as automatic-regular-compulsory and unintentional (right amount of water) flushing leads to improvement in the health, hygiene, and sanitation in urinal-toilets as well as helps in water saving (water conservation). Touch-contact free flusher operation eliminates the exposure to disease-causing bacteria that can occur when users operate manual flush fixtures. The technology is very useful for Government of India's 'Clean India Mission' because it is a low cost and affordable flushing technology for improving sanitation and hygiene in rural areas. CSIR-NEERI has also filed international patents for the product.

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Ladies Urinal Unit
(Low Cost PVC
Model)



Gents Urinal Unit
(With cover box for
public places)



High End Stainless
Steel Model

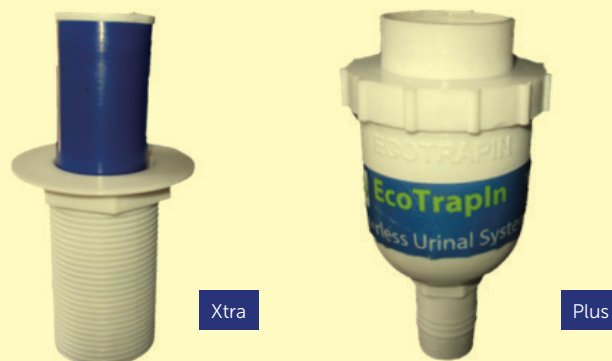
EcoTrapIn, a Waterless Urinal



Technical Specifications

EcoTrapIn (patent technology), a waterless urinal, is a project for ergonomic and pro-environmental product that tackles water scarcity and sanitation. This retrofit green technology converts conventional urinal into waterless, saving 167,900L of potable water annually per urinal, thus promoting water conservation. The no-flushing trap technology prevents reaction between urine and water; hence the urinal is free

from foul smell, scale formation, and drain pipe blockages. The two products are described as follows: *EcotrapIn Xtra*: Gets fitted at the base of urinal bowl and consists of an inlet and outlet anti-bacterial cartridge through which urine passes and seals the outlet once the urine is drained out. *EcotrapIn Plus*: Gets fitted below the urinal bowl and consists of an antibacterial inlet/outlet through which urine passes and a float that seals the outlet once urine is drained out.



Advantages/Key Features

- Ergonomic and extremely hygienic and recyclable
- Moist free and odourless washroom experience
- Easy installation and maintenance
- Substantively reduce the environmental burden with significant cost savings by slashing water and utility bills by 99%
- No sensors required and, therefore, saves power
- No fittings are required as there is no need of inlet water pipeline in case of new construction

Roadmap/Role in Cleanliness Drive

Since EcoTrapIn clean technology curbs ammonia formation, malodour, and harmful bacteria cultivation that converts conventional urinal into waterless urinal it has an important role to play in the cleanliness drive launched by the Government of India. As there is no foul smell produced from urine, people will be encouraged to use these urinals. This touch-free green product's cost is ₹8/day with the savings of 90% in utility bills, namely, water charges, cleaning agent, plumbing/repairing service, electricity/battery, etc.

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Innovative VIKASA Model



Technical Specifications

As an improvement on the conventional sanitation system and after making structural changes, the cost effective & efficient models of (i) ECOSAN system and (ii) the Defence Research Development Organization (DRDO) inoculum bio-digester system evolved. In the modified systems, the efficiency of decomposition has been enhanced by introduction of earthworms, filters, and plants around the units. In order to ensure the decomposition of organic matter, the following two methods are in practice:

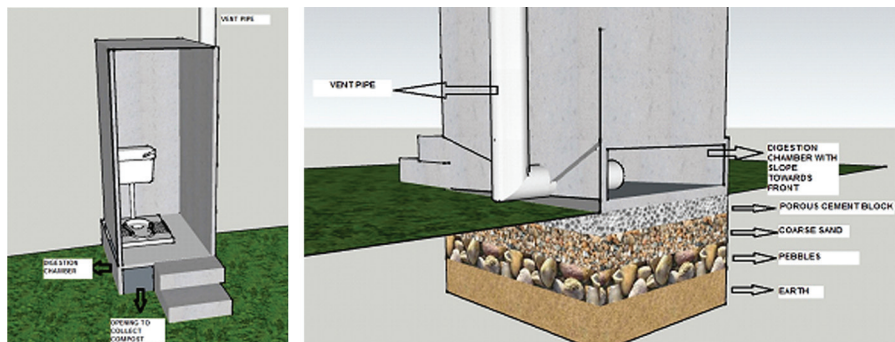
- ECOSAN model—Aerobic process combined with wormy-composting (earthworms)
- Bio-digester (DRDO)—Anaerobic process with microbial inoculums (developed by DRDO)

Advantages/Key Features

- Ensures complete sanitation of the environment
- Decomposition of waste by an organic process
- Conversion of all waste into wealth—organic manure
- Cost-effective at the national level

Roadmap/Role in Cleanliness Drive

The organization envisages future partnership with the government programmes and voluntary distribution of the pre-fabricated model for benefit of the poorer sections of society.



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Ecological Sanitation: The Dharma Rao Model



Technical Specifications

The Dharma Rao model is an extension of ECOSAN model tank and the Defence Research Development Organization (DRDO) septic tank model enabling separation of fecal material and urine with a special type of water closet.

In the Dharma Rao ECOSAN model toilet, a perforated sand filter is provided beneath the fecal decomposition chamber which allows water to percolate down leaving behind only fecal matter for aerobic digestion by drying and oxidation. Most importantly, introduction of earthworms into the fecal decomposition chamber further accelerates the decomposition process and destruction of pathogens and the decomposed compost matter can be used as manure and realizes the objective of conversion of waste to wealth. In the Dharma Rao system the faecal materials gets dried up easily as after every use as it is proposed to add either saw dust, ash, lime or some fine earth which increases the rate of bio-digestion and it is converted as compost. As sterile urine can be used directly on crops, adding a design aspect which diverts urine to prevent contamination with faeces has also been conducted.

Several studies on vermi-composting of human faeces for nutrient recycling examined the suitability of vermin-composting technology using earthworms for processing source-separated human faeces. The vermicompost produced showed an average vermicompost production rate of 0.30 kg-cast/kg worm/day with complete inactivation of pathogens.

Advantages/Key Features

- Decomposition occurs under either aerobic or anaerobic conditions therefore no odorous gas emission or pathogens remain.
- The groundwater is not affected as digested effluents are converted as compost and pathogen free liquid fertilizer also allowing more water saving.
- Suitable for use in all soil conditions
- The system is largely dry and does not breed mosquitoes. Hence, there are no odour or insect issues.
- No sludge build-up as composting takes place within a short period of two months.
- As footprint for bio-digester is low, the land requirement is less.





- The operation and maintenance costs are negligible and high value organic manure is generated for use.
- Earthworms promise to provide cheaper solutions for handling human waste. Their body works as a bio-filter and they can purify, and also disinfect and detoxify the solid waste. Earthworms not only create a biological mechanism to eliminate pathogens, but also provide a suppressive environment to down-regulate pathogenicity of harmful microorganisms and induce mineralization of organic matter.

Roadmap/Role in Cleanliness Drive

This technology adopts a multi-pronged approach to change the face of Indian sanitation facilities. Bioclean® BD is accredited by Dr Mashelkar Committee, Ministry of Drinking Water and Sanitation. The technology has been used extensively by the Indian Army, Svadha, Brihanmumbai Municipal Corporation (BMC), Navi Mumbai Municipal Corporation (NMMC), Municipal Corporation of Greater Mumbai (MCGM), SMC, INTEXTb, L&T, Tata Housing, Shapoorji Pallonji Estate, and many other organizations.

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Bioclean® BD—A Natural Biotech-based Solution for Sanitation Issues



Technical Specifications

Bioclean® BD, a specialized formulation, aims to end sanitation issues, such as emission of foul odour, clearing clogged drain lines, and suppression of diseases, by enhanced production of hydrolytic enzymes, which enhances acid formation, acetate formation, and methane formation.

Bioclean® BD forms the heart of bio-digester tanks. The efficacy of the cultures constituting the formulation ensures that faecal sludge is treated optimally and only treated water is released in the environment, thereby reducing the requirement of specialized sewer lines. In addition, the size of the tank is reduced considerably, thus making the process of installation of toilets in slums easier. Bioclean® BD is a natural biotech-based solution which can be easily used in community toilets, individual household toilets, pit latrines, twin toilet models, and bio-toilets and is effective in maintaining better water quality and reduced sludge volumes. A pilot project has been successfully completed at Rann of Kutch for sewage remediation and reuse of water for irrigation.

Advantages/Key Features

- Digester tanks are feasible to be installed in small houses and rural areas
- Provides solution for the toilets that demand on site degradation
- Aids in restoration of defunct toilets without any structural modifications
- Effective over a wide range of temperature (4 °C–55 °C) and pH
- Behavioural modification due to reduction of sludge volumes and odour reduction
- Suppression of communicable diseases (especially cholera-causing pathogens)
- Significant odour control and enhanced anaerobic digestion

Roadmap/Role in Cleanliness Drive

This technology adopts a multi-pronged approach to change the face of Indian sanitation facilities. Bioclean® BD is accredited by Dr Mashelkar Committee, Ministry of Drinking Water and Sanitation. The technology has been used extensively by the Indian Army, Svadha, BMC, NMMC, MCGM, SMC, INTEXTb, L&T, Tata Housing, Shapoorji Pallonji Estate, and many more.

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UV Sanitizer



Technical Specifications

The usage criterion of the UV Sanitizer is based on germicidal lamp which produces UV-C light. The germicidal lamp, controlled using microcontroller for better usage and safety, transmits ultra-violet light in a spectral band that is effective for sterilization. The UV-C wavelength of 254 nm will inactivate bacteria, viruses, mold, and cysts by preventing DNA replication and thus, can protect from infections. In order to protect from UV-C exposure, tilt sensors have been provided to protect the users from UV light exposure. The *protective sensors protect the user if the lamp is rotated towards the face or if the device is away from the surface area.*



Advantages/Key Features

- Effective disinfection over the useful lifetime of the lamp ensures high system efficacy
- Environmentally-friendly as it does not rely on chemicals or filtration materials and therefore can be used effectively and safely for many applications, such as hand held gadgets, hospital beds, hotels, toilet seats, kitchen surfaces, and door handles.
- Best sterilizing properties
- Light weight and handy to use
- Presence of safety sensors protects the user
- Sleek design ensures easy grip

Roadmap/Role in Cleanliness Drive

A proven technology for the destruction of air-borne bacteria, viruses, and mold spores, the UV Sanitizer with its widespread application in hospitals, hotels, washrooms, door handles, and the kitchen in homes, presents a ready to use product that ensures all round sanitation and furthers the objectives of the Swachh Bharat Mission such as cleanliness and bringing an end to the endemic sanitary problems in the country.

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Malodorex Activ (MXA)— Sustainable Sanitation



Technical Specifications

Malodour causes problems with respect to both health and aesthetics. Removal of malodours is a prerequisite to successful tourist trade, pleasant dining, and the perception of cleanliness in hospitals and clinics and in providing a generally healthy atmosphere.

Praras Biosciences Pvt. Ltd has developed a technology where chitosan nanoparticles are used to entrap fragrance molecules to ensure sustained release of fragrance. These nano-complexes are then added to a suspension of non-pathogenic bacterial consortium which can breakdown malodour causing compounds, thus providing a dual action by breaking down malodourous compounds as well as giving out sustained freshness for long term malodour management.

Advantages/Key Features

- MALODOREX-ACTIV is a liquid concentrate of bacterial consortium adept in malodour management and commercial fragrance
- Microbial enzymes work synergistically by decomposing the malodour compound. Simultaneously, fragrance is released in the environment
- Fragrance lasts up to 3 hours
- To achieve sustained release of the fragrance over longer period, polymer nanotechnology was applied

Roadmap for Technology Adoption

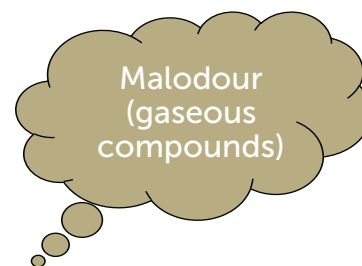
Stages to commercialization:

1. Synthesis, characterization, toxicity studies of chitosan fragrance nanoparticles (MXA-SLR), and studies of fragrance release—1 to 6 months
2. Application studies to various public places—7 to 12 months
3. Promotion of product by advertisement and marketing—13 to 18 months

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Zinc Ricinoleate (Jagrosorb-ZR) – Solution to the Bad Odour Trapping



Technical Specifications

Jagrosorb-ZR helps in trapping bad odours (in decreasing order) generated from following substances:

Mercaptans | Thioethers | Amines | Bacteria | Proteus Vulgaris | Aldehydes

Small molecules and low-branched molecules are trapped better compared to large organic compounds with highly branched structures. Polyaromatic or strongly substituted aromatics e.g. esters, alcohols and ketones are not trapped. This information is used in formulating Jagrosorb-ZR into various formulated & perfumed products as most of these products contain these ingredients.

Zinc Ricinoleate is derived from renewable resource (Renewable content > 90%). It is an odour neutraliser.

It can be formulated as a water-miscible or alcohol miscible product that can be used as a spray over garbage bins, garbage trucks, toilets, floors, carpets, animal houses, plastics recycling or can be added into clothes detergent formulations to eliminate the bad odour.

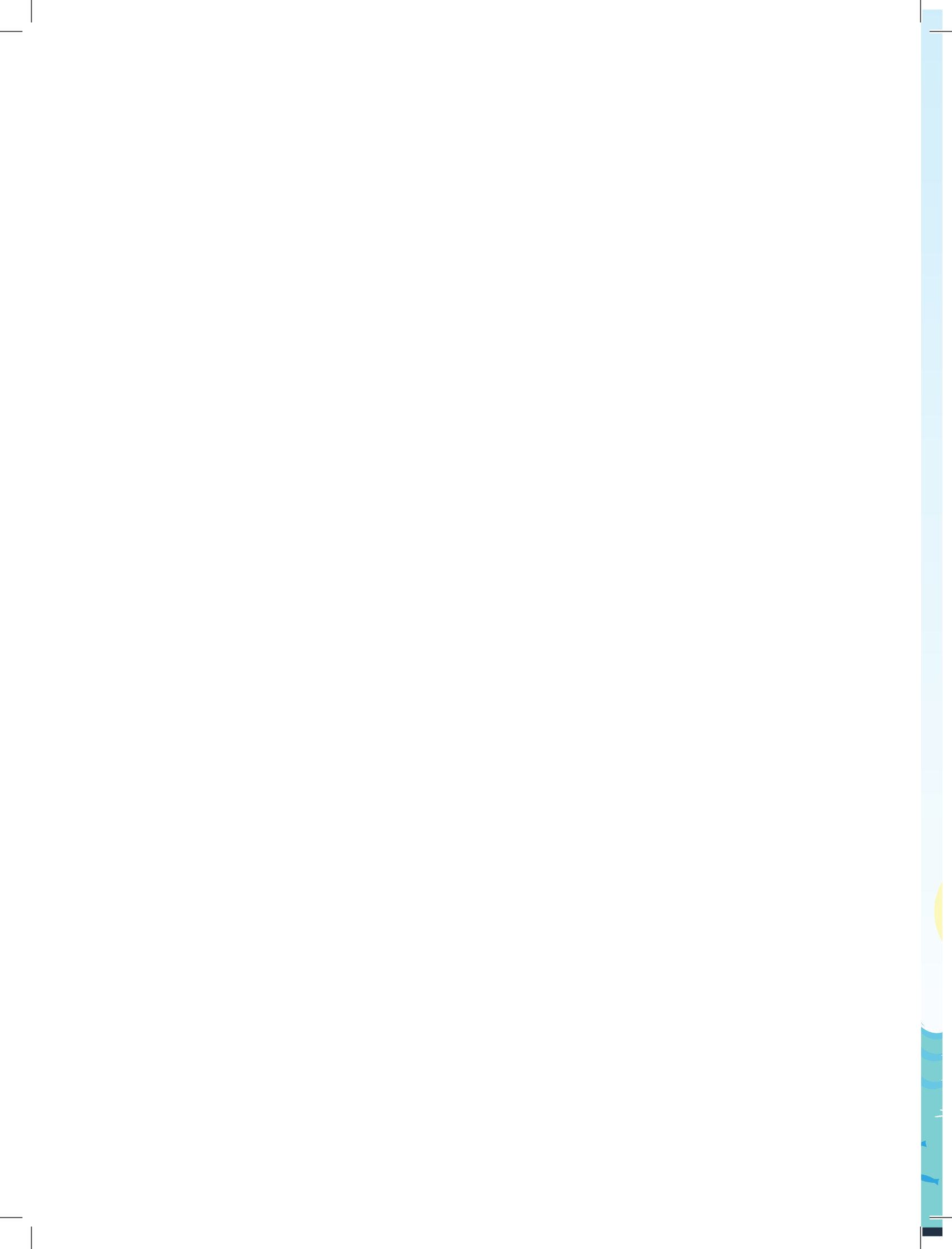
Advantages/Key Features

- Jagrosorb-ZR is true odour remover and not a masking agent like perfumes
- It has a long-duration odour reduction
- Jagrosorb-ZR helps in keeping bad odour under control and thus, helps to maintain garbage/waste area odour free
- Aids in ensuring a clean environment

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EFFLUENT/WATER TREATMENT



Phytorid Technology for Sewage Treatment



Technical Specifications

Council for Scientific and Industrial Research-National Environmental Engineering Research Institute (NEERI) or CSIR-NEERI developed the Phytorid technology, which is a constructed wetland exclusively designed for the treatment of municipal, urban, agricultural, and industrial wastewater. Normal plants, such as Cattails, Reeds, Cannas, and Yellow flag iris, including filtration and treatment capability are used in development of the technology. Recommended for decentralized plants with varying capacities of 5000 L/day to 8–10 MLD, the technology does not require usage of any chemicals or electricity.



Advantages/Key Features

- The technology is cost-effective insofar as the operation and maintenance expenses (energy and supplies) are negligible
- Ensures preservation of natural water resources such as lakes, rivers, and marine ecosystem
- Treated water quality meets the norms for disposal on land or water as prescribed by the Central Pollution Control Board. The treated water can be reused for gardening, road washing, toilet flushing, irrigation, etc.
- Phytorid is a sub-surface flow method and thereby there is no exposure of sewage on the top, no water clogging, and no mosquitos
- The use of improved hydraulic and bio-media culture in phytorid leads to usage of minimal space in case of as compared to other wetlands
- Phytorid essentially uses leakage free RCC construction avoiding contamination of ground water by seepage
- The capital cost of the Phytorid is similar to other technologies and in some cases even less than 20%.

Role in Cleanliness Drive

The treatment technology is being utilized at several places across the country, including the Lonar Lake, Rajyapal Bhavan, Maharashtra, and Shahdara Lake, New Delhi, preventing water pollution. With more than 100 plants installed with various capacities, Phytorid is providing approximately 5,000 million liters of treated water for reuse. Two international patents have also been granted for this know-how—Australian Patent no. AU 2003223110 A1, 2005 and European Patent no. WO2004/087584A1, 2005.

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Electrochemical Drinking Water/ Waste Water Treatment Systems



Technical Specifications

The R&D facility at TitaN has developed the Electrochemical Sewage (RT Pure) and Effluent (RT Eco) Treatment Systems, principally operating on electrochemical treatment technology supported by few selected pre-and post- treatment components that aid in polishing the treated water, facilitating safe reuse of the treated water. The technology outcomes conform to the environmental discharge limitations of most of the countries. The electrochemical treatment comprises two major processes, that is,

1. Electrocoagulation where coagulant is generated in situ
2. Electrooxidation wherein the contaminants/pollutants present in the sewage are oxidized

Advantages/Key Features

Technological

- Low sludge generation
- Removal of multiple pollutants
- Allow treating high salty waters

Process

- Low operation costs

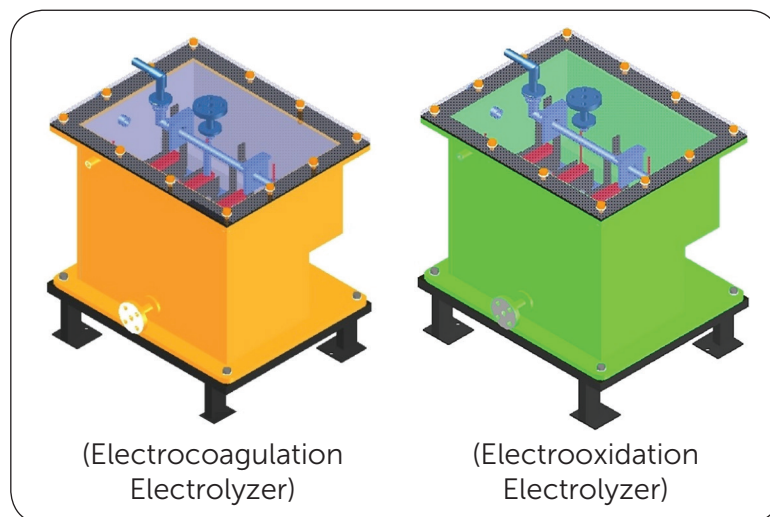
- Possible continuous and online treatment for large scale application
- Self-cleaning and easy maintenance

Structural

- Small footprint
- Modular system and easy expansion
- Possibility of mobile treatment plants

Role in Cleanliness Drive

The technology can be exploited to treat sewage emanating from domestic, commercial, and community sources. In addition to providing a dependable, locally-controlled water supply, water recycling provides remarkable environmental benefits such as ways to decrease over exploitation of water from sensitive ecosystems and prevent pollution. The eco-friendly systems have been successfully commercialized worldwide.



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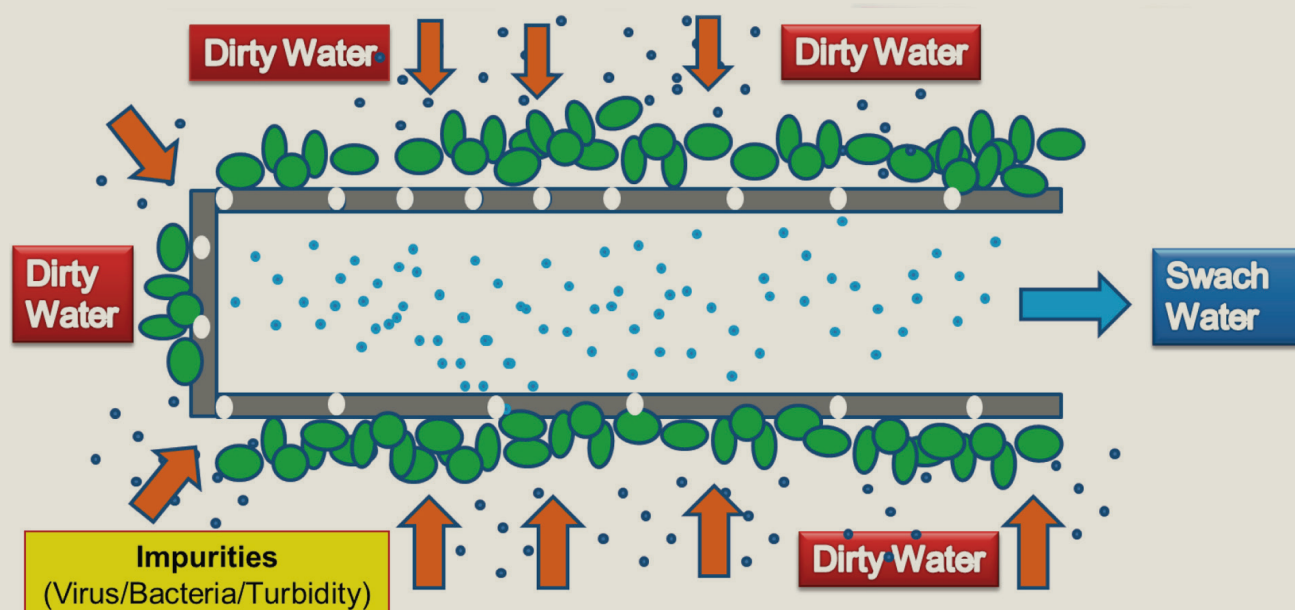
Tata Swach—Point of Use Water Purification Products



Technical Specifications

Tata Swach, developed at TATA Chemicals Ltd's DSIR-approved in-house R&D facility, the Innovation Center in Pune, is a trusted name in producing revolutionary water purifiers. Amongst the advanced technologies, organic rice husk ash embedded with nano silver particles as purification media is the first breakthrough in the water purification industry, through which Swach purifiers started their journey in 2009. The purification principle in these purifiers is based on Nano silver with Tata Swach reverse flow (TSRF) technology. At the initial stage, macro particles are trapped by a non-woven mesh and clarified water enters the purification cartridge, that is, the bulb. The fast action ultra-light Tata Swach bulb, the heart of the purifier, is able to remove 99.9999% bacteria and 99.99% virus from contaminated water, thus complying with the USEPA norms.

In addition to TSRF and nano silver purification, Tata Swach also implemented occlusion based microfiltration in conjugation with bulb in Silver Boost purifier. The silver Boost with microfiltration membrane is capable of removing 99.9% protozoan cysts along with bacteria and virus and stands as the most efficient purifier at standard price point. With advancement in water purification arena, Swach team have recently developed occlusion based anti-biofouling ultra-hollow fibers (UHF) which is able to work on minimal gravitational pressure being world's first desktop model ultrafiltration purifier- Tata Swach Desire plus. The sleek futuristic design of the UHF cartridge comply NSF norms and occludes the minutest particles, pathogens- the viruses from input water, thus rendering the output completely safe for drinking upto a volume of 6000 liters.





Advantages/Key Features

In addition to TSRF and nano silver purification, Tata Swach also implemented occlusion based microfiltration in conjunction with bulb in Silver Boost purifier. The silver Boost with microfiltration membrane is capable of removing 99.9% protozoan cysts along with bacteria and virus and stands as the most efficient purifier at standard price point. With advancement in water purification arena, Swach team have recently developed occlusion based anti-biofouling ultra-hollow fibers (UHF) which is able to work on minimal gravitational pressure being world's first desktop model ultrafiltration purifier- Tata Swach Desire plus. The sleek futuristic design of the UHF cartridge comply NSF norms and occludes the minutest particles, pathogens- the viruses from input water, thus rendering the output completely safe for drinking upto a volume of 6000 liters.

Role in Cleanliness Drive

With a vision of providing safe drinking water to 5 million households in 5 years, Tata Swach commits to reduce water-borne diseases and alleviate the health and livelihood of the rural and urban Indian population. The easy installation and negligible maintenance cost of the purifiers lead to offering safe drinking water to the masses with per liter purification cost less than 10 paise, thus, making it the most affordable water purifier.

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Ethylene Oxide Abatement System



Technical Specifications

Pure ethylene oxide (EtO) and its admixtures (carbon dioxide [CO₂] and nitrogen [N₂] as diluents) are the popular sterilants used by pharmaceutical/cosmetic industries and agro-Industry. Post-exposure, the spent gases are exhausted to the atmosphere. Highly toxic in nature, EtO is classified as a mutagen and possible carcinogen and therefore spent gases must be effectively disposed to prevent possible human and environmental exposure. Developed



as a first in the subcontinent, the ethylene oxide abatement system is a process that traps spent gases and converts them into a safe and stable form such that these are not environmental hazard.

Advantages/Key Features

The ethylene oxide abatement process provides:

- Sustainable industrial effluent management technology
- Eco-friendly solution to sterilization of disposable medical products and devices, a variety of associated products/packaging material, raw material for pharmaceutical/cosmetic industries, agro-produce, such as herbs, spices, etc.
- This process is a first in the sub continent.

Role in Cleanliness Drive

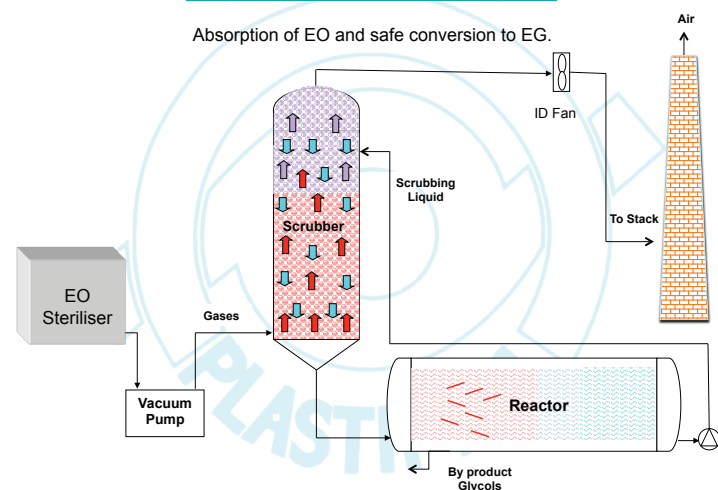
- The in-house design team of PCP chemicals scaled the experimental study, built, erected & commissioned commercial systems complying with OSHA norms.
- In the last 6 years over 10 plants are operating across India & abroad.

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Ethylene Oxide Abatement System



Bioremediation of Industrial Effluents

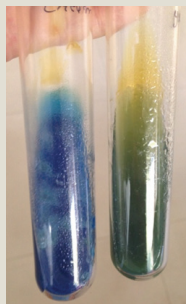


Technical Specifications

Use of living organisms to remove environmental pollutants from soil, water and gases has been widely demonstrated in the past to tackle various environment issues.

Loyola Centre for Research and Development has reported development of:

- Bacterial consortium Kit for industrial effluent treatment to effectively and efficiently reduce harmful content of sulphur from effluent before being released into the environment. Organization has prepared a bacteria based kit to cater the need for industrial effluent treatment by the process of sulphidogenesis. It is easy to handle and economically viable. At the same time it is effective and affordable tests, which are easy to interpret and can be performed at room temperature in any environment.
- They have also developed an ecofriendly and cost effective consortia of living organisms to be used in bioremediation of chromium contaminated water/soil caused due to industrial effluent. Industrial effluents were collected from different locations of Sanand, Gujarat, for the isolation of indigenous microbes which were used for the bioremediation study of chromium. Five different bacterial strains were isolated from industrial effluent sample. The isolates showed high capacity for bioremediation of chromium and were identified through 16S rRNA sequencing method. For fungal bioremediation study, the dead biomass of *Aspergillus niger* was used to check bioaccumulation capacity.



Citrate Utilization Test



Sulphate reduction test



Metal Analysis using FAAS at Loyola Centre

Advantages/Key Features

- Bacterial consortia to effectively reduce sulphur contamination of Industrial effluent
- Bacterial and fungal consortia for bioremediation of chromium contaminated water/soil
- Effective and economically viable

Role in Cleanliness Drive

Technologies have been demonstrated in lab and the organization looks forward to collaboration for validation with further field trials on a large scale.

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Bag House Filter for Clean Air



Technical Specifications

TTP Technology Pvt Ltd is the leading transformer radiator manufacturer in the world with an in-house HDG plant based on superior methodology to galvanize wide range of radiators and structurals. For the first time in India, TTP Technologies Pvt Ltd has committed in installation of Bag House Filter for structural galvanizing plant at its Tumkur unit as part of Research and Development activities in order to allow contaminant free air to the atmosphere. It is an air pollution control device that removes particulates out of air or gas released from the Hot Dip Galvanizing Process. The Modular Baghouse collector comes in two models: the MBT allows walk-on, top access to the bags (clean-air side) of the collector. This configuration is ideal for indoor or tight budget applications. The MBW offers a walk-in clean-air plenum, so bags can be replaced in any kind of outdoor weather.

It has two inlet configurations; the most common configuration allows the dirty-air to enter through the hopper inlet located under the bag filters. The dirty air hits a deflector at the end of the inlet, which causes heavy particulate to fall directly into the hopper. This reduces the amount of dust that comes in contact with the bags resulting in longer bag life and lower pressure drop.



Roadmap/Role in Cleanliness Drive

For the first time in India, TTP Technologies Pvt Ltd has committed towards the installation of Bag House Filter for structural galvanizing plant at its Tumkur unit as part of R&D activities in order to allow contaminant free air into the atmosphere.

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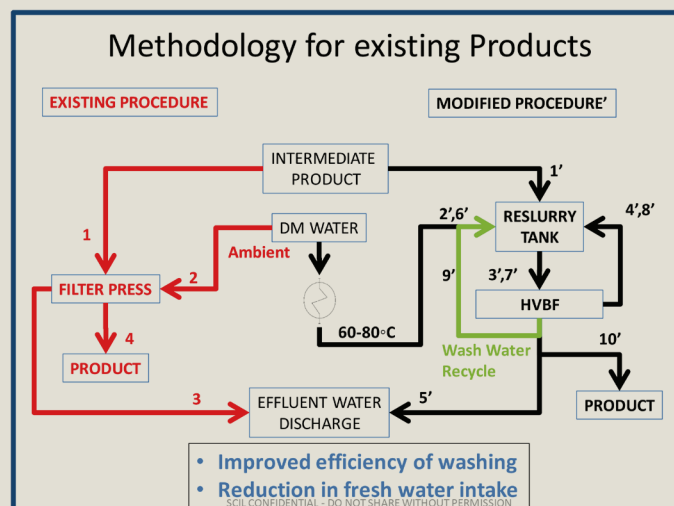
Less Water-Lower Effluent Catalyst Manufacturing



Technical Specifications

As a major manufacturer of industrial catalysts in India, Sud-Chemie India Pvt. Ltd (SCIL) manufactures and supplies catalysts to the fertilizer, refining, petrochemical, fine, and specialty chemical sectors in India. The manufacture of catalysts is water intensive and generates copious effluents which load water resources and the ecology. Techniques, such as reverse osmosis and horizontal bed filters were innovatively combined to halve water intake and decrease the corresponding effluent discharge. The manufacture process comprises the following steps:

- Ambient wash water replaced with hot water in order to ensure improved solubility
- Reslurry instead of once through wash leads to improve solid-water contacting
- Recycle of wash water which is low in impurities to ensure conservation
- Replacement of filtration hardware from plate filter to horizontal bed vacuum filter
- Better water-solid contacting and improved mass transfer leads to improved efficiency of washing



Advantages/Key Features

- Significant reduction in use of fresh water and corresponding reduction in effluent discharge by an innovative combination of recycling water, recovery by reverse osmosis, and increased efficiency with horizontal bed vacuum filtration.
- The estimate for projected effluent discharge decreased from 1514 KLPD to 800 KLPD along with a saving of ₹1.65 crore per annum.
- Conservation of fresh water and decreased load on the ecology due to reduced effluent discharge.

Roadmap/Role in Cleanliness Drive

The water-intensive manufacturing process of catalysts ensures the purity of water, especially at a time when there is an urgent need to conserve and save water for the future generations. The methodology of the manufacture is in line with the National Water Policy and Action Plan for India 2020. The reduction in effluent discharge also aids in a decreased load on the ecology and helps to maintain the diversity of life.

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Treatment of Aqueous Effluents from Chemical Industry



Technical Specifications

Hyderabad Chemicals has developed two extremely effective waste treatment methods for converting aqueous effluents into useful by-products that can be used in-house or sold in the market.

The aqueous effluent from the Buprofezin product contains ammonium chloride salt and treatment of the effluent in Multiple Effect Evaporation (MEE) is not possible as it liberates ammonia into the environment. So, the aqueous effluent containing ammonium chloride is treated with calcium carbonate



to convert it into calcium chloride which is a useful by-product. It is then used as a brine solution in the chilling plant to achieve temperature as low as -200°C .

The other aqueous effluent from Thiamethoxam product contains potassium chloride, potassium carbonate, and potassium bicarbonate mixed salts. Treating the effluent in MEE leads to lot of inorganic salts which are then disposed to the authorized transport, storage and disposal facility, thus leading to soil pollution. In the method thus developed, potassium carbonate and potassium bicarbonate is converted to potassium chloride as a single salt solution which is then sold to the fertilizer industry as a rich source of potassium.

Advantages/Key Features

- Offers effective and viable solutions for converting aqueous effluents into by-products for further usage in the market and in house.
- The by-products are used as a source of potassium in the fertilizer industry.

Role in Cleanliness Drive

The industry ensures sustainable consumption and production patterns to achieve environmentally sound management of chemicals and the resultant waste throughout their life cycle.

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WASTE-TO-WEALTH TECHNOLOGIES



—“

Devote 100 hours every year
towards the cause of
cleanliness.

—**Shri Narendra Modi**

”—

Novel Mycoherbicide for Water Hyacinth Management and Preparation of Manure



Technical Specifications

Water hyacinth (*Eichhornia crassipes*), a free-floating, perennial aquatic plant, is an aggressive invader which can form thick mats on the water surface. It becomes a fierce competitor with other micro flora and fauna in the aquatic ecosystem for light, space, nutrients, and water. A G Biosystems has developed innovative and patented Mycoherbicide products for controlling the growth of water hyacinth. After the application of AGWH#11 for controlling weeds, the dry weeds were taken out and used for manure preparation. Studies were carried out on the physico-chemical and biological transformations during agitated pile composting of the harvested biomass .

Advantages/Key Features

- Composting of water hyacinth
- Increases boat-dependent tourism and recreation in the area
- Increases the water supply
- Aids in reduction in flood risk
- Supports commercial fishing
- Low-cost NPK enriched manure for crops
- Reduces its bad effect on water bodies

Roadmap/Role in Cleanliness Drive

Dry weeds have a high concentration of N, P, and K that makes them suitable for manure application. The composting of water hyacinth reduces the allelopathic effect, but also increases its nutrient quality thus making it promising for organic farming and bioremediation. The use of decayed tissues of unwanted plants to provide nutrients for crops is a crude but effective way of exploiting weeds and is a simpler technique as compared to other alternatives available.

Water hyacinth, now considered as a serious threat to biodiversity, is being utilized/managed as a means of controlling it. Use of water hyacinth as biofertilizer revealed an increased performance of certain plants, especially wheat.

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Enhanced Acidification and Methanation (TEAM) Process for Food Waste Treatment



Technical Specifications

The Energy and Resources Institute (TERI) has developed a high rate, resource efficient biomethanation treatment process of organic solid waste (TEAM). TERI has installed and commissioned TEAM at Delhi Gymkhana Club (DGC), Lok Kalyan Marg, New Delhi, to provide a sustainable source of fuel for cooking. Complying with the mandates of 'zero waste discharge' and 'Swachh Bharat Abhiyan', the club is utilizing its food waste (approx. 1 tonne/day) for the production of clean energy and manure.



Food waste is treated in a bi-phasic anaerobic digester in a very short period of solid and liquid retention time (< 7 days) as compared to any other biogas plant. The first six days are required for first phase—acidification and one day for biogas generation. The performance of the plant is not affected by the presence of smaller volume of inorganic/inert materials. For regular operation of the plant, personnel of DGC were trained during the course of erection, commissioning, and monitoring of the plant to ensure regular operation of the plant. The plant has been in operation since the past one year.

Advantages/Key Features

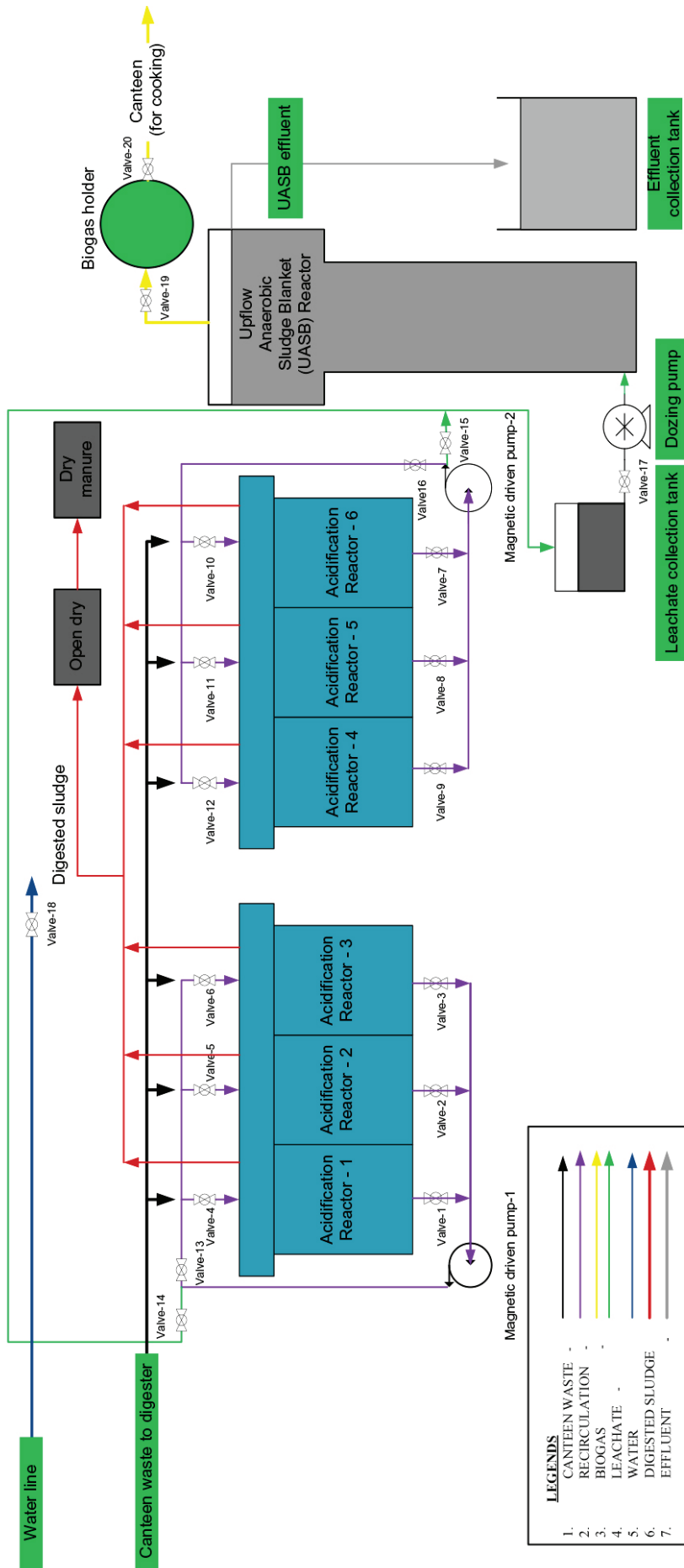
TEAM is patented for treatment process of organic solid wastes (Patent no. 2655/Del/97) revised no. IN 3875/DEL/2011).

- Captures 50–60 m³ of methane and ~ 20 m³ of CO₂ from every tonne of food waste and, thus contributes to make the environment cleaner
- Use of manure also reduces the use of chemical fertilizers as digestate has high NPK values.
- High methane content in biogas (>75%)
- Elimination of scum formation - a feature in small-size plants
- Production of non-flowable/ semi-solid digested residue
- Suitable for small and decentralized applications
- Very low water requirement due to recycling within the process
- Aesthetic look with low maintenance cost

Roadmap/Role in Cleanliness Drive

TEAM technology offers a robust and decentralized solution to combat with the ever-increasing problems of organic waste disposal. DGC, as part of its commitment to protect the environment took the initiative for in-house treatment of organic waste which was otherwise discarded at the municipal waste disposal site. The nature of such waste also attracts vector diseases and has an overall negative impact on the environment.

BIOMETHANATION PLANT (TEAM PROCESS) – PROCESS FLOW DIAGRAM



Contact Details

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Brick Manufacture from Industrial Sludge



Technical Specifications

The Travancore Titanium Products Ltd (TTPL) produces titanium dioxide by sulphate process. During the process, unreacted raw material, namely ilmenite, is separated as sludge. The high pH content, however, makes the sludge disposal difficult. Hence, the sludge is neutralized with calcium oxide and the cement bricks are constructed. For normal brick preparation, the raw materials used are baby metal, cement, and M-sand. Herein, sludge is used instead of M-sand or the volume of M-sand is reduced. A series of experiments have been conducted in lab scale preparation of cement bricks (small sizes) with a different combination of raw materials along with a tabulation of the results. All this while, the pH content of the cement bricks in alkaline condition is maintained. To ensure alkalinity, acidic sludge is neutralized with calcium oxide while maintaining the workability with the admixture, which is a water reducer and plasticizer. Significantly, all contents of the cement brick are mixed in minimum quantity of water and kept in mould for hardening.

Advantages/Key Features

- Sludge, thus produced as part of the sulphate process, high in pH content, is difficult to dispose off. The technology thus adopted at TTPL ensures neutralization of the sludge with calcium oxide and therefore the construction of the bricks.
- The technology is in the process of being transferred to local brick making units (MSEs). The company is planning to start brick making for in house usage.
- Solid waste from the company will be utilized by local brick manufacturing units to make low cost hollow and solid bricks.

Role in Cleanliness Drive

In light of the huge demand of building materials, engineers have been working on devising ways to convert waste to useful building and construction material. Recycling of such waste as raw material will contribute towards checking the exhaustion of natural resources; conservation of non-renewable resources; improvement in the state of the environment, and a substantive reduction in waste disposal costs. Also, manufacturing bricks from waste offers a potential and sustainable solution to effective waste management.

Contact Details

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Pelgreen Composorb



Technical Specifications

Pelgreen Composorb (PCS) is an aerobic composting agent developed from ligno-cellulosic materials, such as coir pith, palm leaves, areca nut husk, hay, etc. The presence of around 2 lakh CFU microbes in Pelgreen Composorb serve to decompose waste aerobically in few days' time into high nutrient organic planting media and manure. PCS works on the proprietary technology of advanced composting using aerobic assistance or ACUAA which provides a sustainable solution to aerobic composting challenges. Through ACUAA, the Pelgreen Composorb provides a two-pronged solution for maintaining the aerobic nature of composting which gets progressively difficult due to leaching liquid and size reduction in the composting material. Besides, the solid and liquid waste is sandwiched between spongy matrixes (PCS) that can absorb moisture and thus, also adsorbs stench and obnoxious gases and provides for the aerobic condition, when waste disintegrates into uniform particles along with the matrix into healthy nutrient rich organic manure/ soil-less planting media.



Advantages/Key Features

- The aerobic composting bins can be used for individual households which generate around 0.5 to 1 kg of waste in a day.
- Two layers of 2 inches of wet waste are sandwiched between layers of one inch of Pelgreen Composorb on a daily basis and continuously added on the top, till the bin is full. This is thereafter left for composting for a period of 35–45 days.
- The quality of the compost generated is such that that it can be used to create an excellent kitchen garden.

Role in Cleanliness Drive

Relying on green processes and by using carbon neutral and positive resources, Pelgreen Composorb creates wealth from waste, provides a long-term and viable waste management solution (in homes, schools, hospitals, institutions, resorts, etc.) thereby, preserving and enhancing ecosystems for a healthy life today and for the future generations.

Contact Details

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Domestic Bio-Gas Reactor— An Economic Solution for Biodegradable Waste



Technical Specifications

In an endeavour to transform household waste into energy and tackle the tendency to throw household waste on roads and streets, the domestic bio-gas reactor presents a holistic and economically viable solution. The reactor degrades all domestic bio waste and produces an efficient cooking fuel, biogas. The left over slurry is 100% organic manure for plants. Thus, besides producing energy, a kitchen garden can also be created for organic vegetables.



Advantages/Key Features

- Biogas obtained comprises 70%–80% methane
- Daily availability of 250–600 litre of methane-rich biogas created from 1–3 kg waste
- Provides an alternative fuel for cooking
- Hygienic to use in so far as it does not generate odour, flies or insects
- Easy to install and handle and requires little maintenance
- Completely safe to use and small in size
- Suitable for all types of kitchen waste-cooked/uncooked, vegetarian/non-vegetarian, and organic

Role in Cleanliness Drive

As a system that ensures domestic decentralized garbage processing, the usage of the domestic bio-gas may be encouraged in households and rural areas to ensure efficient garbage management, produce energy and efficiently degrade household waste.

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Waste Organic Matter to Organic Slurry



Technical Specifications

Jay Research and Biotech India Pvt Ltd, a leading manufacturer in the field of bio-fertilizers and bio-pesticides, uses different substrates, such as rice, bajra, etc., for solid state fermentation of different microorganisms for the production of bio fertilizers and bio pesticides. These production processes result in the generation of huge amount of waste materials as byproducts. The industrial waste management technology developed by the research centre converts several mixtures of waste organic matter into organic slurry.

Industrial waste management technology developed at JRABIPL



Incubation of Microbial Cultures in SSF (Solid State Fermentation)



Product processing

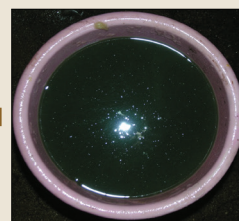
The Substrate after Solid State Fermentation is extracted with buffer to Release the conidial mass/spores for preparation of final Product; SL (Soluble liquid Formulation)



The By Product waste is dumped in the slurry tank for semi anaerobic digestion of the organic waste



Byproduct/waste



Conidial Mass/Spore Suspension after extraction (SL formulation)

Advantages/Key Features

Field Trial Results:

- Healthy rhizosphere, better root development
- Improved sugarcane production in rocky soil (100 tonne/acre)
- 10% increase in tea production and improved capsicum production

Role in Cleanliness Drive

The organic slurry generated as a result of the production process, comprising highly nutritious components for plant growth, is used in the cultivation of various crops and reduces the use of chemical fertilizers and pesticides by 50%–70%. The technology is regarded as safe, cost effective, eco-friendly and devoid of any harmful chemicals.

Contact Details

Dr Santosh B Chavan

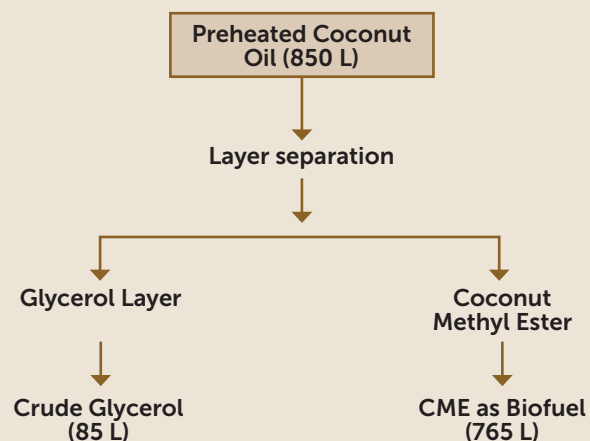
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Eco-friendly Biofuel via Coconut Oil



Technical Specifications

The merit of coconut oil at nutritional, therapeutic, industrial levels has provided a distinct status to coconut as an oleaginous crop. The functional property of coconut methyl ester (CME) produced from coconut oil by chemical trans-esterification has been proved in diesel vehicles by test run directly as biofuel without any modifications in the engine and in the fuel lines. The test run showed the technical specifications torque (Nm) and power (bhp) similar to the efficiency of diesel fuel. The higher mileage of CME (22.5 km/L) than diesel fuel (16 km/L) in test run indicates the thermal efficiency of CME during the performance of the vehicle. The low carbon residue, minimal acidity and the absence of sulphur elements further support the fuel energy of CME as an eco-friendly fuel.



Advantages/Key Features

- This can be used straight away as fuel in diesel engines
- Procures higher mileage than fossil fuel
- No modification required in engine components and fuel lines
- This fuel need not be blended with any other fuel in diesel engines and requires no additives
- Rapid and easy processing
- Effective utilization of sub-products makes it cost effective
- Physico-chemical features of CME are competent as a good fuel
- Low carbon residue and the absence of sulphur elements and other contaminants supports the ecofriendly nature
- Envisaged as a new horizon for coconut growers and farmers

Roadmap/Role in Cleanliness Drive

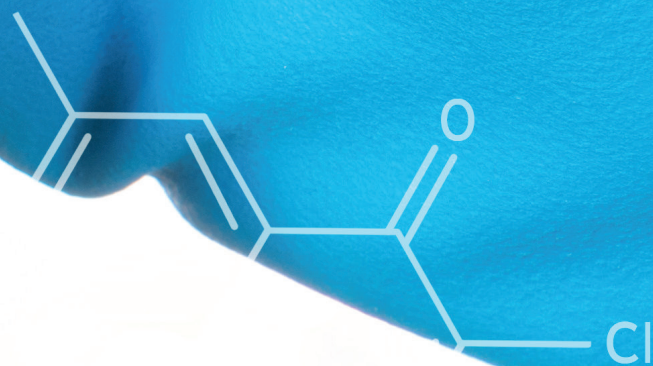
The impending energy crisis and the need to find alternatives to the rapidly depleting non-renewable energy resources, which are also environmentally sustainable, has led to a state today where vegetable oils and their derivatives hold huge promise. In this background, coconut methyl ester (CME) produced from coconut oil by chemical trans-esterification has been adequately proved in diesel vehicles as a biofuel and thus, offers an environmentally friendly source of renewable energy.

Contact Details

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ENERGY EFFICIENT GREEN PROCESSES



“

Sanitation is more
important than independence.

”

Green Chemistry Process for Production of Viscose Fibre



Technical Specifications

India is the world's largest producer and exporter of viscose fibre. However, till today its production using the viscose process depends upon toxic chemicals to treat cellulose wood pulp. The Birla Research Institute for Applied Sciences devised innovative methods to reduce the amount of sodium hydroxide concentration during 'steeping' as well as the amount of carbon di sulphide in the 'xanthation' of alkali cellulose. This led to minimizing the free alkali availability in alkali cellulose and reduce the consumption of carbon di sulphide in byproduct formation (thiocarbonates). These byproducts on decomposition, eliminate toxic gases like H₂S and CS₂. Similarly, in Modal process they were able to xanthate the alkoxide with 10% to 15% less carbon di sulphide. The xanthate so formed is easily converted into viscose and therefrom fiber without deterioration in properties.

Advantages/Key Features

- A 20%–25% reduction achieved in emission of toxic gases (compared to emissions of regular process), making the process more feasible by saving carbon di sulphide. Also leading to a saving of ₹15–₹20 crore per annum on production of 450 tonnes of fiber per day.
- In modified Modal process, emission of gases reduced to 10%–15% (against the emissions of control process), making the process more economically viable by using less quantity of carbon di sulphide. A saving of ₹20–₹25 crores per annum after producing 450 tonnes of fibre per day.

Roadmap/Role in Cleanliness Drive

Overall, it is concluded that the emission of toxic substances maybe remarkably reduced by modifying viscose processes (Normal & Modal) and also make them economically more viable. These modifications also contribute to significantly improve the environment around production sites and everyday life and health of the communities residing in the vicinity of viscose factories.

Contact Details

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Energy Efficient Coatings



Technical Specifications

In line with Swachh Bharat initiative, Krishna Conchem Products Pvt Ltd with technical know-how from CSIR-NIIST, Thiruvananthapuram (DSIR, Ministry of Science and Technology, Government of India) has developed Swachh Coat, the simplest cleaning tool innovative self-cleaning energy efficient coatings for cleaning building walls, terraces etc. Each and every painted surface on buildings loses its aesthetic appearance due to mud splashing, humid climate, polluted dust, and vehicle emissions, the Swachh Coat, is a know-how Nano TiO₂-based photo catalytic and air purifying coating that is self-cleaning in nature. These coatings have Anti-graffiti, heat reflective properties; long life & excellent weathering properties.

Advantages/Key Features

- Easy to use self-cleaning system and high on aesthetic appeal
- Anti-graffiti properties
- Significantly reduces roof surface temperature
- Excellent long life weathering resistant
- Dirt pick-up resistant technology
- Excellent elongation and adhesion
- Carbonation resistant
- Breathable and waterproof
- Green building product



Roadmap/Role in Cleanliness Drive

In line with the mandate of the Swachh Bharat Mission, Swachh coatings is a simple cleaning tool displaying innovative self-cleaning energy efficient coatings for cleaning building walls, terraces, etc. Aiming to reach with Swachh-Coat to larger sections of society different approaches are being followed by the Company:

- Conducting architect/consultants meet at R&D Centre
- Educating end users about this technology
- Reaching upto engineering teams of government bodies for cleaning & protecting structures of national importance like bridges, government fertiliser units, reactor structures (NPCIL) and port terminals
- Arranging demonstration of innovative technology at numerous places
- Training painters, carpenters, masons at site & our lab to develop their skills.
- Conducting awareness programmes for housing societies.

Contact Details

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Eco-friendly Tailing Disposal System by Filtration of Iron Ore Tailings



Technical Specifications

NMDC has worked on development of an eco-friendly tailing disposal system by filtration of iron ore tailings and has studied issues related to their transportation & storage.

The entire system comprises of four phases and the specifics of these are enumerated as follows:

Phase 1: Collection of iron ore tailings from different origin/mineralogy or preparation of engineered tailings in order to ensure characterization of all different tailings

Phase 2: Preparation of engineered mixtures comprising linear variation of alumina and settling tests with these mixtures followed by settling studies with different tailings using three different flocculants

Phase 3: Filtration studies/Paste thickening studies with different tailing samples

Phase 4: Studies to ascertain transportability & stacking characteristics

Advantages/Key Features

- It is technically possible to filter tailings of upto 17%–18% aluminium oxide (Al_2O_3) having D80 less than 30 micron and produce a cake with about 15%–25% moisture.
- The filtered cake can be transported by conveyor belt and stacked upto moisture content of 20.2%, 22.6%, and 26.7%, respectively, for samples 1, 2, & 3. This moisture is about 3% more than the expected filter cake moisture of all three tailing samples.
- The tailings are amenable for paste thickening and yield stress values indicate that the paste tailing can be transported by centrifugal/positive displacement pumps from deep bed thickener to paste disposal location.
- Filtration of tailings enhances the water recovery by 10%–12% and subsequently reduces the land requirement by 53% to 64%

Roadmap/Role in Cleanliness Drive

The basic idea behind NMDC's disposal system is to develop a process which can maximize the recovery of water from the process input and enable disposal of tailings in solid or semi-solid form in order to minimize the environmental hazard; the same may also be classified as eco-friendly tailing management which endeavours to make iron ore mining more sustainable.

NMDC Limited has categorized major environmental impacts from waste disposal at mine sites into two categories:

1. The loss of productive land following its conversion to a waste storage area
2. The introduction of sediment, acidity, and other contaminants into the ecosystem

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HIGREN™ Oxo-Biodegradable Additives (HIGREN™-OBA)



Technical Specifications

Conventional plastics have been developed over the years to have excellent physical and barrier properties for specific applications and to have excellent processability when converted into final products. However, non-biodegradable Plastic is one of the major toxic pollutants of present time causing harmful impacts on human and aquatic life. Making these polymers oxo-biodegradable without changing any of its properties has promising and progressive prospects. In this light, HPL Additives Ltd with an international collaboration will manufacture and sell Totally Degradable Plastic Additive (TDPATM) in India under the brand name of HIGREN™ Oxo-Biodegradable Additives (HIGREN™-OBA).

Advantages/Key Features

- The oxo-biodegradable quality of the polymers serves to retain their original properties. It simply adds the property of accelerated degradation and subsequent biodegradation and makes them oxo-biodegradable (OBA).
- Plastic products incorporating OBA will degrade, biodegrade, and not release any toxic chemical compounds.
- The Higren OBA additives comply with product safety regulatory standards and are safe for direct food contact applications.

Higren OBA additives comply with product safety regulatory standards and are safe for direct food contact applications.

Roadmap/Role in Cleanliness Drive

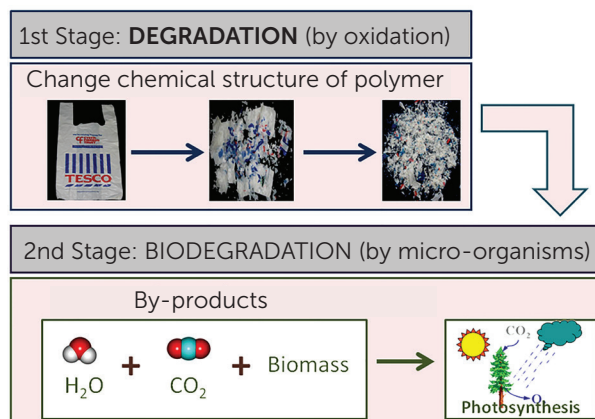
Plastics are important in the daily life of human beings, considering their multifaceted nature and usage in multiple applications that make our life easier. However, at the same time they also have a harmful impact on the planet.

From landfills to environment pollution, the havoc is constantly growing. The product to be manufactured at HPL Additives' state-of-the-art plant in Faridabad, Haryana will help in accelerating the degradation of the plastic and reducing the lifetime of conventional plastics.

Contact Details

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Oxo-Biodegradation: 2-Stage Process



Go Green—Green Maple Leaf Recyclable Barrier Tubes



Technical Specifications

Developing an environmentally friendly alternative to traditional products forms an intrinsic part of Swacchta goals of clean & green living. On these lines M/s. Essel Propack has developed a fully recyclable laminated tube, Green Maple Leaf (GML) that helps prevent oxidation of contents and is well-suited for cosmetics, toiletries and food products. A 50 mm diameter HDPE-based cap has also been developed to promote unification of structure. The organic polymer-based (fossil fuel free hydrocarbon) version of GML-C2 promotes enhanced sustainability.

Advantages/Key Features

- GML provides an excellent recyclable barrier tube that helps protecting packed product such as oral care, cosmetics, food and home care products.
- Promotes eco-friendly packaging solutions, thereby leading to a greener, better, and healthier planet, besides a substantive reduction of carbon footprint.
- Ensures product stability, shelf life properties and excellent tube resilience, and achieving sustainability goals.

Roadmap/Role in Cleanliness Drive

Green Maple Leaf has today, succeeded in establishing a new benchmark in packaging innovation by providing a more sustainable and eco-friendly option to endorsers, brands, and customers.

Contact Details

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GENERAL PRODUCTS TOWARDS SWACHHTA



“

Swachh Bharat Tha Bapu ka Sapna,
Sacche mann ke kartavya
banaye ise Apna

”

Solar Cabinet Dryer



Technical Specifications

Society for Energy, Environment, and Development (SEED) has developed solar cabinet dryer, which runs on solar thermal and solar photovoltaic power technology, for processing of agro-horticultural products. The solar thermal energy raises the temperature to 65 °C–70 °C in the cabinet due to greenhouse effect and causes moisture removal from the processed products. High efficiency is achieved through forced circulation of air by solar fan, powered by solar photovoltaic energy. The ambient air enters into the cabinet through the louvers at the bottom of the cabinet, which helps in moisture removal. Thus, solar dehydration process is achieved.

Advantages/Key Features

The solar cabinet dryers integrate all three benefits (social, environmental, and economic) for the community.

- *Social:* The dryer reduce post-harvest losses, increase shelf life of the product, is clean and hygienic
- *Environmental:* Use of clean energy and no carbon emission
- *Economic:* Income generation with zero energy cost as well as opportunity for rural women and farmers in establishment of microenterprises in solar food processing industry and extend business activity into small-scale industry level

Roadmap/Role in Cleanliness Drive

Roadmap consists of technology adoption by scaling up the dryers capacity, R&D in underutilized fruits and vegetables and other food products, skill development training in solar food processing technologies, and income generation for rural women and farmers through microenterprises in food processing technology.

Contact Details

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Society for Energy, Environment, & Development (SEED)

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Uniphos Continuous Emission Monitoring Systems (CEMS)



Technical Specifications

UNIPHOS (CEMS) is an online analyser for measuring the concentration of various toxic gases in industrial process/boiler stack. The UNIPHOS SO₂ analyzer is based on UV fluorescence technique that utilizes measurement of SO₂ fluorescence, typically, in the range of 240–420 nm resulting from the optical excitation of SO₂ molecules. UNIPHOS stack gas analyzer comes with sample conditioning system incorporating dust filters/scrubbers for zero air generation, etc. With a purge system, the instrument can be programmed to periodically purge the sampling probe at the required intervals. Highly specific, the technique chooses gas-specific infrared absorption wave length of the target gas by cutting off all other wave lengths.

Advantages/Key Features

- COD analysis based on sample oxidation using potassium dichromate
- Measures the chemical–oxygen demand by measuring the absorbance of Cr+3 generated
- Ten times reduction in chemicals used as compared to traditional methods
- Ten times reduction in cost of analysis
- Fully automated instrument with a precision syringe drive system
- Programmed automatic calibration facility
- Can be correlated to the BOD value (optional)
- Data communication compatible with the required SPCB/CPCB norms

Contact Details

Dr R C Naik

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Adoption of Biogas Plant for Industrial Solid-Liquid Waste Management



Technical Specifications

The company, Tasty Bite Eatables Ltd., has put a biogas plant into operation in order to explore clean and efficient systems of sustainable energy production based on the use of waste and other sub-products from the plant. The food plant generates about 2–2.5 tonnes of solid food waste per day which is collected in a feed tank from where it is pumped in to a digester. At this stage, anaerobic digestion takes place which helps in transforming organic material into biogas (digested sludge). The biogas thus generated is utilized for electric power generation. The research centre, recognized by DSIR operates completely on the electricity generated from the biogas.

Advantages/Key Features

- High, solid digestion process, the digester works at 10% of the total solids as compared to a conventional digester
- Continuous stirrer digester uses hydraulic stirring
- Recirculation of gas and slurry to increase methane percentage in the gas
- Recirculation of water, reduction of freshwater requirement by 50%
- As food waste from factories contain a considerable quantity of maida, about 200–250 CuM of biogas/MT of food waste is generated against the expected 80 CuM/MT.

Roadmap/Role in Cleanliness Drive

With the biogas plant, it is possible to reduce the environmental impact caused by organic waste. As part of the farmer's training programme, a demonstration of the operation of the biogas plant will be done. Also, farmers will be educated on the benefits of installing biogas plants at their farms to utilize farm and animal waste. Farmers will be assisted in setting up biogas farms of a size suitable to their needs.

Contact Details

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Effluent Treatment Plant for Industrial Wastewater Treatment



Technical Specifications

Enaltec Pharma Research has established a separate effluent treatment plant (ETP) designed for treating the industrial waste water for its reuse or safe disposal to the environment.

Advantages/Key Features

- Offers an economic solution to clean industry effluent and recycle it for further use
- Reduces the usage of fresh/portable water in industries and therefore reduces expenditure on water procurement
- Meets the standards for emission or discharge of environmental pollutants from various industries set up by the government
- Safeguards the environment against pollution and contributes towards sustainable development

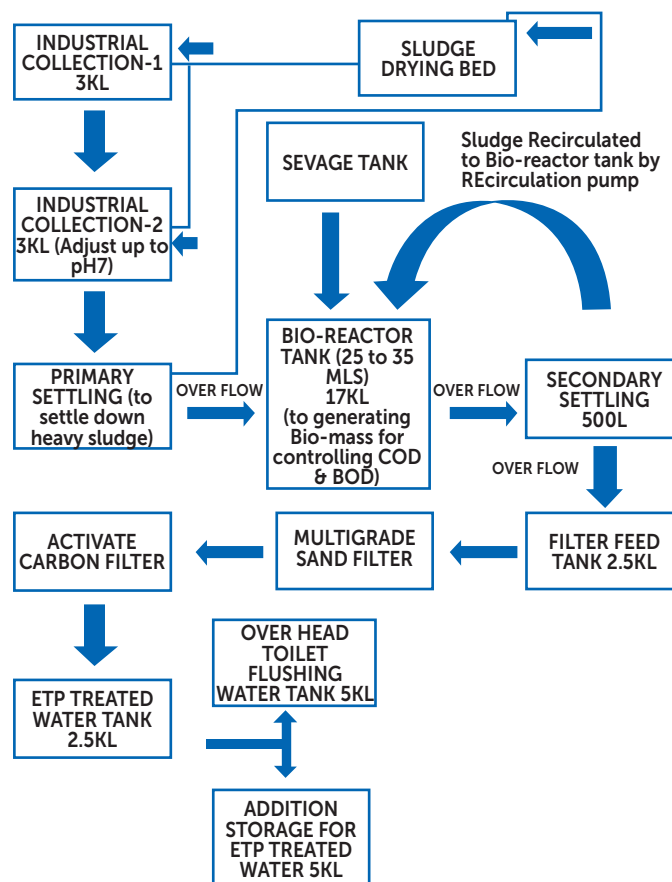
Roadmap/Role in Cleanliness Drive

Industrialization contributes to enhanced municipal solid and liquid waste generation and degrades the urban environment. Increasingly, the DSIR-recognized industrial units are becoming responsible and responsive towards in-house solid and liquid waste management by adopting the available technologies. Although these are not novel technologies, however, the companies have put forward their innovation and commitment of zero waste effluents. In this background, Enaltec Pharma follows such technology modifications and adoptions in the operation of the ETP.

Contact Details

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SUCCESS STORIES



“

Hum Sabne yeh thana hai,
Bharat Swachh banana hai!

”

Reliance Industries Ltd— Adoption of 3R's



As a manifestation of environmentally responsible behaviour, the 4R's—reduce, reuse, recycle, and recover—provide an ecologically sound and environment friendly approach to minimize and manage waste. In this context, Reliance Industries Ltd, Jamnagar, Gujarat, through various measures enumerated below, display their environmentally friendly approach.

Reduce

Solar Water Heater

Installation of solar water heaters for residential units, guest houses, and swimming pools in RIL township leads to energy savings of 9.5 million units per year.

- Usage of evacuated type solar collector technology ensures provision of hot water 24X7.
- Two units of 600l and 500l cater for a family of 8
- Insulation of hot water lines to conserve energy
- Installation of temperature gauge on every solar tank for monitoring heater's efficiency

Details of Solar Water Heater installed

Sl. no	Type of Solar unit Capacity in Litres	Installed Qty.	Total Capacity in Litres
1	600	763	457800
2	500	280	140000
3	2000	10	20000
4	750	3	2250
5	500	14	7000
Overall Capacity installed			627050

Plastic Free Township

To limit the use of and make the RIL township single use plastic free, encourage the use of reusable materials such as cloth bags, biodegradable disposable plates, and other alternatives.

Reuse

In order to maintain clean and hygienic conditions, an end-to-end domestic waste management process—for biodegradable and non-biodegradable waste—has been developed. Waste segregation occurs at the source wherefrom it is transferred to the biogas plant for production and usage for cooking.



Recycle/Recover

Diversion of wastewater to landscaped areas via the wastewater distribution infrastructure (see Figure 1) ensuring 100% usage of treated wastewater, both for potable and non-potable purposes.

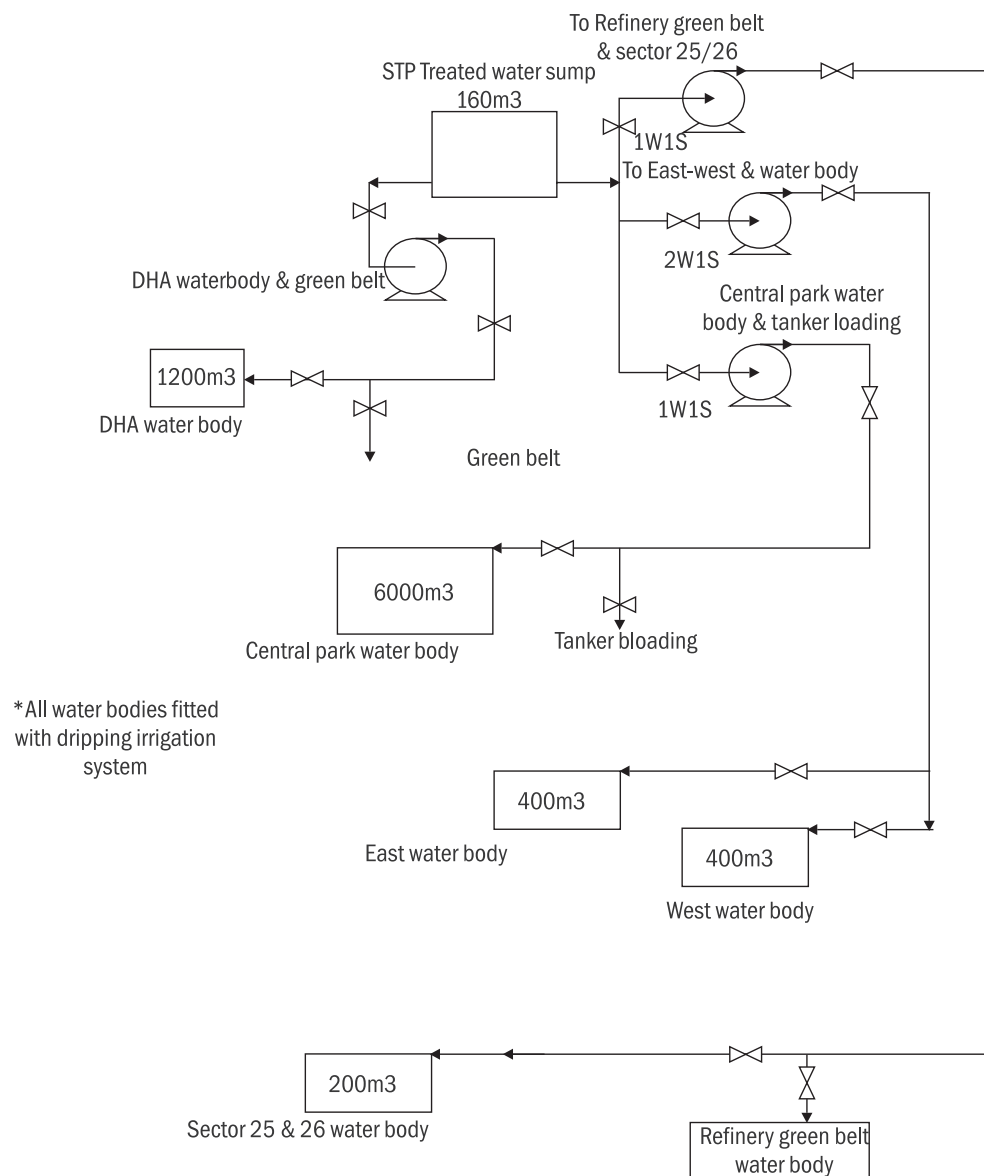


Figure 1: Treated water distribution

Contact Details

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Oilzapper Technology—A Move Towards Sustainable Environment



With the goal for sustainable environmental governance, The Energy and Resources Institute (TERI) strives to continuously provide innovative solutions in an eco-friendly manner. Soil contamination with oil at petrochemical plants and oil spills during transport of oil is a major global concern for companies in the petrochemicals sector. Oil spill contamination in intentional conflict zones also poses a huge challenge for nations worldwide. Oil contaminants are hazardous in nature and result in environmental degradation that includes farmers' land and loss of soil fertility, thus effecting farmers' livelihood. Over 20,000 tonnes of petroleum sludge is generated every year in India alone. Petroleum companies spend huge amount in compensation claims from affected parties/farmers and local communities.

With the vision to ensure environmental protection from hazardous petroleum hydrocarbon contaminants, TERI's research focusses on an in depth modern biotechnology-based remediation approach with the seed funding support from the Department of Biotechnology, Ministry of Science and Technology, Government of India. 'Oilzapper is a cocktail of oil-eating microbes that aids in complete decontamination of hazardous petroleum hydrocarbon-contaminated soil. Broad spectrum implication potential of this technology is poised further to achieve global recognition in overseas countries. Further, TERI's state-of-the-art large fermentation research centre facility has aided towards implementation of this bio-product in large field scale.

TERI's Oilzapper technology is the only bioremediation tool kit being demonstrated and is by far one of the largest such initiatives by the Indian biotechnology sector.

Reduce

Completely eliminates hazardous oil contaminants

'Oilzapper' developed by TERI is the only biotechnology-based process that is implemented successfully in large field scale across the nation as well as in overseas countries. The use of Oilzapper has resulted in reduction in environmental damage in and around refineries and in significant decline in liability payments in case of leakages caused in transporting of oil via pipelines. Till date, the 'Oilzapper' technology helped to remediate around 5, 97,000 metric tonnes of oil-contaminated soil (oily sludge and drill cuttings) across the nation as well as in overseas countries. Currently, 'Oilzapper' is in use in 16 oil refineries in India and in two oil exploration companies, mainly ONGC and Oil India Ltd.

Recover

Converts hazardous oil contaminants to bio-fertilizer that enhance soil fertility

The use of 'Oilzapper' restores the environment and recovers waste in the form of value added microbial biomass that eventually functions as a bio-fertilizer and enhances the soil fertility, thereby increasing the crop yield in farmers' lands. Over the past two decades, 'Oilzapper' has contributed significantly to the clean-up of oil contaminated farmers' land and oil fields on a large scale across the country and recovered several farmers' lands in Gujarat and Assam and restored their livelihood.

Recycle

Oilzapper aids in recycling of oily contaminants in the form of bio-fertilizer

Oil contaminants are recycled into value-added biomass through the oil-eating microbes of the 'Oilzapper' tool kit. The essence of this technology is that it is eco-friendly and restores the degraded environment in a sustainable manner without impacting other environmental spheres.

Reuse

Contaminated lands after restoration through Oilzapper treatment are reused as fertile agricultural lands and enhance crop productivity.



Large-scale production of Oilzapper in 13,000 litre bioreactor



Zero Day Picture of Radhika Nagar Oil Spill



After completion of lifting & transportation of oily slush

Contact Details

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Annexure-I

Format of Questionnaire



SUBMIT FOLLOWING INFORMATION OF YOUR INNOVATION/PRODUCT OR TECHNOLOGY FOR PUBLISHING IN COMPENDIUM OR MINISTRY WEBSITE

- I. Details of Organization (Name, Address):**
- II. R&D Location, DSIR Recognition Number & Validity:**
- III. Details of Contact Person; Tel No; email ID:**
- IV. A brief write up on Novel Technology/Product in any of the following category aiming towards Clean India Mission of Government of India (max. 400 characters) (give patent details, if any):**
 - i. Industrial waste/effluent management technology**
 - ii. Drinking Water**
 - iii. Sustainable Sanitation**
 - iv. Urban/Rural solid –liquid waste management**
 - v. Clean Energy**
- V. Road Map for Technology adoption /diffusion to larger section of society or Micro & Small Enterprises (MSE) (If any):**
- VI. Attach Jpeg image, presentation (max. 5 slides), Video (2min) or MP3 of the product/ technology:**



एक कदम स्वच्छता की ओर



Department of Scientific and Industrial Research
Ministry of Science and Technology
Government of India
May 2018