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SQ
raising the Sustainability Quotient

In this Issue

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Editorial

Sustainable Assessment of Technologies

According to Banta[1], technology is defined as "science or knowledge applied to a definite purpose." Technology assessment is a form of policy research that examines short- and long-term consequences (for example, societal, economic, ethical, legal) of the application of technology.

Technologies are often assessed for the interest of comparison. New or innovative technologies also need to be evaluated using assessment framework. Assessment frameworks are used to guide technology development as well.

For conducting technology assessment, conventional cost-benefit analyses is deployed to work out Return on Investments (RoI) over various application scales, followed by sensitivity studies to evaluate the robustness of the results against the assumptions made.

More recently, experience has shown that limiting to conventional economic analyses alone may not lead to holistic assessment of technologies. Environmental and social (E&S) perspectives of the technology need to be explicitly factored. Technologies assessed solely on economic grounds may not lead to sustainable solutions. A technology could be cheap, but highly risk prone on matters related safety or toxicity; a technology could be very effective on process efficiency but not acceptable to the neighbourhood on accounts of noise or odour release.

In India, we still follow conventional economic analyses (often called as Life Cycle Benefits and Costs) to decide on the technology options.

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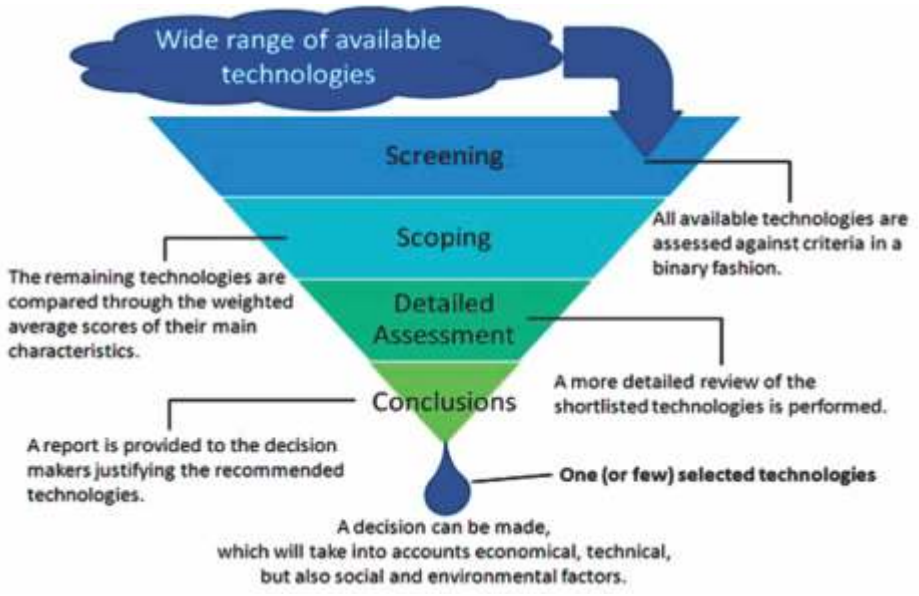
Although, the term Life Cycle should include externalities on E&S counts, in practice, the E&S perspectives are not embedded in the decision making. The bidder with L1 is often selected! Consequently, many projects do not remain viable nor yield anticipated benefits or outcomes. It is important that sustainability considerations are explicitly included in the technology/project evaluation frameworks.

Sustainability considerations are equally important in technology development. Incorporation of sustainability often fosters innovation. Innovation emerges when expectations on economic, environmental and social aspects are simultaneously to be met. These innovations lead to reduced cost, better performance, higher social acceptability and lower adverse impact/risk to the environment. Many business houses have realized this "innovation advantage" of sustainability and have included E&S consideration in the R&D activities. We need to build convincing case studies however that underscore the importance of sustainability in development and assessment of technologies. We hope that this issue of SQ provides an inspiration in this direction.

- Prasad Modak

[1]*What is technology assessment D. Banta, International Journal Technology Assessment Health Care. 2009 Jul; 25 Supplement 1:7-9. doi: 10.1017/S0266462309090333. Epub 2009 Jun 12*



Source: http://www.unep.org/ietc/SATAssessing/tabid/56441/Default.aspx

Promoting Environmentally Sound Technologies: UNEP's International Environmental Technology Centre

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At the Earth Summit in Rio de Janeiro, Brazil, in 1992, governments agreed on Agenda 21, an action plan to promote sustainable development. Central to Agenda 21 is the promotion of environmentally sound technologies (ESTs). As defined in Agenda 21, ESTs protect the environment, are less polluting, use less resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more efficient manner than the technologies for which they were substitutes.

In 2004, the Bali Strategic Plan for Technology Support and Capacity-building[3] reinforced the need for the provision of technology support and capacity-building to developing countries as well as to countries with economies in transition. In 2012, the UN Conference on Sustainable Development (UNCSD), or Rio+20, in its outcome document "The Future We Want", again emphasized the importance of technology transfer to developing countries.

Technology transfer remains one of the important topics in the international arena as it is seen as playing a critical role in the global response to the challenges in sustainable development. It is important to remember that achieving this goal will not just be a matter of bringing new tools to a new location, but will also bring in suitable policy environment, unobstructed markets, adequate financing, and capacity building.

For more than 20 years, UNEP's International Environmental Technology Centre (IETC) has had a comprehensive and leading involvement in promoting the development, transfer, uptake and use of environmentally sound technologies (ESTs). This involves data gathering and information management in relation to ESTs, as well as the development of decision support tools to assess life cycle performance and the environmental benefits of ESTs. It also facilitates technology transfer and supports capacity building initiatives to assist in the development, demonstration and dissemination of ESTs.

IETC's role in the transfer of ESTs

Inaugurated in 1992, IETC's mandate is the transfer of environmentally sound technologies (ESTs) to developing countries and countries with economies in transition. Over the course of time, IETC has worked on urban development, including disaster management and water and sanitation. In recent years, IETC has focused on waste management. IETC is committed to further work on this area to become a global centre of excellence on waste management in the future. The holistic definition of waste defines waste as the unwanted by-product of human activities in solid, liquid and gaseous form. IETC is promoting this holistic approach to waste, considering waste as a resource and supporting proactive prevention policies.

Why waste?

The world is going through an unprecedented transition setting new trends for the 21st century. With the global population increasing from currently around 7.3 billion to 9 billion by 2050 and 11 billion by the end of the 21st century, the urbanization trend is expected to continue with more than 80 per cent of humanity living in cities by 2050. Most of these people will live in African and Asian cities where city growth rates are the highest, followed by Latin America and the Caribbean.

The industrial revolution has pursued a linear path of extracting natural resources, putting it through an industrial process for goods and services with the end product as waste. Waste is generated at all stages of the production and consumption chain. With increasing income levels, there will be 3 billion new middle class consumers in the coming decades. The demand for goods and services and consequently the waste generation will grow exponentially. The World Bank estimates that the current 1.3 billion tonnes of municipal solid waste (MSW) will increase to approximately 2.2 billion tonnes per year by 2025. Waste characteristics are also changing from mainly organic to containing more hazardous substances having a negative impact on human health and environment. Waste management poses an important challenge for governments and the cost of inaction is high. Improper waste

[2] *United Nations Environment Programme (UNEP), International Environmental Technology Centre (IETC)*

[3] *To know about the Bali Strategic Plan for Technology Support and Capacity building, visit the page - http://www.unep.org/GC/GC23/documents/GC23-6-add-1.pdf*

management impedes the provision of basic necessities for public health such as clean water, clean air and safe food. Untreated waste contaminates soil and water through leachate. Burning of waste significantly increases the air pollution having adverse impacts to human health. Like most environmental hazards, deficiencies in waste management also disproportionately affect\poorer communities more as wastes are often dumped in land adjacent to slums and waste pickers are exposed to hazardous substances.

Photo: Open burning of waste

Opportunities: resources, growth, jobs

The emerging problem of waste is an opportunity making a contribution for growth and jobs. If waste is considered a resource, it acquires a value to be used. With a preventive and precautionary approach and the application of new environmentally sound technologies, it is possible to manage waste in a sustainable way.

The opportunities and benefits of sustainable waste management include: less environmental pollution, reduced costs in managing waste, reduced greenhouse gas emissions, contributions to equity and poverty alleviation. Improved health, health costs that are avoided, water contamination that is prevented, and the ensuing cost of alternative water supply are also important benefits.

In addition to environmental benefits, sustainable waste management can also facilitate economic opportunities and growth. Economic benefits of proper waste management will mainly come from considering waste as a resource, that is, by reusing products, recycling waste and recovering materials and energy including converting waste to biogas. Converting waste into energy can assist countries in meeting their energy needs and thus has significant benefits for energy security. The benefits of sustainable waste management for job creation can also be significant. UNEP's Green Economy Report shows that recycling creates more jobs than it replaces. Sorting and processing recyclables alone sustain ten times more jobs than land filling or incineration on a per ton basis.

IETC's experience

Over the past couple of years, IETC has assisted countries in transitioning to sustainable waste management through technical assistance, guidance, and pilot projects. IETC has advised around a dozen cities in Asia, Africa and Latin America in devising integrated waste management plans. In this context, IETC developed guidelines, built the capacity of local authorities in developing the plans and carrying out demonstration projects. In India, IETC assisted the City of Pune in developing its integrated waste management plan, in cooperation with the Pune Municipal Corporation and the Environmental Management Centre (EMC), Mumbai.

IETC has been working on converting agricultural waste (biomass) into energy. Converting agricultural waste into energy can provide a decentralized energy source in rural areas while simultaneously achieving a cost effective solution to waste disposal, and a reduction in greenhouse gas emissions.

Photo: Project on converting waste agricultural biomass into energy

One of the examples, IETC built the local capacity in six Asian countries to identify and implement environmentally sound technologies (ESTs) for waste agricultural biomass and assess their potential for resource conservation and greenhouse gas emission reduction. A compendium of sustainable technologies was developed that demonstrated these technologies as pilot projects. Sub-regional workshops were organized to share and exchange experience on the projects. In India, IETC worked with the Birla Institute of Management Technology (BIMTECH). In the replication of the project in Costa Rica, IETC facilitated the dissemination of Indian technologies.

Under the Climate and Clean Air Initiative (CCAC) Municipal Solid Waste Initiative (MSWI), IETC is implementing a project on improving organic waste management in Penang, Malaysia. This will help in reducing greenhouse gas emissions from the municipal waste sector, such as methane, which is generated through the anaerobic decomposition of organic waste in landfills. To reduce these emissions from the municipal waste sector, one of the most feasible and immediate solutions is to divert organic waste for recycling. This will reduce methane emissions from landfills and deep open dumps. IETC is assisting Penang in developing an organic waste management plan, including pilot projects on segregation and digestion technologies. The bio-digestion technology that is being piloted is based on microbial digestion to produce liquid fertilizer. This fertilizer can then either be used for gardens or be sold back to the technology supplier.

In its endeavor to assist countries in assessing and choosing environmentally sound technologies that match their needs, IETC has developed a methodology, the Sustainability Assessment of Technologies (SAT), as well as a number of reports on waste management technologies, a compendia of technologies.

These are intended to provide information on technology options as well as to assist the policymakers and technology decision makers in the identification of appropriate technologies with respect to local economic, environmental, social and technical characteristics. See Box 1 an illustration of one of the ESTs that IETC is working on in Penang, Malaysia.

Box1: Development of Organic Waste Management Plan in Penang, Malaysia

Under the Climate and Clean Air Initiative (CCAC) Municipal Solid Waste Initiative (MSWI), IETC is implementing a project on improving organic waste management in Penang, Malaysia. This will help in reducing greenhouse gas emissions from the municipal waste sector, such as methane, which is generated through the anaerobic decomposition of organic waste in landfills. To reduce these emissions from the municipal waste sector, one of the most feasible and immediate solutions is to divert organic waste for recycling. This will reduce methane emissions from landfills and deep open dumps. IETC is assisting Penang in developing an organic waste management plan, including pilot projects on segregation and digestion technologies. The bio-digestion technology that is being piloted is based on microbial digestion to produce liquid fertilizer. This fertilizer can then either be used for gardens or be sold back to the technology

In response to an increasing need to manage growing amounts of e-waste, IETC also prepared a series of user-friendly manuals, to assist developing countries in developing e-waste management systems, including assessing e-waste and its risks, evaluating current e-waste management practices, and designing environmentally sound e-waste policy frameworks.

Most recently, in collaboration with the United Nations Institute for Training and Research (UNITAR), IETC developed "Guidelines for the development, review and updating of national waste management strategies". These guidelines provide a conceptual and methodological framework for national planning that countries may adapt to their particular circumstances. It also establishes a clear rationale for making waste management a national priority. The guidelines are currently being pilot tested in 6 Asian countries. The objective of this project is to assist countries in developing national and city-level waste management strategies. Once the initial piloting has taken place, lessons will be collected for replication and up-scaling in a next phase. In India, IETC is working with the City of Kota, Rajasthan, to support the development of a city-level waste management strategy.

Photo: Workshop on national waste management strategies

On the global level, IETC, in collaboration with the International Solid Waste Association (ISWA), is developing a Global Waste Management Outlook. The Outlook will provide an overview, analysis and recommendations for action of policy instruments and financing models for waste management.

Concluding Remarks

IETC's experience shows that its approach to technology transfer is holistic, including capacity building, knowledge and organizational development as well as developing an enabling environment for the uptake of technologies. To be successful, transfer of technology requires more than just the moving of equipment from point A to point B. Other requirements include enhanced knowledge, management skills and technical and maintenance capabilities of those receiving the technology. Integrating human skills, organisational development and information networks is also essential for effective technology transfer. Thus technology transfer is a broad and complex process if it is to contribute to sustainable and equitable development.

With the experience of working with government and private sector from many different countries, IETC will be a good partner for the Indian private sector to facilitate knowledge exchange, business partnerships and to provide a platform for cooperation with other Asian countries.

India, one of the biggest countries in the world, is at a very important crossroads. The country faces a dual challenge: rapid urbanization and economic growth on the one hand; and enormous pressure on natural resources to keep up with demand for production and consumption on the other hand. To create a win-win situation for economic growth and natural resources, ESTs can play a vital role. India can capitalize on ESTs to reduce waste during the production process. Based on its vast engineering base, India can also innovate and produce ESTs for local and overseas markets to further boost economic and job growth.

The waste sector has huge potential for adoption of ESTs to promote sustainable development as ESTs reduce waste and improve the production efficiency. ESTs can also convert waste into a resource to further boost economic activities and living standards. To materialize these ideas, policy makers, scientists and engineers, private sector and investors, and citizens' representatives may form a team to assess the current and future needs for ESTs for local and international markets and then to draw up a roadmap to produce and implement ESTs.

Sustainability Priorities of the Cement Industry in India

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India is one of the most important regions for the cement industry around the world, second only to China in terms of installed capacity. At the same time, the country is enhancing continuously its sustainability performance.

The World Business Council for Sustainable Development's (WBCSD) Cement Sustainability Initiative (CSI)[5] is working actively in various fronts of sustainable development for the Indian cement industry. 10 cement producers, including 3 India based companies and 7 subsidiaries of international groups, contribute to the encouraging results delivered by the CSI's regional work programme in India.

Being one of the most energy efficient performers amongst cement producers in the world, Indian cement producers are building new plants with latest technologies and there is a zeal to create the most efficient plants in the world.

Good safety practice – designated pedestrian pathways inside the plant

This is an industry which does not believe in resting on its laurels, but rather continues to relentlessly seek out newer, better and breakthrough technologies to further improve their performance. The Indian cement industry has successfully reduced total CO_2 emissions from a substantially higher level of 1.12 tCO_2/t cement in 1996 to an industrial average of 0.719 tCO_2/t cement in 2010 (latest publicly available data).[6]

CSI India plans to focus on managing safety and climate change issues initially, being consistent with the overall work program developed at CSI worldwide. It will progressively cover the other issues, henceforth.

Safety is the number one priority for CSI member companies

A key priority area for CSI work globally and in India is Safety. Through the years, CSI members have made notable progress in improving safety and reducing fatalities amongst their employees. Having said that, companies around the world and in India agreed that more work is required to improve contractor and logistics safety.

Ensuring safety of drivers and vehicles on roads continues to be a challenge for India as a country. India is one of the most densely populated nations in the world; its roads are often choked with traffic and have become increasingly perilous. In addition, roughly 60 to 70% of road crashes in India are related to commercial vehicles and hence improving fleet safety management can contribute significantly to overall road safety.[7] CSI members in India are working collaboratively to put in place the highest standards of safety not only within their plant boundaries but also along their logistics chain, while dealing with various local challenges.

Good practice for driving safety – installation of convex mirrors

One of the high risk factors identified is fatigue and tiredness around driving. Unfortunately many drivers, particularly commercial drivers do not adequately realize the importance of this, or for various reasons do not take into

[4] *Readers may contact Esha Sar, Coordinator (India operations), CSI at sar@wbcsd.org*

[5] *CSI is an initiative of the World Business Council for Sustainable Development (WBCSD). CSI is a global effort by 24 leading cement producers, with operations in more than 100 countries. Collectively these companies account for around 30% of the world's cement production (in India, CSI members represent around 60% of the national production) and range in size from very large multinationals to smaller local producers. All CSI members have integrated sustainable development into their business strategies and operations, as they seek strong financial performance with an equally strong commitment to social and environmental responsibility.*

[6] *Global Cement Technology Roadmap: Low Carbon Technology for the Indian Cement Industry, WBCSD-CSI, IEA*

[7] *Source: Global Road Safety Partnership website : http://www.grsproadsafety.org/*

consideration the impact of fatigue and tiredness during driving, and sometimes push themselves to the limit. To address this issue, the CSI India working group on safety has developed a document to highlight good practices for fatigue management.

The safety working group is also collaborating with transporters, drivers and companies of other industrial sectors to enhance safety awareness through training and motivation, to ensure better working conditions for drivers, better enforcement of regulations, and to improve the safety and quality of vehicles. A culture of knowledge sharing is promoted within the group, on both success stories and pitfalls, to help members learn from the good practices and mistakes of peers so to improve the overall safety performance.

In addition, CSI India is collaborating with Global Road Safety Partnership (GRSP), which is working under the umbrella of the Red Cross and Red Crescent. Some local projects and initiatives are currently being explored with GSRP which will benefit CSI India and add to their knowledge experience.

Low-Carbon Technology for the Indian Cement Industry

Following the Global Cement Technology Roadmap[8] developed in 2009 through a partnership between the CSI and the International Energy Agency (IEA), CSI members in India joined hands with IEA in early 2013 to develop a 'Low-Carbon Technology for the Indian Cement Industry'[9]. The country specific adaptation was required to better address the local issues and develop targeted actions. The initiative in India is supported by the International Finance Corporation (IFC), a member of the World Bank Group.

The India roadma poutlines a low-carbon growth pathway for the Indian cement industry that could lead to carbon intensity reductions of 45% by 2050, from the 2010 level. It proposes that these reductions could come from increased clinker substitution and alternative fuel use; further improvements to energy efficiency, and the development and widespread implementation of newer technologies.

The roadmap is based on a set of technical papers entitled 'Existing and potential technologies for carbon emissions reductions in the Indian cement industry'[10], developed by the Confederation of Indian Industry (CII) Green Business Centre and National Council for Cement and Building Materials (NCB). The modelled results projected in the roadmap are a combination of information from these papers, and emissions data from about 65% of the India cement industry, gathered through the CSI "Getting the Numbers Right" (GNR) database[11].

Partners supporting this project brought different kinds of expertise and contributions to the table: IEA brought expertise in data analysis and modelling capabilities and roadmap development; technical consultancy was provided by the CII and NCB; IFC supported the development financially; and the CSI provided a platform to solicit participation of key India cement producers.

The Roadmap lays out the way forward for the industry along a low carbon trajectory, it identifies key levers for reducing emissions, outlines technologies, policy frameworks and investment needs to reduce CO_2 intensity in the Indian cement industry. Through wide consultation amongst different players, roadmaps allow for greater buy-in amongst stakeholders on the actions needed to achieve a given goal. The Roadmap has provided the industry with a tool to identify its future pathway.

Waste heat recovery (WHR) is one of the key levers identified in the technology roadmap - WHR boiler

A number of CSI member companies in India have commissioned studies to assess the potential and feasibility of implementing the technologies outlined in the technical papers. There are plans to disseminate the knowledge captured in the technical papers to a wider audience spanning the entire cement

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[8] *Refer the link for the Global Cement Technology Roadmap : http://www.wbcsdcement.org/pdf/technology/WBCSD-IEA_Cement%20Roadmap_centre_spread_actual_size.pdf*

[9] *Refer the link for Low Carbon Technology for the Indian Cement industry: http://www.wbcsdcement.org/index.php/technology/india-roadmap*

[10] *To read the technical papers, visit the link: http://www.wbcsdcement.org/index.php?option=com_chronocontact&chronoformname =ExistingandPotentialTechnologiesforCarbonEmissions1ReductionsintheIndianCementIndustry*

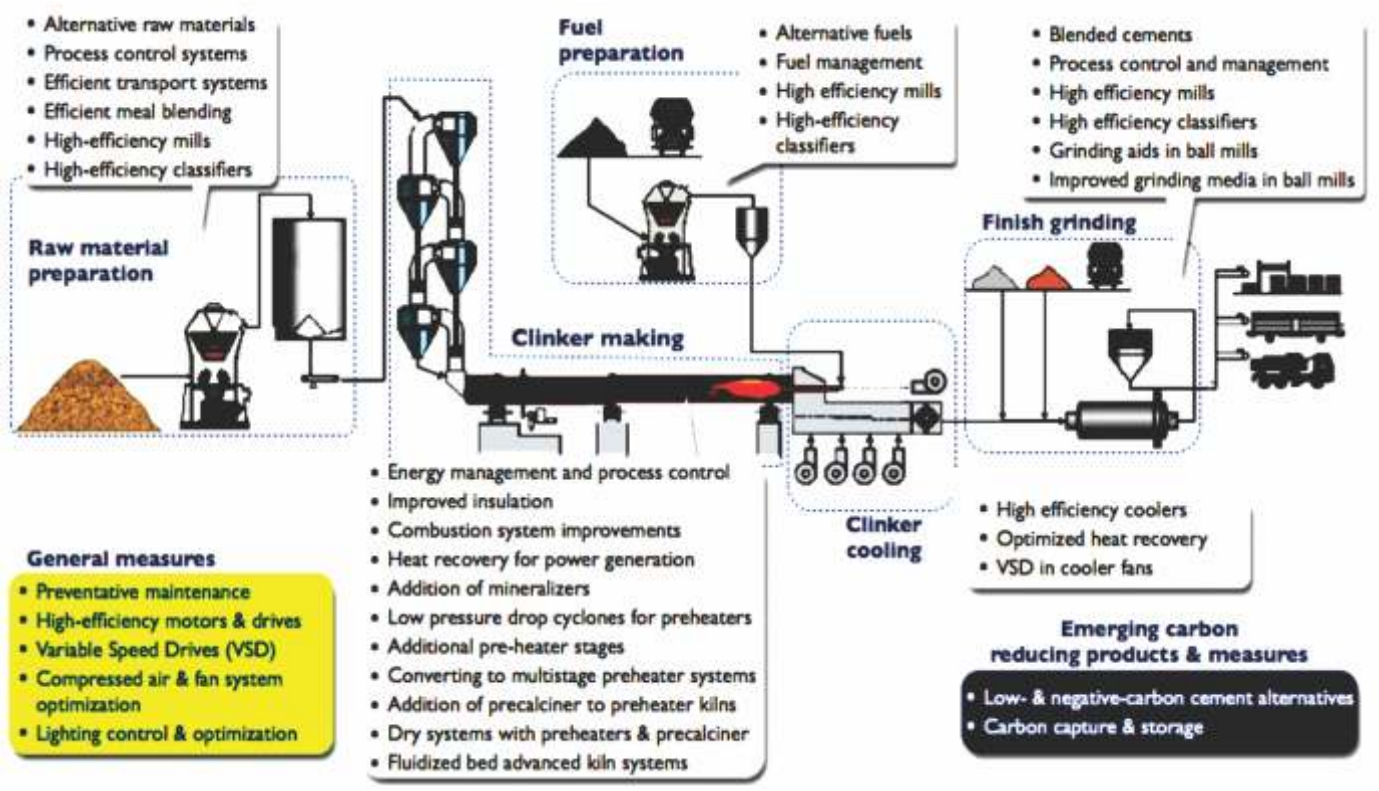
[11] *To see the GNR database, visit the link: http://www.wbcsdcement.org/index.php/key-issues/climate-protection/gnr-database*

industry in India in order to scale up actions. Learnings from the feasibility studies would also be shared with the industry to enable greater replication and reduce time spent by other companies on the learning curve. Non-CSI member companies have also approached IFC to explore the possibility of conducting feasibility studies in their plants, a development that is fully encouraged by the CEOs of the CSI members in India and bears testament to the utility and importance of the work undertaken by the Roadmap project.

Venturing into new work areas to address emerging sustainability issues in India

CSI members in India are also exploring newer areas for collaborative action viz. biodiversity management, water management and emissions control. With support from the International Union for Conservation of Nature (IUCN), a first workshop in India on WBCSD Business Ecosystems Training (BET) will take place in early May 2014. Similar activities for other areas will be organized in coordination with the CSI global task forces.

The work programme for CSI in India has been growing continuously to respond to the needs of an expanding membership and enlarged work scope and to match the overall CSI work program. Companies acknowledge the fact that our societies expect business not only to manage its own sustainability issues, but to help society manage wider issues. Members of the CSI are committed to their stakeholders by becoming part of the solution through driving progress and sustainability of the cement industry in India.



Cement manufacturing is the third largest energy consuming and CO_2 emitting sector, with an estimated 1.9 Gt of Co_2 emissions from thermal energy consumption and production processes in 2006. If Best Available Technologies can be adopted in all cement plants, global energy intensity can be reduced by 1.1 GJ/t-cement, from its current average value of 3.5 GJ/t-cement. This would result in CO_2 savings of around 119 Mt.

Source: http://ietd.iipnetwork.org/content/cement

Sustainable Energy Solutions for Grassroots Development

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Renewable energy solutions are a much sought after technologies in today's world. While many renewable energy solutions are technologically possible, there are issues like economics, irregularity of the natural resource, and resistance in modification of established systems. The imminent issues of fossil fuel depletion, global warming, and pollution, have compelled the nations to spend on research and development towards this cause.

Centre for Technology Alternatives for Rural Areas (CTARA) in IIT Bombay is a unique centre in the country, working to apply technology and policy solutions for development, addressing the needs of the people at the bottom of the pyramid. CTARA conducts research in the areas of drinking water, energy, rural electrification, planning, agriculture and food, appropriate technology, and, policy and governance. CTARA research is geared to be close to implementation and is largely stakeholder driven.

Sustainable development is one of the basic tenets of CTARA's work, and so there is a strong component of research in sustainable technologies. CTARA has worked in the areas of biomass, solar photovoltaics, biogas, biofuels, wind energy and energy efficiency. Projects in the area of sustainable technologies included analyses of various models of implementation, new technologies, and optimization of technologies. A few of these works in energy efficiency is described below.

Case 1: Community level biogas plant in Bhintbudrak, Gujarat

Biogas from cattle-dung, or gobar gas, has been promoted by the government since the 1980s but it hasn't really taken off as much in rural India. While there were several reasons for that, a community level biogas plant can be a lucrative initiative if managed in the right setting as proven in Bhintbudrak, Gujarat.

Photo: Biogas plant at Bhintbudrak, Gujarat

Bhintbudrak is a dairy village where each family has 4-6 buffalos. A community biogas plant was initiated by SUMUL dairy to supply biogas to the homes of villagers for cooking through a piped network. The villagers supplied cattle dung to the plant. The slurry output from the plant was vermi-composted to produce organic fertilizer and sold. Villagers received cooking gas for 2 hours in the morning and 2 hours in the evening. The sale of the organic fertilizer made the whole process economically feasible.

Considering the success at Bhintbudrak, the replication of such plants in large number of villages was initiated by the Government of Gujarat. The study of the ongoing replication process involving GSRDC (Gujarat State Rural Development Corporation Limited) and BOO/BOOT (Build-Own-Operate/-Transfer) agencies in the 24 villages revealed a variety of problems in the process and confirmed the role of local community participation in deciding the fate of such a project.

Sustainability analysis for community based biogas plant:

In the community-based biogas plant, dung from 200 cows is fed to an 85m^3 biogas plant. The biogas produced can be used by 60 families to cook or to generate electricity. In such a case, a biogas generator can produce 135 kWh of electricity. A recent quote of such a plant at Rs.28,00,000 (no gas delivery piping), with a low fertilizer sale price of Rs.3 per kg (market values can be between Rs.6-10), a sale of electricity at Rs.4 per unit and an operating cost of approximately Rs.100,000 per year, will deliver a payback period of 4.5 years. The cow dung has been assumed to be free in this calculation. While the biogas is more

effective when used for cooking rather than electricity generation, the biogas is hard to cost since the value of it to the villagers depend on many factors such as, the alternative source of fuel as firewood which is either free or very cheap, and willingness to pay for the health of the women folk who are most exposed to the chulha smoke.

The biogas needs to be piped to homes if it is to be used for cooking, and the cost of piping depends on the village layout. In the Bhintbudrak project, the cost of the piping was about 25% of the setup cost. Bottling of biogas is infeasible since the H_2S in biogas needs to be scrubbed, and that is a very expensive process.

CDM credits will make the plant much more viable. This has been implemented by Bagepalli CDM Biogas Project (Karnataka).

Case 2: Retrofitted twisted tape Swirlers for improved chulha efficiency

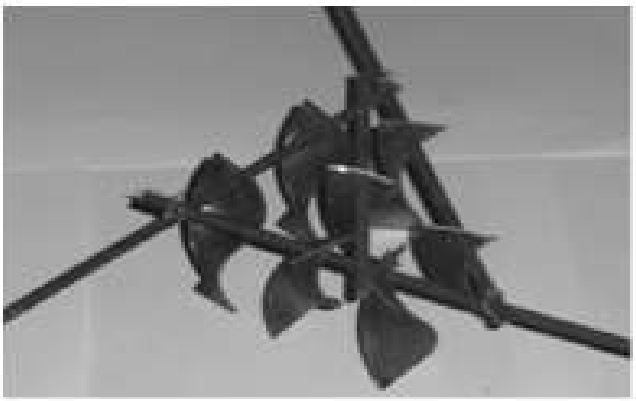
The dissemination of improved cook stoves has not been particularly successful over the years for several reasons, among which are high initial costs and maintenance issues. In this solution, an incremental change has been made to the traditional setup making adoption easy. Yet it has resulted in significant soot reduction and reduced firewood consumption.[1]

The incorporation of twisted tapes in the hearth generates a swirl motion of the gases which improves the jet impingement heat transfer at the pot bottom. It also improves combustion of volatiles by increasing air-fuel mixing and the residence time of the reactant gases.

The optimization of the twisted tape device was first carried out in the laboratory and then implemented in the field. The field-level tests resulted in reduction of firewood consumption by around 21% which is a substantial improvement for such a device. It was also found that the improvement in efficiency - reduced soot accumulation by around 38% and reduced time of cooking preparations by around 18.5%.

The twisted tapes are a simple technology that local blacksmiths have adopted. The cost of the product, which includes a profit for the blacksmith, comes to Rs.65. This product is being sold and used by people in Raigadh district of Maharashtra. Similar traditional cook stoves are found across the coastal belt of Maharashtra, hence the retrofitted device will work across the region without modifications.

Twisted tapes sitting atop a traditional cook stove



Detail of twisted tape swirlers

Case 3: Biodiesel from waste vegetable oils

Biodiesel has caught the attention of many because of the relative simplicity in production and its possible use in a decentralized manner. Different vegetable oils from rapeseed, palm, coconut and soya are used in various countries for biodiesel production. India has explored various non-edible oils for the purpose out of which *jatropha* and *pongamia* have shown promise. However, these plants are still not available on a large enough scale, or at a competitive price leading to an unviable cost compared to petro-diesel.

CTARA conducted a study to test waste oils such as acid oils and used cooking oils which are available in India at cheap rates, around Rs 21 per litre or less. Acid oil is a by-product of vegetable oil refining, and has high amount of free fatty acid (FFA) along with some triglyceride content in it. The high acidity of this material does not allow the use of the conventional one-step process of alkaline catalysis, because of the formation of soap that causes problems in the steps of washing and purification of biodiesel, thereby reducing the overall yield. The two-step process as reported in the CTARA study used esterification, followed by trans-esterification of oil using methanol, and a chosen catalyst.

Biodiesel was first made on a laboratory scale at 20 litres/batch, and then in a pilot plant, up to 400 litres/batch. Besides the waste oils, jatropha, karanja and palmoline oil were also tested by the same process for comparison

Photo: The pilot biodiesel plant

purposes. While the acid-oils were procured from nearby edible oil making units (Ruchi-Soya Ltd.), the used cooking oils were procured from the nearby McDonald outlets. The process flow design, mass balances, and the batch scheduling were studied. Standard laboratory methods were used to characterize the biodiesel made for density, viscosity, flash point and moisture content. The results from the pilot plant are given in Table 1.

The method showed a yield of 70% of biodiesel. The fixed capital engaged, without considering land cost, was Rs. 15 lakhs in year 2010. With optimization two batches of 400 litres each could be produced in a day.

The unit is being evaluated by a village entrepreneur to assess the economic sustainability of the biodiesel unit installed in a village industry centre. If the raw material availability is ensured on a sustained basis, the product will easily find market in the vicinity of the production facility.

More details about the process can be obtained from the publication related to this work.[2]

Access to modern, sustainable and affordable energy sources is an important factor for development. CTARA continues its efforts in the area of renewable energy and sustainable technologies, keeping in mind improved accessibility for the underprivileged in our society.

References:

1. *"Development of a fuel efficient cookstove through a participatory bottom-up approach", V. H. Honkalaskar, U.V.Bhandarkar and M.A. Sohoni, Energy, Sustainability and Society, 2013, 3 (16).*

2. *"Biodiesel Making from Waste Vegetable Oils: A Case Study of Lab to Plant Technology Transfer" N.G.Shah, Shoyeb Khan and S.M.Mahajani, Journal of Agricultural Engineering, 2010, 47(2).*

Table 1. Characteristics of biodiesel made from different raw materials

Sample	Density (g/cc)	Calorific Values (MJ/Kg)	Kinematic viscosity (cSt)	Flash Point (^{0}C)	Moisture content (%)
BIS standard	0.87 - 0.90	-	3.5 - 5.0	> 100	0.05
Palm biodiesel	0.86	40.1	7.02	124	0.35
Acid oil biodiesel	0.85	39.1	5.35	115	0.32
WCO* biodiesel	0.86	39.6	5.09	118	0.36
Jatropha biodiesel	0.86	39.5	7.21	130	0.17
Karanja biodiesel	0.86	39.4	6.44	126	0.41

*Waste Cooking Oil

Sustainable Technology Interventions for a Modern Rice Mill in Tamil Nadu

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Rice is the staple food of Tamil Nadu and paddy is the major crop cultivated. Rice milling is an important economic activity in Tamil Nadu and the mills are located in clusters near the paddy growing areas. One such cluster of 116 modern rice mills is in the district of Kanchipuram that handles paddy in the range of 50-100 tonnes per day. Power availability and its cost is critical for these rice mill units as they deal with erratic power supply. The detailed description of rice mills in Kanchipuram and sustainable technology interventions introduced in one of them is discussed in this article.

Modern Rice Mill operation

Paddy needs to be processed to produce rice which involves the removal of husk and bran from the paddy grain for edible consumption. There are traditional rice mills which carry out cleaning, drying, grading and polishing of rice manually. The modern rice mills as most of them in Kanchipuram use machineries like rubber shellers, polishers, dryers, whiteners, boilers, elevators, air compressors, motors, etc. for cleaning, parboiling, drying and milling of paddy.

The production process of a typical modern Rice Mill in Kanchipuram district is given in Figure 1.

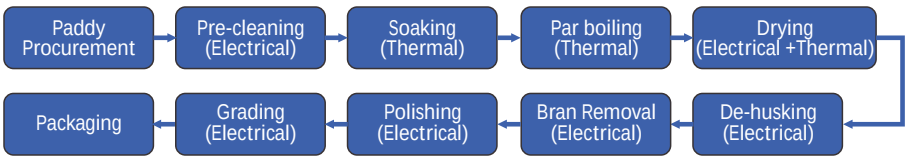


Figure 1: Production Process of a Typical Rice Mill

Paddy procured is stored in silos and pre-cleaned to remove impurities like weeds, soil, leaves and straw. The pre-cleaned paddy is soaked in hot water (85°C – 95°C) for 8-12 hours depending on the moisture content of the paddy. Hot water is re-circulated in the soaking tanks every 3-4 hours to ensure the temperature of water is maintained. The soaked paddy is then par-boiled by direct injection of steam for approximately 2 hours. Parboiling ensures that the nutritional quality of rice is maintained and reduces the breakage during milling.

The par boiled paddy is then dried with mechanical driers. The moisture content of paddy should be brought down to less than 15% for efficient milling. The dried paddy is then de-husked in a huller mill. The husk separated constitutes 12.5% of the total paddy content which is generally burnt in the boilers to generate steam. The de-husked paddy is then passed through separators to remove bran. The brown layer covering the rice grain is then removed in polishers using equipment like emery and cone polishers. The polished rice passes through sieves and sorters to remove broken/unpolished rice. There are colour detectors sorters also to determine the grade of rice. The unbroken polished rice is then sent for packaging and dispatched. The paddy is carried across different sections of the rice mill through bucket elevators.

Typically a rice mill handling 100% paddy will produce 75% of boiled rice and 12.5% of Rice Husk.

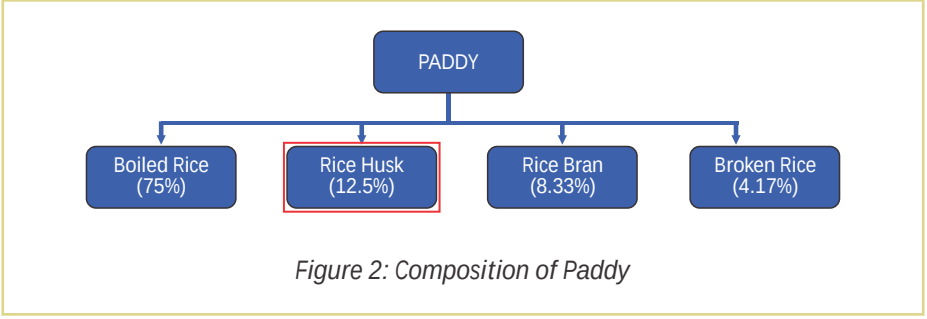


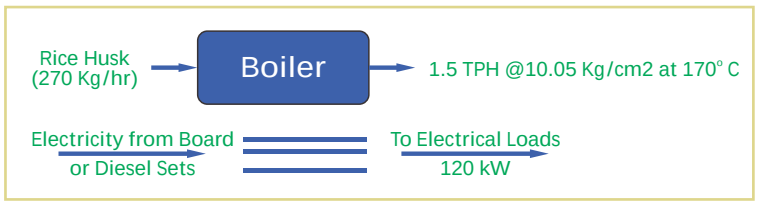
Figure 2: Composition of Paddy

Energy Requirements of a Modern Rice Mill

A modern rice mill requires both thermal and electrical energy for operation. Electrical energy is supplied through the State electricity grid and thermal energy is supplied by burning rice husk in the boiler. The state electricity board currently allots 120 kW per rice mill plant and each rice mill has a boiler of capacity 1.5 TPH. The most energy consuming processes are drying, parboiling and milling. Drying and soaking requires both steam and electrical power and is in operation for 24 hours a day as they are batch processes. The milling section operates for approximately 8-12 hours/day depending on the capacity of the dryer.

The equipments in the milling section consisting of elevators, de-huskers, bran removers, colour sorters, blowers, air compressors etc. are rated to a total of ~140 kW. The drying and boiler section equipments are rated at 50 kW.

Baseline Energy Requirements



The Tamil Nadu state electricity board tariff amounts to Rs.7.00/kWh for rice mills. The supply from the electricity board has been erratic resulting in loss of production and many units idling. A few units generate power through diesel generator sets which proves to be uneconomical amounting to Rs.18.00/ kWh.

Rice husk generated during milling is used in the boilers.

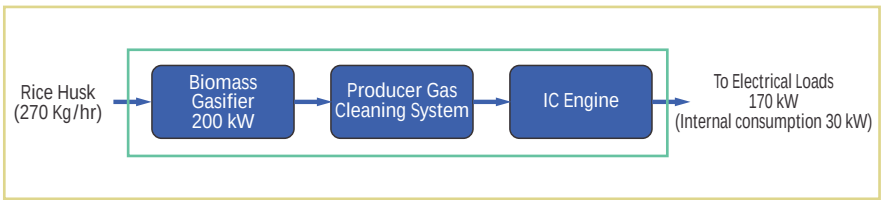
Currently units use the entire quantity of rice husk generated for burning in their boilers which results in a wastage of resources and heat. The rice husk ash generated is disposed off into waste lands and contaminate the soil (loses fertitlity over a period of time), water bodies and air.

Sustainable technologies adopted at a Modern Rice Mill in Kanchipuram

It is essential to introduce sustainable technologies throughout the product /service life cycle. The following case study discusses the different sustainable technologies interventions adopted at a Modern rice mill in Kanchipuram.

A. Biomass gasification power plant of 200 kW using rice husk for captive power generation

Biomass gasification is the process of converting agricultural waste (wood/ wood-waste, agricultural residues etc.) into a combustible gas mixture called Producer Gas which is cleaned to run engines and generate power.



The biomass gasifier is a self-sustaining captive unit which does not depend on external sources for raw material and on the electricity board for power.

Benefits of Biomass gasification power generation are outlined below:

- Available continuously unlike solar power which is available only during the day or wind power which is available only seasonally
- The cost of generation per unit is cheaper
- Power generated is captive with no requirement to wheel the power to the state electricity grid
- Land banks not required

Box 1: Cost-Benefit Analysis of Biomass Gasification in Rice Mills

Cost per unit generation using Biomass gasifier

1) Input Rice husk Cost: Rs. 1.5/ kWh
2) O&M Cost: Rs. 0.80/kWh
3) Finance Cost: Rs. 1.5 /kWh

Total Cost of Unit Generation: Rs. 3.80 /kWh

Savings compared to Electricity from

1) State Electricity Board: Rs. 3.2/kWh
2) Diesel Generator Sets: Rs. 14.42/KWh

Payback period is less than 4 years

B. Reusing fuel and recycling feed water to the boiler:

Rice husk when crushed and conditioned prior to feeding into the boiler lead to effective burning thereby consuming significantly lesser quantity of rice husk. Similarly a rise in the feed water temperature by heat recovery i.e. re-circulating water from the par boiling and drying sections resulted to a significant saving in rice husk consumption in the boiler.

The rice mill initially using 300 kg/hour of rice husk now uses only 150 kg/hour for the same heat output.

C. Using rice husk ash as a resource

The rice husk ash generated from the boiler and gasifier pose environmental hazards if not disposed properly. The rice mill has tied up with an organization which utilizes the rice husk ash produced to make rice husk ash bricks. These bricks are eco-friendly, economical and stronger compared to native clay bricks. These rice husk ash bricks have found a good market as green building materials to most of the upcoming construction development in Sri Perumbudur and Kanchipuram.

Photo: Rice Husk ash disposed near Rice Mills

Photo: Rice husk ash brick compared to clay brick

Way forward

As illustrated in the case above interventions through sustainable technologies should be considered in a holistic approach and should not be perceived as an overhaul of the present system. It not only increases efficiency but also help in substituting renewable energy systems to meet necessary mandates. Hence, it is important to look at the life cycle of product or a service and their associated technologies that can be substituted by sustainable technologies. Reducing energy and resource consumption through sustainable technologies can be translated into savings with attractive returns. Decentralized renewable energy power generation systems such as solar and biomass gasification power plants can provide for the gap in energy demand.

Plants that survive on metal!

The new species called *Rinorea niccolifera*, has a unique lifestyle - it eats nickel for a living - and can be a crucial entrant in the field of green technologies. This plant species absorb nickel in very high amounts and can accumulate up to 18,000 ppm of the metal in its leaves without itself being poisoned. Nickel hyperaccumulation is such a rare phenomenon with only about 0.5-1 percent of plant species native to nickel-rich soils having been recorded to exhibit the ability. Such an amount is a hundred to a thousand times higher than in most other plants.

A study conducted by Professor Edwino Fernando revealed that throughout the world, only about 450 species are known with this unusual trait, which is still a small proportion of the estimated 300,000 species of vascular plants. The new species was discovered on the western part of Luzon Island in the Philippines, an area known for soils rich in heavy metals.

To know more about the study, click here - *http://www.pensoft.net/journals/phytokeys/article/7136/rinorea-niccolifera-violaceae-a-new-nickel-hyperaccumulating-species-from%C2%A0luzon%C2%A0island-%C2%A0philippines*

Kolhapur Municipal Corporation to use green technology to treat sewage

The Kolhapur Municipal Corporation (KMC), which has inadequate facilities to treat sewage generated in the city, will utilize a technology that involves using specific plants to treat sewage flowing in minor nullahs.

The technology, usually referred to as phytorid technology, has been developed by Nagpur-based National Environmental Engineering Research Institute (NEERI). It involves construction of wetlands in the nullah stream using plants such as dwarf palm and elephant grass. These plants use pollutants like nitrates and phosphates as nutrients to facilitate removal of pollutants from the water. However, the technology cannot be used in major nullahs as the flow of sewage water in these nullahs is faster and may wipe out the wetland beds.

According to NEERI, the technology reduces the biochemical oxygen demand (BOD) between 75 to 90%, it also removes the suspense solid by 80% of the suspended solids can be removed. The concentration of other pollutants such as nitrates and phosphates, which can be hardly reduced in any mechanically driven sewage treatment plant (STP), can be reduce to about 60% with the help of this technology.

To know more about the phytorid technology, click here - *http://www.pas.org.in/Portal/document/ResourcesFiles/WorkshopPDFs/Citywide%20Sanitation%20Workshop/16_Phytorid%20Technology%20(R%20Biniwale).pdf*

The Update section has been compiled by Sonal Kaushik, Associate Vice President, Environmental Management Centre LLP, Mumbai.

Seminar on Office Safety

June 26, 2014

Convention Hall, 4th Floor, Y B Chavan Centre,
Nariman Point, Near Mantralaya, Mumbai – 400 021

Programme

9.30 a.m.	Registration / Inaugural Session	
10.00 a.m.	Welcome	Mr. Dinesh Pillai Security Group Head - Sustainability Committee Bombay Chamber & CEO, Mahindra SSG
10.05 a.m.	Keynote Address	Mr. Amol Tope Founder, SucceedSafe
10.20 a.m.	Vote of Thanks	Mr. Vikas Gadre Director General, Bombay Chamber
	Tea break	
10.45 a.m.	Importance of office safety (Learning from the recent incidents - fire, elevator failure, woman safety)	Mr. Nikhil Raval Member Sustainability Committee, Bombay Chamber & Director, HSE Sanofi India Ltd.
12.00 noon	Session on Slips Trips Falls (STF)	Mr. Amol Tope Founder, SucceedSafe
12.30 a.m.	Emerging Health Challenges in Corporate Offices, Health trends observed, Probable causes, Simple solutions - Office Ergonomic, Health & Hygiene in office	Dr. Madhav Rege Occupational Health Consultant, Corporate Health Services, Tata Motors Ltd.
1.15 p.m.	*Lunch*	
2.15 p.m.	Computers and Office Ergonomics Illumination, Circulatory Disturbances) (Spondylosis & other risks,	Dr. Madhav Rege Occupational Health Consultant, Corporate Health Services, Tata Motors Ltd.
3.00 p.m.	Emergency preparedness including Fire Safety and Electrical	Mr. Alok Chandra Member Sustainability Committee, Bombay Chamber & Corporate Head- Sustainability, Rallis India Ltd.
4.15 p.m.	Vote of Thanks	Ms. Usha Maheshwari Joint Director, Bombay Chamber
4.30 p.m.	*Tea*	

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