ICPE
INDIAN CENTRE FOR PLASTICS IN THE ENVIRONMENT

Envis Eco-Echoes

Management of Plastics, Polymer wastes and Biopolymers and impact of Plastics on the Eco-system

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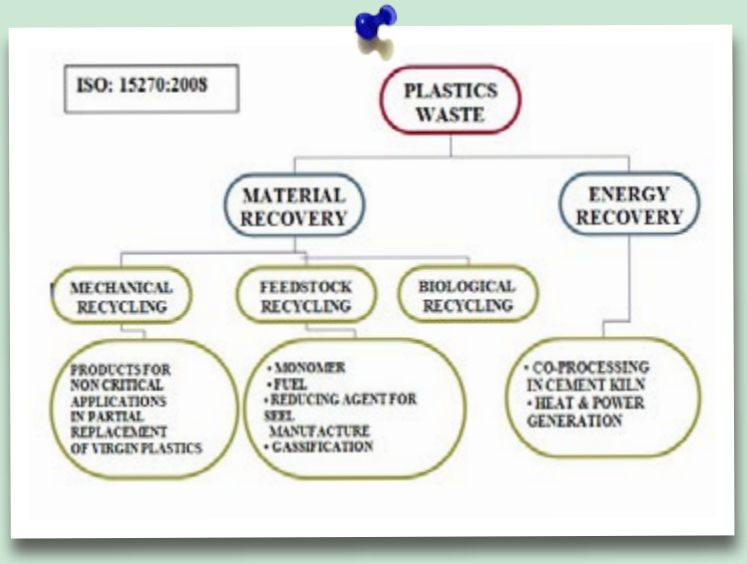

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Area of Activity

Capacity Enhancement Programme on Management of Plastics, Polymer Waste and Bio-Polymers, Impact of Plastics on Eco-System

Editorial

We all rip the benefits of Plastics from its various applications, be it in agriculture and water distribution in the form of pipes, various health care applications, electrical and telecommunication cable insulation, various building applications, household appliances, furniture, education and toys – and the single largest application – Packaging. Broadly, packaging can be categories in two sectors – food contact applications (contain foodstuffs, pharmaceuticals and drinking water) and non-food contact applications. For using any primary packaging material in direct contact with any food products, pharmaceuticals and drinking water, prior approval of the competent authority is mandatory by the packers / users for safe use of such materials. The competent authority relies on the specific approvals conferred by scientific bodies based on National and International Standards. These Standards are devised after prolonged studies and research over a period of time and after due process of deliberations in International / National forums and are adopted by the regulatory authorities in the respective countries. International Organisation for Standardisation (ISO) is the largest such body in the world having 164 countries as its Members, including India. Bureau of Indian Standards (BIS) follows ISO Standards.

BIS approves use of various plastics materials in contact with Foodstuffs, Pharmaceuticals and Drinking Water. List of such plastics materials is available in ICPE website. All Commodity Plastics – Polyethylene Terephthalate (PET), Polyethylenes (PE - High Density, Low Density, Linear Low Density), Polyvinyl Chloride (PVC), Polypropylene (PP) and Polystyrene (PS) are included in the list. Specialty / Engineering Plastics Materials also are approved for such applications. Details of the approval conditions are laid down in the Standards. Presence of residues of the catalysts (used in the polymerisation reaction process) is allowed up to some limitations. Moreover, there are additional conditions of migration limits of these residual catalysts in to the liquid/s coming in contact with the plastic materials. Mere presence of any such catalyst residue / any other additives in the migration test, per se, is not a ground for any concern unless it exceeds the limits laid down in the BIS Standards.

However, this aspect seems to be ignored by section of the society, when a health safety issue is raised against the use of some plastics materials in contact with Foodstuffs, Pharmaceuticals and Drinking Water. ICPE continues to set right the wrong conceptions in the minds of such sections of society.

What is more required today is, we all should pay more attention to the real issue which is creeping our country today – the Solid Waste Management issue including Plastics Waste Management. We have discussed this issue in the present edition.

Readers' comments welcome.

Editor
Mr. T. K. Bandopadhyay

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ENVIS is sent free of cost to all those interested in the information on Plastics and Environment.

Readers are welcome to send their suggestions, contributions, articles, case studies, and new developments for publication in the Newsletter to the ICPE-ENVIS address.

Plastics and the Environment

Creating Fire artificially in the Stone Age was considered the beginning of civilization. Civilisation brought about industrialization. As the civilization progressed, so did the needs of human race. Great inventions changed the world and accordingly changed our life style also. Industrialisation was rapid since the beginning of 19th century. The environmental effects of many inventions were far reaching. The development of industries has created an enormous impact on the environment to such an extent that it has become a concern to the very existence of the civilisation.

When we analyse different reasons for environmental pollution, we note that the following are the major ones –

- Air pollution due to various types of gaseous emissions Volatile Organic Compounds (VOCs), Hazardous Air Pollutants (HAPs) and Suspended Particulate Materials (SPM)
- Water and Soil pollution due to various types of effluents and disposals untreated from different industrial units / other operations
- Global Warming due to **CO_2 e** emissions from various industrial operations
- Depletion of ozone layer caused by emissions of certain types of emissions to the upper atmosphere

Air Pollution is considered the most serious concern, mainly in the highly populated / industrial areas. Emissions from vehicles and industries are among the major causes of air pollution. Production of plastics raw materials causes minimal effect on BOD and COD of water in comparison to alternative materials. For example, in comparison to paper industry, contribution to BOD and COD level by plastics are less than 10%.

Ozone layer in the upper atmosphere of Earth has the valuable ability to block most of the Sun's ultraviolet rays and other harmful radiations, preventing those to reach Earth's surface. Depletion of Ozone layer due to certain chemicals is a serious concern for the living beings. Attention has already been drawn and measures taken to restrict the use of such chemicals in the chemical industry. These chemicals do not find application in the manufacture of Commodity Plastics. There are certain chemicals which have been identified as Ozone Depleting Substances (ODS). They cause depletion of Ozone layer. CFC (Chloro Fluoro Carbon) is one of them. CFC-11 has been used as blowing agent in certain uses of plastics to give foamy structure. Hydrocarbons, specifically cyclopentane has replaced CFC-11 as blowing agent. Other ODS substances are Halons and Methyl Chloroform (MCF). These do not find applications in the manufacture of commodity plastics.

Global Warming phenomenon is considered the single most serious environmental issue, the world is facing today. Melting of glaciers in the poles has increased during the last 100 years at a level, which, if not resisted, would cause an environmental catastrophe in the entire world in the coming years, initially beginning with the areas near the sea sore.

Among the Top Ten Green House Gas Emission Saving Sectors - Four are Plastics

Under the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC), after going through scientific findings has concluded that significant reduction in the Green House Emissions is essential to slow down the rate of growth in atmospheric concentrations of CO_2. The IPCC analysis highlights that to achieve emissions reductions on the scale necessary, political intervention is must. Studies have been made to assess the impact of GHG emissions in two scenarios to 2030, a Business–as-Usual scenario that is, by allowing today's industrial activities to continue without imposing any restrictions or without any modifications in the process, and an "abetment scenario", by imposing necessary restrictions to achieve the target result. While world leaders are discussing on various measures to arrest the emissions of **CO_2 e**, a well researched carbon-Life Cycle Analysis (cLCA) conducted by McKinsey under the initiative of **International Council of Chemical Associations (ICCA)** and others, reveals that in 2005 the total GHG emission in the world was 46 G Tons **CO_2 e** . Due to the Chemical Industries there was about 11% savings in the **CO_2 e** emissions. Among the top 10 GHG emission savers, 4 are Plastics – Insulation, Packaging, Automobiles and Piping. These are the essential utilities we use in today's life. Plastics reduce

Plastics and the Environment

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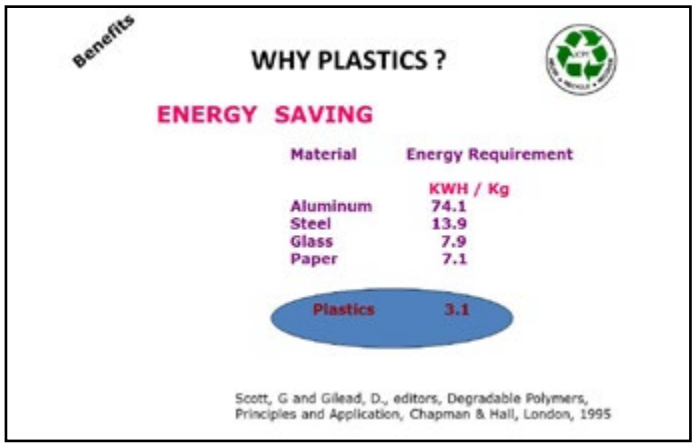
the GHG emissions which not visible by naked eye. Plastics consume least energy for conversion in to final product. Any process which requires less energy is always categorized as environment friendly.



Although plastics are employed in myriad applications where they actually conserve natural resources, there are some issues which have been surrounding the material ever since its growth rate increased. These issues mostly relate to the management of waste created by plastics products after its use, mostly in the packaging applications. Apart from the issue waste management, there are some other issues / controversies relating to health, safety and toxicities of certain types of plastics products. The major issues related to plastics could be listed as below:

- Plastics Waste – land area
- Plastics Waste – in the sea water
- Vinyl Chloride Monomer and manufacturing of PVC
- Use of Phthalate Plasticisers in PVC
- Use of Polycarbonate as Baby Feeding Bottle

Most prominent among the above is the issue of waste management. The plastics waste management relates mainly to the waste generated by packaging – the single largest application sector in plastics. The cause is mainly littering habit and inadequate infrastructure for waste management activity and absence proper recycling facilities preferably close to the place of generation of waste.

Over a period of last two to three decades, many countries have been able to address this particular issue in an appropriate manner and resolve the same to a great extent. However the issue of plastics waste in sea water is yet to be resolved to the satisfaction of all. According to the United Nation's Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), land based sources account for 80% of marine pollution, rest being from the ships. Although there is conflicting figures on the volume of marine plastics waste pollution, however there is no denying that the problem is definitely serious. More and more attention and efforts are required to address the issue.

80% of Marine Pollution originates from land area

On residual Vinyl Chloride Monomer content in PVC, the controversies have been addressed fully with proper Standards – International as well as country specific, and its effective control through the testing facilities, which are available across the world. On the use of certain types of Phthalates, research work is still continuing for proving the safe use of controversial varieties Phthalates in PVC products for food and medical applications while at least four of five types have already been declared as safe for use. However for certain applications most Nations in the world have imposed restrictions in usage. These are toys and other materials which come in easy reach of children below 3 years of age. Many countries have imposed restrictions on use of Polycarbonate Baby Feeding Bottles due to the 'Bisphenol A' issue although the alleged 'migration' of the basic raw material to the product being packed, beyond the permissible level has not been exclusively proved. In the mean time, alternative plastic material - Polypropylene Random Copolymer is being developed for this application area. In any case, for food contact applications, adequate safety measures in terms of adhering to the National and International Standards are taken .It is clear that plastics protect the environment by conserving precious natural resources and energy. More awareness drives and improvements in developing infrastructure for handling waste especially for the flexible packaging waste is required.

Plastics Waste Management: Recycling & Recovery Options

Due to its multifaceted benefits, use of plastics in variety of applications has been increasing at a galloping rate all around the world, including in India. Plastics contribute various benefits to the modern world from providing safe and hygienic packaging materials for food and pharmaceutical products, to conserving Land, Water, Forests and Energy resources to practically in all areas of our life. The list below gives a quick overview of major application areas of plastics:

- Agriculture
- Healthcare / Medical
- Education
- Pipes for Water, Gas and Sewerage
- Building & Construction – Flooring / Doors & Windows / Drainage Pipes, Water Storage Tanks, Construction Linings etc
- Cables – Electrical and Telecommunication
- Electrical & Electronics Equipments
- Thermal Insulation
- Automobile, Aviation & Railways
- Packaging
- Household
- Furniture
- Toys & Others

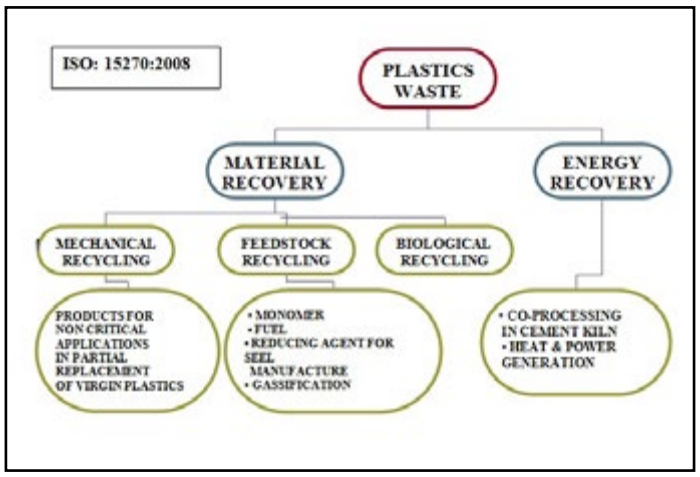
Some of these applications are for long time use and some for short term. Packaging is the single largest sector of applications of plastics which account for about 35% - 40% of consumption globally. Consumption pattern in India is similar. Flexible packaging applications are mostly for short term use. Management of waste created by the discarded used plastics items, especially the ones used for flexible packaging applications has become a challenging task, more so in the developing countries of the world.

Developed countries have established effective infrastructure for the management of plastics waste of all kinds by adopting proper collection system and different recycling technologies. However in the developing countries the general trend is to opt for selective collection of some types of plastics waste, which are easy to recycle by Mechanical Recycling Process (referred later) abandoning a large chunk of plastics waste, which are difficult for recycling.

These find their way to the landfill or simply remain in the surroundings, creating an environmental issue (chocking of drains or creating other health issues). New technologies and economics have come to play an important role in plastics recycling. When we talk about plastics recycling, it principally refers to 'Recovery', which is divided into 'Material Recycling' and 'Energy Recovery'.

Various options for plastics recycling / recovery have been described by the International Organisation for Standardisation (ISO) in its Standard: 15270:2008.

PLASTICS RECYCLING / RECOVERY OPTIONS



The choice between Mechanical Recycling, Feedstock Recycling or Energy Recovery will depend on the types of plastics waste and the relative ease / difficulty in total or partial segregation of different groups of plastics materials from each other or from other waste materials / contamination.

Brief Description of the options

Mechanical Recycling

- This is most preferred and widely used recycling process.
- Cost effective.
- This process converts the waste in to products for same or new areas of application. For example a milk packaging film waste is converted in to barsati film (water proofing purpose). A broken bucket is remoulded in to a bucket or mug etc. An automotive battery is converted in to briefcase. A PET bottle waste is recycled in to fibre for further conversion in to a carpet or a T-shirt.
- Recycled material is available at 50% – 60% cost of virgin material, at a lower property though.

Requirement:

Requirement for Mechanical recycling is Homogeneous input of same type of plastics waste. When different types of plastics are mixed together, specific segregation technique is employed to accumulate similar groups of plastics materials separately. Cleaning is an important part of the process. The process flow chart is as follows:

Sequence of operations

The mechanical recycling option generally comprises the following sequence of unit operations, some of which may occur simultaneously, that are carried out as part of the recyclate preparation and production process:

"Collection → Identification → Sorting → Grinding / Shredding with or without dust removing → Washing → Drying → Separating → Agglomerating → Extruding / Compounding → Palletizing

In some cases where the sorting process is able to group same type of plastic waste together, the "separating process" after washing and drying may not be necessary."

ISO 15270

Feedstock Recycling

This option is opted for converting plastics waste to different products:

1. Conversion to Monomer
2. Fuel
3. Reducing Agent in Blast furnace for production of iron
4. Gasification to constituent chemicals in reasonably purer form

1. Conversion to Monomer:

Some types of plastics waste have already been converted to its monomer for reusing the same as the base material for re- polymerization. At least 30 – 40% of PET waste has been re-polymerized to fresh raw material. This is a high technology process and is generally pursued by the basic plastics raw material manufacturers.

2. Fuel from plastics waste:

Waste generated out of mixed plastics, co-mingled plastics and plastics materials made out of a combination of different plastic materials are generally difficult for normal recycling (mechanical recycling) and are mostly abandoned in the waste stream as it is, and hence creates waste management problem.

Success has already been achieved in converting such plastics waste in to industrial fuel in an environmental friendly technology in some countries in the world including in India. This option has the benefit of using mixture of different types of plastics waste, mixed together, without segregation. Elaborate cleaning / washing is also not required. Industrial Fuel made out of the plastics waste is substitute of fossil fuel (LDO). This process is also used for Recycling of Electronic Waste, containing plastics.

Principles Involved

All plastics are polymers mostly containing carbon and hydrogen and few other elements like chlorine, nitrogen etc. Polymers are made up of small molecules, called monomers, which combine together and form large molecules, called polymers.

When this long chain of polymers breaks at certain points, or when lower molecular weight fractions are formed, this is termed as degradation of polymers. This is reverse of polymerization or de-Polymerisation. If such breaking of long polymeric chain or scission of bonds occurs randomly, it is called 'Random de-Polymerisation. Here the polymer degrades to lower molecular fragments. In the process of conversion of waste plastics into fuels, random de-Polymerisation is carried out in a specially designed reactor in the absence of oxygen and in the presence certain catalytic additives. The maximum reaction temperature is around 400°C.

This process can convert all types of hydrocarbon polymers including thermo plastics and thermosetting plastics, rubber products including used automobile tyre and synthetic fibre. Economic viability depends on the volume of operation and types & cost of inputs. Commercial scale plants are already running in some parts of the country. Pilot Plant is running successfully at a Colony in the heart of New Delhi since beginning of 2014. There is a growing feeling among the civic authorities for decentralizing the treatment processes of MSW closer to the waste generation area, if possible, so that the waste need not travel a long distance. Keeping that requirement in mind, Technologies are nowadays offered so that smaller batches of waste could be treated without causing any untoward environmental nuisance in the vicinity. The model project in New Delhi has been set up keeping this as a background. The plant is based on pyrolysis technology and runs in batch process. The batch capacity is 50 Kgs. The technology helps in converting all types of synthetic polymers into liquid hydrocarbon fuel and LPG rage gas at a temperature range of 150 - 450° C with the help of a unique pyro-cracking catalyst developed and patented by the technology provider. A special characteristic of the technology is that the volatile gases from the heated polymer react with the catalyst which is packed in a cartridge placed outside the reactor. This, as per the technology provider, ensures greater safety of the whole reaction process. The gas generated during the process burns with a blue flame and can be used for domestic cooking purpose. The residue after pyro-cracking is a mixture of carbonaceous material along with some percentage of inorganic debris. This residual material has sizable calorific value and could be used as solid fuel similar to coke. Any metal part which was embedded in the plastic waste product, would settle down at the bottom of the reactor to be collected separately at the end of the reaction.

The conversion rate depends on the type of plastic waste. Typical conversion rates are:

Liquid Fuel	25 – 80 %
LPG range Gas	15 – 50 %
Soil Fuel	5 – 25 %

Some amount of water vapour formed during the reaction process evaporates while collecting the fuel. Polyethylene and Polypropylene gives highest conversion rate to fuel while polyester gives low conversion. By mixing different types of plastics together, the optimum conversion could be achieved. No untoward VOC's are emitted in the surrounding environment. The hydrocarbon fuel is in the range of Light Diesel Oil

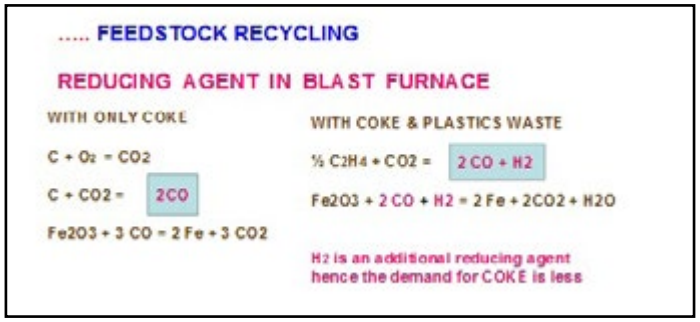
(LDO) and can be used in boilers, transformers, generators etc. Gross calorific value of the fuel is around 10, 500 cal/G.

Normally rigid plastics waste like bottles, jerry cans, broken buckets etc are mechanically recycled in plants located at industrial areas. The packaging films – mostly multi layered films and Thermocole (Expanded Polystyrene) materials which are abandoned by the mechanical recyclers, are put into such Waste to Fuel plant for scientific disposal. It is observed that average quantity of multilayered and other film waste and Thermocole waste generated in the colony is around 15 to 20 Kgs / per day, which is fully converted to fuel. At present no plastics waste (and no MSW) generated in this Colony, goes to the Landfill! Collection of waste can be extended to a wider area, even covering the nearby roadsides, so that larger capacity plants could be set up.

3. Reducing Agent in Blast furnace for production of iron

Successful examples are available for use of waste plastics as a reducing agent in the blast furnace for the manufacture of iron from its ore. Use of coke in the blast furnace provides only one type of reducing agent – Carbon Mono-oxide - (CO). In contrast, use of plastics waste provides one additional type of reducing agent – Hydrogen (H) apart from Carbon Mono-oxide. The process also reduces generation of 'ash'. A steel manufacturing facility having production capacity of 3 million tons per anum, can consume 600, 000 MTs of plastics waste. Japan is the leader in the world for implementing such process in various steel plants in their country.

The reaction involved is described here:



Energy Recovery

1. Co-Processing of plastics waste in Cement Kilns
2. Incineration for energy recovery / power generation

As the recovery option depends on many prevailing circumstances, Life Cycle Analysis (LCA) may be applied to decide, depending on the type and composition of the plastic wastes, which options are environmentally more favourable and sustainable.

1. Co-Processing in Cement Kilns

One of the most effective methods of recycling of plastics waste for recovery of energy is its use as an alternative fuel in cement kilns. The list below gives a comparison of the calorific values of different plastic materials as compared to coal.

Polyethylene	:	46 MJ/kg
Polypropylene	:	44 MJ/kg
Polyamide (Nylons):		32 MJ/kg
PET	:	22 MJ/kg
Coal	:	29 MJ/kg

The high temperature used in the cement kilns gives a scope for use of even some type of plastics waste contaminated with toxic chemicals like pesticides and some other hazardous materials without creating any increased emissions in the air or water. No segregation or cleaning is required for such type of disposal. Low-end plastics waste, which creates a waste management problem, may provide the vital energy to the cement industry.

Practically all types of plastic wastes can be used as an alternate fuel in cement kilns. Halogen containing plastics also can be used in kilns having suitable arrangements. It is observed that the emission levels of various gaseous substances including Dioxins and Furans, TOC, Heavy Metals, SPM, CO2, SO2 and NOx etc, either came down or remain within the acceptable norms. This is indicative that disposal / co-processing of all types of plastic wastes in cement kiln in Indian condition is an environmentally safe option.

There are about 170 cement kilns in the country, in different zones. Out of which about 150 Cement Kilns can use plastics waste as an alternative fuel. Even if each Cement Kiln replaces about 10% of coal with plastics waste (Germany replaces more

than 60% coal with plastics waste), more than half a million tons of plastics waste of the country could be disposed of scientifically and also saving close to one million ton of coal (for every Ton of coal about 0.6 MT of plastics waste is sufficient, because of higher calorific value of plastics). For using more quantities of plastics waste in the feed, certain modifications are required considering the light weight of plastics.

2. Incineration for Energy Recovery / Power Generation

After the selection of various types of plastic waste for mechanical recycling, there may still remain some types of plastic waste, heavily contaminated with various types of contaminants including different toxic chemicals or hazardous products. The best way of re-utilizing these wastes is to use the latent energy content of the plastics waste by co-processing in cement kilns or to incinerate them and recover the heat energy, instead of dumping them diffusely on landfills. This recovers their calorific values. The choice of incinerators is very important. Modern incineration technology has answers to tackle any incineration problem without polluting the environment and in many cases recovering the calorific value out of the waste being incinerated. Heavily contaminated plastics waste collected from different waste stream can be utilized for energy recovery by waste incineration plants. Cost of this system of recovery is considered highest among all the other alternatives. When considering incineration as an option, it is to be remembered that waste incineration plants are not operated with the aim of producing energy. The main purpose is and remains to reduce the volume of waste to a considerable degree by means of incineration in an environment friendly manner. Plastics waste contain calorific values equivalent to fuel. The list below gives the comparative energy values of different plastics vis-à-vis fuel oil and coal in Btu / pound.

Energy Values	
Material	**Btu/pound**
Plastics	
PET	10,900
HDPE	18,700
Other Plastic Containers	16,400
Other Plastics	17,900
Rubber & Leather	12,800
Newspaper	8,000
Corrugated Boxes (Paper)	7,000
Textiles	9,400
Wood	7,300
Average for MSW	5,900
Yard Wastes	2,900
Food Wastes	2,900
Heat Content of Common Fuels	
Fuel Oil	20,900
Wyoming Coal	9,600

There are 121 energy recovery facilities operating in the United States, with a designed capacity of nearly 97,000 tons of waste per day with the capacity to generate 2,700 MW of electricity (enough to power approximately 2 million homes), saving an equivalent of 30 million barrels of oil per year and preventing the release of 40 million tons of CO2 equivalents annually. At present more than 19 percent of the nation's MSW is processed by energy recovery facilities. A recent national survey found that 97 percent of opinion leaders support expansion of energy recovery in the United States and 89 percent would prefer remaining plastics to go to energy recovery facilities instead of landfills.

How do plastics contribute to waste-to-energy incineration?

Plastics are derived from petroleum or natural gas, giving them a stored energy value higher than any other material commonly found in the waste stream. In fact, one pound of plastics can generate twice the energy as Wyoming coal and almost as much energy as fuel oil. When plastics are processed in modern waste-to-energy facilities, they can help other waste combust more completely, leaving less ash for disposal in landfills.

- **Use of plastics waste in the construction of asphalt road:**

Use of plastics waste in the construction of asphalt road has been demonstrated by at least two to three technologies in the country in the past 3 – 4 years. There is scope of using some types of low-end plastics waste without elaborate cleaning, for improving the property of tar road by replacing bitumen to an extent of about 10 – 15 %. Such roads have been laid in different parts of the country. Tamil Nadu took initiative in encouraging the implementation of the technology developed by a Madurai Engineering College followed by Karnataka, which adopted a technology developed by CSRI Laboratory, Central Road Research Institute, Delhi. Later ICPE also took initiative in developing a technology for laying roads with plastics waste in some other parts of the country. MoEF has recognized the benefits of this process and encourages for its wide scale adoption. Flexible plastics packaging waste can be used in the process after suitable modifications.

Plastics Waste used in Road Construction

- PE / PP / PS / EPS
- Multilayered Plastics @ 15% of total Plastics Waste

For 1 KM long and 7 feet width Road, 1 MT of Plastics Waste is used with 9 MTs of Bitumen in the bottom layer. Road with seal coat requires extra Plastics Waste.

There is a saving of about Rs.20, 000/ per KM of 7 ft wide road. Quality of road also is improved.

Segregation / Collection and Transportation of Waste for converting it in to Wealth:

To make the whole process successful, at the first place it is important to segregate Waste in to 'Dry' and 'Wet' at the source of waste generation itself. This is the action which is taken by the waste generator – households / occupiers. Once this is done, the next step is collection of the waste, specifically the Dry Waste, for further segregation in to different types. This action can be accomplished appropriately by engaging waste separators, who segregates plastics, papers, metals, glass etc wastes separately so that the same could be forwarded to respective recycling industries for their conversion in to suitable products for use. Such practice of engaging manual workforce for segregating Dry Waste in to specific categories does exist in some parts of our country.

In Mumbai such model projects have been successfully being carried out with the initiatives of ICPE along with NGOs and fully supported by Brihanmumbai Municipal Corporation. In this model project, in select Mumbai Wards, about 80 (now 100) waste pickers have been engaged for collecting Dry Waste from the residential societies, shorting the waste in to different categories in the areas allotted by the Municipality Corporation and selling the shorted dry waste to Waste Dealers / Recyclers at market price. This help the waste pickers earn their livelihood and also Municipality Corporation to reduce the load in the landfills. Corporation also saves the cost of transporting the waste to far placed landfills.

Waste Management System at Brihanmumbai Municipal Corporation :

In Mumbai, constant effort is being made to separate the Dry and Wet waste at the source itself, so that the Dry wastes could be further segregated into different types of wastes and could be sent for recycling, resulting in lesser load to the landfill, sites.

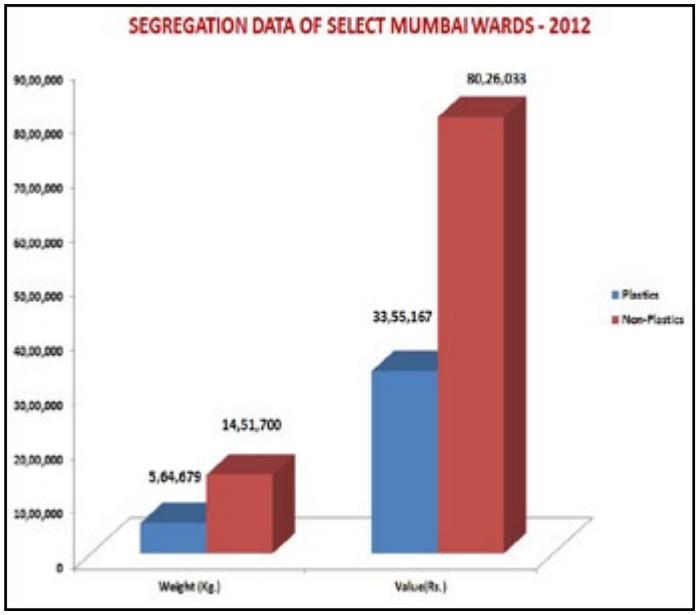
There is an increasing activity among various Local Self Government Councils to treat the wet waste also through vermiculture or similar process, to generate compost which can be used as fertilizers. ICPE along with some NGO's have joined hands with BMC in some Wards of Mumbai to propagate the Proper Solid Waste Management culture among the citizens. The results are evident in at least some Wards of Mumbai.

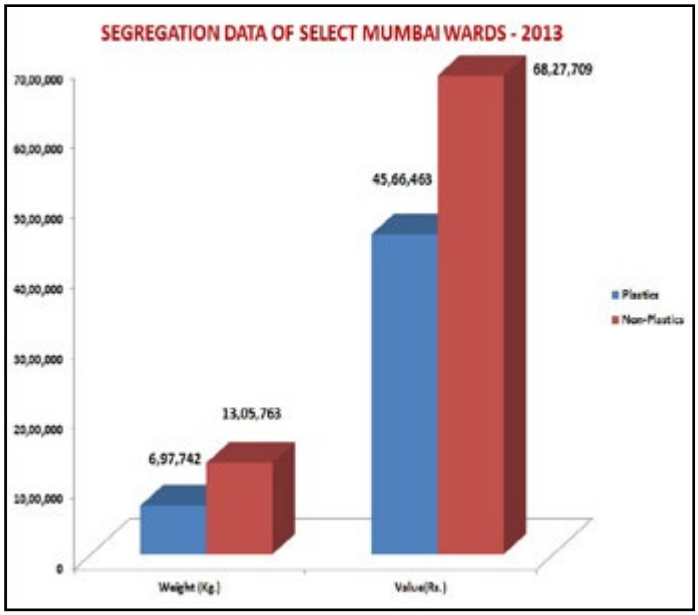
Here is a brief description of the work being practised:

'A' – Ward (Cuffe Parade Area):

1. BMC has given a secured area and a shed for segregation of dry waste.
2. BMC has also provided 2 nos. 1 toner vans with drivers, free of cost, to move in the locality for 8 hours to collect dry wastes from households.
3. BMC / identified NGOs have issued Identity badges to the rag pickers.
4. Rag pickers accompany the BMC vans and collect dry wastes from door steps of the households/society buildings and bring those to the BMC allotted sheds for segregation.
5. The dry wastes are product-wise segregated into : paper, plastics, metal and others. Obviously, within each product, there are different categories e.g. in metal, there would be iron, aluminum foil etc. In plastics, there would be PE, PP films, polystyrene cups, HDPE solid items / caps etc.
6. These segregated dry wastes are stored in the secured sheds for disposal.
7. When sufficient quantity of waste is accumulated, waste dealers come to these sheds, weigh the scraps and pay the rag pickers / co-coordinator the cost of the waste, and collect the dry waste. Generally, this collection takes place once in a week. (In some places, where the sheds are not well secured, rag pickers dispose off their segregated wastes every alternate day, or even daily to the recycles / traders)
8. The wet wastes are collected by separate BMC vans from the household localities – directly to the landfills.

In some societies, local self government council or the societies themselves are collecting the wet wastes also for composting, resulting into zero garbage concept. However, this is not yet widely practised in all parts of the country as yet.





In 2013, about 100 waste pickers segregated more than 2000 MTs of Dry Waste consisting of about 40% as plastics waste, and earned sales revenue of more than Rs. 1.0 Crore, effectively earning about Rs. 9000/ per month per family, by selling the waste to recyclers. Civic Body and ICPE also shared some expenses. However, at the end 2000 MTs of Dry Waste did not land in the landfill. Such models are worth implementing in the whole country with appropriate modifications depending on local conditions.

Protoprint: MIT grad Sidhant Pai's startup using ragpickers to make green 3D printer

Protoprint's RefilBot converts it into filaments that is used as raw material to print objects in a 3D printer

BANGALORE: Narendra Modi may have never heard of Sidhant Pai, but if the young MIT graduate's plans remain on track then the 21-year-old may unwittingly become an ally in the Indian prime minister's push to clean up Indian cities. In the run up to the general election, Modi had made making Indian cities world-class one of his key poll promises. Along with impressive skyscrapers and airports, cleanliness is a common factor of all great cities.

Which is where a startup like Pai's Protoprint with its innovative solution to transform plastic waste into raw material for 3D printers makes a difference. The Pune-based startup, the first of its kind in India, has tied up with ragpickers who bring in waste they collect from various parts of the city to a site run by Protoprint.

At the site, the plastic materials are segregated and fed into the FlakerBot, a machine built from scratch by Pai to shred the plastic. From there, the shredded plastic moves to the RefilBot, also built by Pai, which converts it into filaments that is used as raw material to print objects in a 3D printer.

"We designed them (the machines) specifically to be low cost," said Pai, who started up through grants and the fellowship money that he received, apart from his work on projects like building an affordable solar cell phone charger in Nicaragua and pedal powered butter churn in Tanzania during his first two years at Massachusetts Institute of Technology in the United States. "As an environmental engineer I wanted to bring technology to the masses."

Of the total investment of $110,000 in the startup, non-profit global investment firm Echoing Green put in about $80,000, said Pai. So far, different commercial 3D printers used filaments of various sizes as raw material. Pai is now trying to change this by standardising the sizes and quality of the filaments. Deepak Raj of Bangalore-based 3D printing design factory Df3d said there is a certain chemical composition that has to be met for a filament to work in a particular 3D printer, stressing on the difficulty in developing a standardised filament. "It's very interesting how this (standardisation of filament) is being done. It is quite difficult," said Raj. Protoprint is working as the first officially certified producer with UK-based charity organisation Techfortrade's The Ethical Filament Foundation, an initiative that partners with organisations worldwide to aid the manufacturing of ethical 3D printer material from recycled plastic waste. Globally, there are a few precedents. While Italy-based Ewe Industries has developed a machine that turns any recycled plastic into filament, UK's Omnidynamics recently raised £64,369 on crowdfunding platform Kickstarter to develop its filament maker.

Source : By Malavika Murali, ET Bureau | 18 Jul, 2014, 04.50AM IST

Court junks PIL for ban on sale of food in plastic wraps

MUMBAI: A public interest litigation (PIL) seeking a ban on the sale of food products in plastic wrappers at Central Railway (CR) stations was dismissed by the Bombay high court on Friday. The PIL, filed by non-profit group Railway Parishad, had contended that in May 2012, the Railways had announced a ban on the sale of plastic items and that it could do so again. "The tracks are overflowing, they aren't at all serious about cleanliness," said the counsel for the petitioners. TJ Pandian, counsel for the CR, said that even if there was a ban on plastic items at the stations, passengers could still carry plastic items purchased from elsewhere with them. "The public can always buy from outside," he said. The petitioners sought to make a representation to the railways. The bench however asked: "Is it possible to impose such a ban?" before disposing of the petition.

Source: 5 Jul 2014Hindustan Times (Mumbai)HTC

Awareness Programme

St. Xeviers & Sai Nath School, Mumbai in July, 2014

ICPE regularly conducts awareness programmes in schools and colleges with emphasis on developing right attitude towards plastics in general and encouraging the students to inculcate the habit of anti-littering and segregation of waste at homes (source) into Dry and Wet to facilitate solid waste management. In 2013 -14 Academic Session, ICPE had organized more than 60 sessions of Awareness Programmes among the students and teachers of schools and colleges in and around Mumbai. About 8000 students including about 200 teachers of 20 schools and colleges were covered under the programme.

In this regard ICPE had engaged Mumbai based NGO – Stree Mukti Sanghathana, for conducting these Awareness Programmes.

The school and college principals appreciated ICPE effort for organizing such awareness programmes among the students. Students, on their part, also responded well to the programmes. The most frequent observations made by the students across various schools was "even if we segregate the waste at homes, Municipality waste collecting vehicles mix up the same and take everything together to the landfill". Students are pacified that our continuous follow up with the civic bodies for abiding the Rules could bring about the required change.

The present design of ICPE School Programme is more suitable for students of programmes for students from class VII to higher classes.

Awareness Programme

Jai Hind College, Mumbai on 31st July, 2014

ICPE had organised Awareness Programme at Jai Hind College, Churchgate, Mumbai on 31st July, 2014. About 100 students of Environment studies & their teachers attended the programme. Shri Tushar Bandopadhyay along with Shri P. P. Kharas *Hon.* Treasurer of ICPE conducted the sessions with the assistance of Shri Sudheer Khurana . The programme included screening of awareness films and deliberations. At the end of the programme a Questionnaire session was also organised. The Principal of the College expressed his gratitude to ICPE Management for deputing its officers for organising the awareness programme for the students on the very important social issue. He expected that ICPE would offer its assistance in conducting such programme in the future also.

IPLEX - 2014

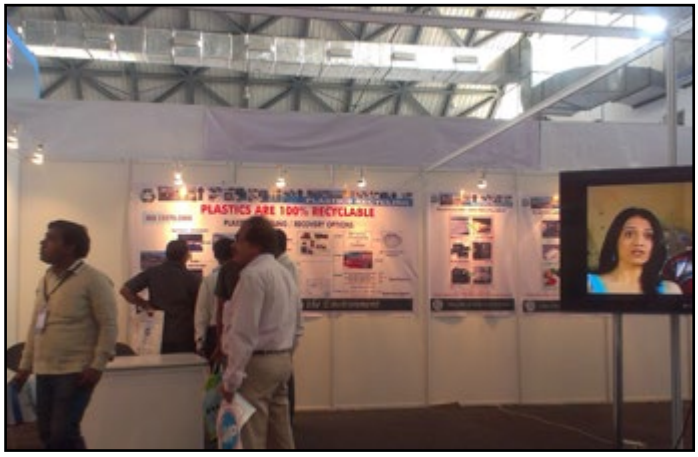
8th - 11th August, 2014, Hyderabad, India

ICPE participated in the IPLEX 2014 Exhibition held during 08th to 11th August, 2014 at HITEX Exhibition Centre, Hyderabad. ICPE organized the Recycling Pavilion where various activities of Plastics Recycling and related matters were exhibited. The exhibition pavilion space was provided free of cost by the Organisers. ICPE had taken initiative in arranging the display of the various knowledgable Panels, which shows the Plastics Waste to Fuel making plant at the recycling pavilion which attracted the attention of large numbers of visitors.

Feedstock Recycling is the desired mode of recycling of mixed plastics waste, including waste of multilayered laminated plastics, expanded polystyrene (thermocole) etc, which causes waste management problem.

Apart from this, Awareness Films on Plastics and the Environment were screened in the Pavilion. Shri Ananth Kumar, Honorable Minister of Chemical & Fertilizers, Government of India had inaugurated the Exhibition. Various dignitaries, had visited the ICPE Pavilion. Senior Executives of large scale plastics products manufacturers as well as packers of various products who use plastics for packaging their products, showed interest in using some of the technologies displayed. Along with them more than 5000 visitors visited ICPE Stall.

The Awareness Campaign also reminds them about their responsibility towards facilitating creation of appropriate plastics waste management system in the country.



DATA SHEET

Summary: Emission monitoring results

Parameter	Units	Norm	Measured stack emission during the trial			Change in Emission s during Co-processing of the waste	Change in emissions after co-processing the waste
			Pre Co-processing	Co-processing	Post Co-processing		
Dioxin and Furan	ng TEQ/Nm^3	0.1	*0.004*	*0.0033*	*0.0029*	-0.0007	-0.0011
TOC	mgC/ Nm^3	20	*5.5*	*7.36*	*6.01*	1.86	0.51
HCl	mg/ Nm3	50	*ND*	*ND*	*ND*	0	0
HF	mg/ Nm3	4	*ND*	*ND*	*ND*	0	0
SO2	mg/ Nm3	200	*77*	*27.75*	*12*	-49.25	-65
SPM	mg/ Nm3		*44.9*	*48.6*	*48.9*	3.7	4
CO	mg/ Nm3	100	*446*	*780*	*313*	334	-133
NOx	mg/ Nm3	400	651	600.5	614	-50.5	-37
Mercury	mg/ Nm3	0.05	0.014	0.046	0.006	0.032	-0.008
Metals(except Cd & Tl)	mg/ Nm3	0.5	*0.047*	*0.041*	*0.037*	-0.006	-0.010
Cd and Tl	mg/ Nm3	0.05	*0.002*	*0.004*	*0.004*	0.002	0.002

Salient Features of the Co-processing trial

- **Dioxins & Furans, TOC, Particulate, CO2 , CO, NOx, HCl, HF, Heavy metals** (Sb,As,Cd,Cr,Co,Cu,Pb,Mn,Ni ,Tl,V) **and Hg emissions** were monitored from kiln stack during each phase of the co-processing trial.

- **<u>The emission monitoring results concluded following.</u>**

  - **All the stack parameters were well within the CPCB norms for Common Hazardous Waste Incinerators.**
  - **Dioxin and furans level were less than 0.004 ng TEQ/Nm3 during each phase of the trial as against the norm of 0.1 ng-TEQ / Nm3.**

- **<u>Recommendations</u>**

  - **The co-processing trial run results concluded that the waste materials namely Poly residue and ETP sludge can be safely co processed in cement kilns without any harmful emissions in the environment.**
  - **The Co-processing technology can provide a better, economical and ecologically more sustainable solution to the waste management problems of the industries.**

Source: Due to its high calorific value, plastics wastes are used as Alternate Fuel in Cement Kilns. However due to non-availability of emission data in Indian conditions, Indian Cement Kilns were not using plastics waste for co-processing. In 2008, ICPE initiated and sponsored a project to evaluate the emissions possible in Indian Cement Kilns in partnership with cement major – ACC Ltd with the permission of the authorities. SGS Laboratories was engaged for collecting the emission samples and testing the same at its Indian and Belgian facilities. On the basis of the positive results, Central Pollution Control Board has since approved use of plastics waste for co-processing in cement kilns.

THINK
Before You THROW

How to dispose waste wisely.

At Household Level

- Keep two waste bins or even two plastics garbage bags.
- Think and throw Dry Waste into one and Wet waste into the other.
- Instruct your sweeper to handle them separately.

At Society / Building Level

- Instruct the Sweeper to keep the collected Dry Waste and Wet Waste Separately.
- Construct two separate areas to store Wet Waste and Dry Waste.
- Local Municipality authority would arrange to collect the Dry Waste and Wet Waste

What is Dry Waste: Consists of plastics, paper, glass, cloth, rubber, metal, etc., i.e., all recyclable material. This forms nearly 70% of the volume of waste

What is Wet Waste: Consists of garden waste, kitchen waste such as fruit and vegetable peels, egg shells, tea leaves etc., i.e. all bio-degradable material

IT'S SMART TO SEGREGATE WASTE
because the waste generated in households, consists of

Dry Waste and **Wet Waste**
Most of the Dry Waste can be recycled for manufacturing useful items.
Wet Waste Can be composted / vermiculated to make manure for growing plants.

Do it - For the Sake of our Environment
Do it - Because it is now the LAW!

Issued in the Public Interest by

Indian Centre for Plastics in the Environment *in association with* **NGO'S, Plastics Associations and Responsible Citizens like you.**

Indian Centre For Plastics in the Environment
(An Autonomous National Body Registered Under Societies Act)

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