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Plastics in the
Environment

Eco-Echoes

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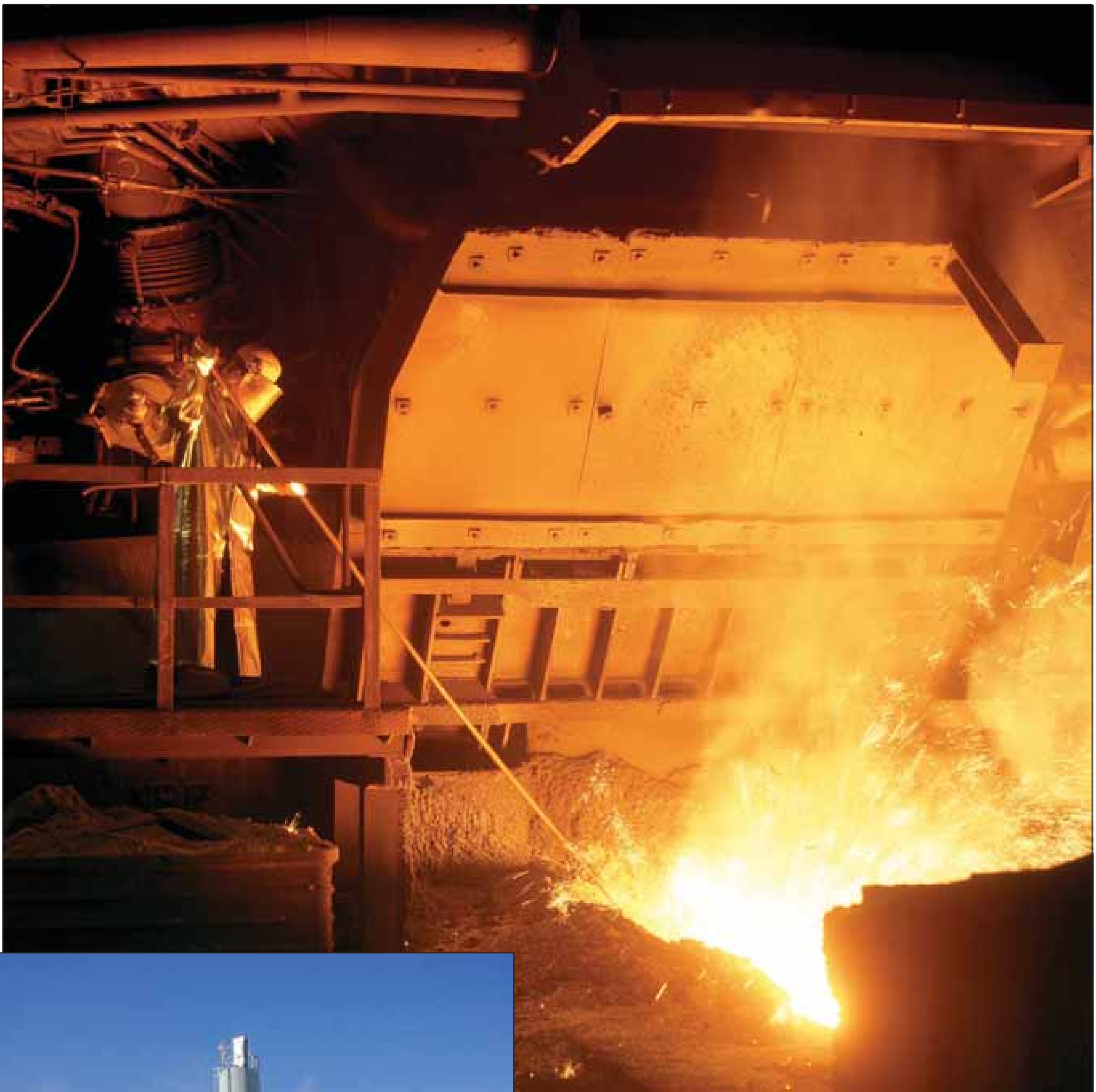
ICPE NEWSLETTER



Use of Plastics Waste in Blast Furnace and Cement Kilns

In this Issue

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

Forthcoming Events

Plexpo India 2007 – Prosperity Through Plastics

4th National Plastics & Packaging Exhibition

25th-28th January, 2007

Ahmedabad

Plexpo India 2007, 4th National Plastics & Packaging Exhibition to be held from 25th-28th January, 2007 follows the stupendous success of previously organized three Plexpo exhibitions.

The exhibition will showcase plastics raw materials, master-batches, machineries, moulds, dyes, ancillary equipments, packaging materials and various plastic end products, etc.

Organized by:
Gujarat State Plastics Manufacturers Association
E-mail: plexpoindia@gspma.org
Website: www.gspma.org

Indplas '06

International Exhibition on Plastics

24th-27th November, 2006
Science City, Kolkata

Organised by
Plastindia Foundation
and
Indian Plastics Federation
Website: www.indplas06.com

Plastivision India 2007

7th National Exhibition and Seminar

6-10 December, 2007
Bombay Exhibition Centre, Mumbai

Organised by:
The All India Plastics Manufacturers' Association
E-mail: aipma@vsnl.com
Website: www.aipma.net

IPLEX '07 – Indian Plastics Exposition

27th-30th April, 2007
Hitex Exhibition Centre, Hyderabad

For more information on Eco-Echoes and about the contents, please contact Mr. T. K. Bandopadhyay, Technical Manager, ICPE, Mumbai.

Use of Plastics Waste in Blast Furnace

Due to its multifacet benefits, use of plastics in a variety of applications has been increasing at a galloping rate all round the world, including in India.

Though plastics contribute various benefits to the modern world from providing safe and hygienic packaging materials for food and food products, to conserving Land, Water, Forests and Energy resources and to practically in all areas of our daily life, the management of the waste created by discarded used plastic items, especially the ones used for packaging applications has become a challenging task in developing countries. Developed countries have established effective infrastructure for the management of plastics waste of all kinds by adopting paper collection system and different recycling technologies. Out of the different recycling technologies, recovery of fuel and energy from plastics waste is a very important and effective option.

One such option is use of plastics waste as a source of energy in Blast Furnaces.

Use of Plastics Waste as Reducing Agent in Blast Furnace

For the smelting of Iron ore for producing pig iron, traditionally coke is used in the blast furnace to generate carbon monoxide (CO) and heat. Many steel companies use pulverized coal, to reduce the cost of raw material. Waste Plastics have replaced a part of coke or pulverized coal for producing pig iron from iron ore. Plastics, when burnt in the absence of sufficient oxygen, produces CO apart from generating the heat energy. This property of plastics has been utilized in blast furnace.

The Process

The plastics waste is first formed into suitable size either by crushing or pellatellising as necessary, and subsequently injected into the blast furnace from the tuyeres at the base of the furnace with hot air. The injected plastic waste material is broken down to form reducer gas – Carbon Monoxide (CO) and Hydrogen (H_2). The reducer gas rises through the raw material layers in the blast furnace and reacts with iron ore. While reducer gas reacts with the iron ore to produce pig iron, the gas, after the reduction reaction, is recovered at the top of the blast furnace which has an energy content to the tune of 800 kcal/NM^3 and is reused as a fuel gas in heating furnaces and generators within the steel plant.

The reactions involved in the process

(A) In the presence of coke or pulverized coal only:
Coke or pulverised coal is burnt rapidly in the first stage of operation when, in the presence of oxygen, carbondioxide is produced.

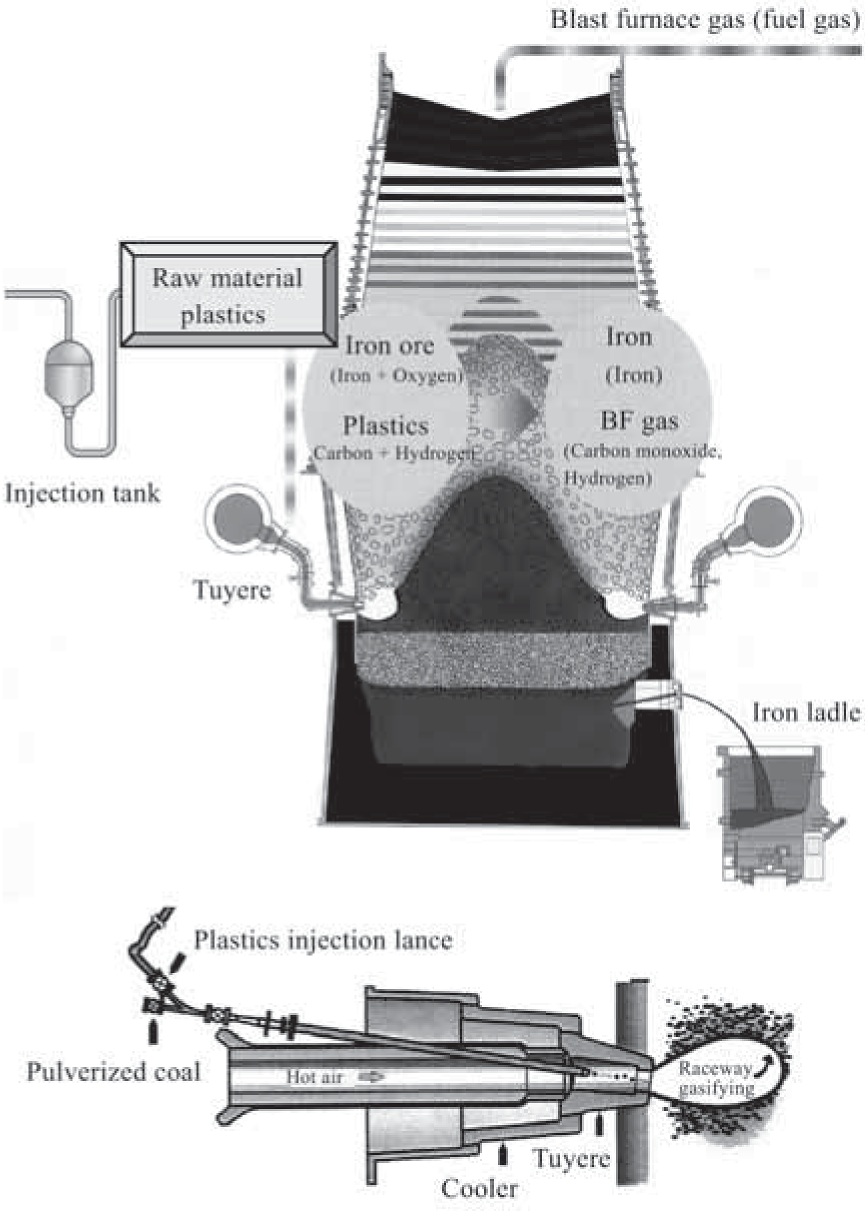
$C + O_2 = CO_2$

When the oxygen in the passage area is fully consumed, carbon monoxide is produced by the reaction of freshly produced carbondioxide with the coke.

(i) $C + CO_2 = 2\ CO$

The carbon monoxide reduces the iron ore into pig iron.

(ii) $FE_2O_3 + 3CO = 2FE + 3CO_2$



Blast furnace process and tuyeres

Plastics may replace coke or coal for the reduction reaction. However, coke has a special function in the blast furnace in moving the gases, liquids and solids within the blast furnace. Plastics and pulverized coal cannot perform this specific function and hence the substitution of coke is possible only up to a certain limit, which has been established at approximately 40% (compared to coke).

As per this calculation, a steel manufacturing facility having production capacity of 3 million tonnes per annum, can consume 600,000 plastics waste annually. When the cost of waste plastics is less than coke, use of plastics waste reduces the raw material cost. Use of plastics waste also reduces the ash generation, ensuring more cleaner operation. There are a variety of low-end plastics waste, whose cost is lower than coke. Basically, these low-end plastics waste create waste management problem as the waste pickers find it unviable to pick up those for normal mechanical recycling. With the utilization of all types of low-end plastics waste in the blast furnace, the waste management

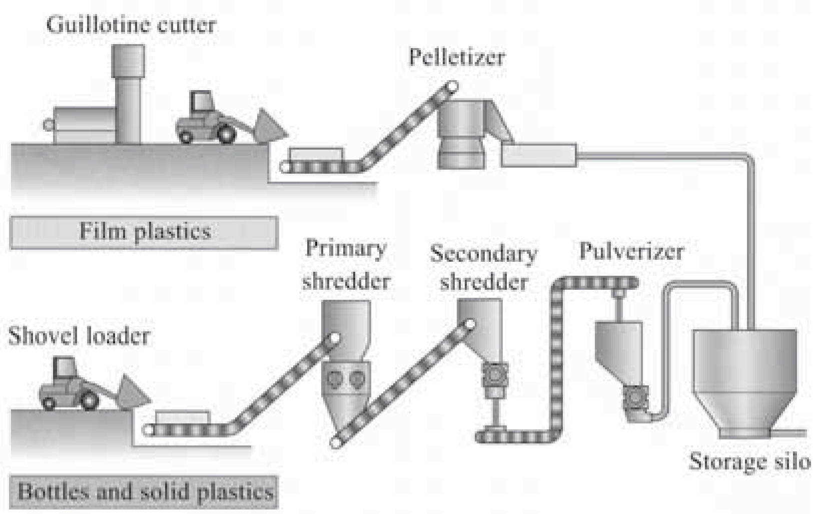
(B) In the presence of plastics waste along with coke.

Plastics materials break down to CO and Hydrogen. This presence of hydrogen, produced by burning of plastics contributes to the reduction reaction, thus reducing the amount of CO_2 generated by coke. (When the waste is polyethylene).

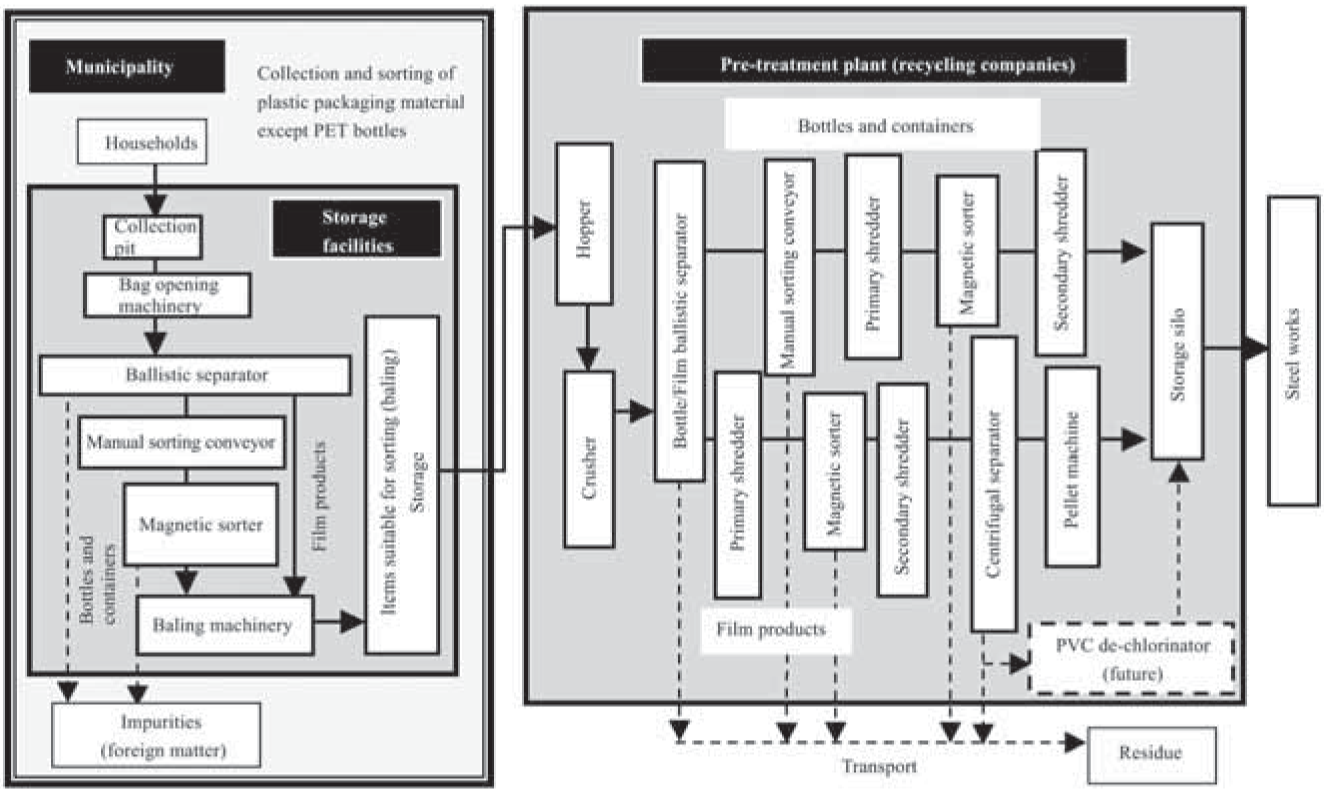
(i) $\frac{1}{2}C_2H_4 + CO_2 = 2CO + H_2$

(ii) $F_2O_3 + 2CO + H_2 = 2FE + 2CO_2 + H_2O$

The Blast furnace temperature reaches up to around 2000^0C



Equipment for conversion of industrial waste plastics to blast furnace material



Processing flow of recycling plastic packaging material except PET bottles for use as blast furnace material

problems can be solved to a great extent.

Types of plastics waste which may be used in Blast Furnaces:

Normally hydrocarbon reach plastics are the preferred raw materials. There is no problem of using chlorine containing plastics, like PVC in the blast furnace. The hydrogen chloride generated furring the burning process, is readily neutralized by the limestone used inside the blast furnace. The high temperature environment inside the blast furnace (around 2000^{0}C) also ensures that there is no possibility of any dioxin formation even if PVC is processed. Furthermore, as the reducing atmosphere in the low-temperature region at the top of the furnace contains no oxygen, no dioxins are produced or re-synthesized in the lower temperature zone also. However as no counter measures are taken against hydrogen chloride corrosion of the equipments used in the treatment or utilization of blast furnace gas, use of chlorine containing plastics like PVC is avoided.

Precautions taken for preparing the plastics waste before injecting into the blast furnace:

1. Reasonable cleaning of the waste, especially from food waste and contamination of non-plastics materials, especially metals.
2. Uniform sizing of the waste.
3. Special measures are required for using expanded polystyrene (EPS/Styrofoam) articles.

Small amounts of paper, stones and sand included in the plastics waste pose no problem as these are discharged as slag.

Visualizing this prospect of utilizing plastics waste as the fuel and reducing agent in the blast furnace, Central Pollution Control Board also is encouraging such practice in India. This would ensure that plastics waste is used as an alternate raw material replacing fossile fuel and also ensuring environment friendly way of plastics waste management in our country.

ICPE Team has already undertaken this idea and initiated discussion with a leading Steel Manufacturer in the country.

Based on information received from published article of M/s. NKK Keihin Works, Japan and ICPE Team's discussion with leading Steel Manufacturers in India.

For more details: http://www.jfe-steel.co.jp/archives/en/nkk_giho/84/pdf/84_01.pdf

Use of Plastics Waste in Cement Kilns

One of the most effective methods of recycling of plastics waste for recovery of energy is the use of plastics waste as an alternative to fossible fuel in Cement Kilns.

Plastics Waste can replace approximately 15% of normal fossil fuel in Cement Kilns. Successful trials have already been conducted in some cement kilns of India for using agricultural waste, like rice husk, as alternative fuel. In fact, any material having calorific value of at least 2,500 kcals are accepted as an alternative fuel in cement kilns, provided it is available at a cost less than the normal fossile fuel – coal. Plastics waste, which have quite high calorific values, some which having more than that of coal, offer a viable alternative fuel.

As Cement Kilns are operated at a very high temperature in the range of 1500^{0}C or more, there is no risk of generation of any toxic emission due to the burning of plastics waste. In fact, Cement Kilns can be utilized for burning of some hazardous waste also.

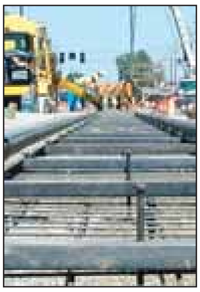
A 1 million ton capacity cement plant can consume about 10,000 MTs to 30,000 MTs of plastics waste annually, creating an enormous opportunity for the proper management of plastics waste, while recovering precious energy out of it for production of cement – one of the basic materials of infrastructure development.

Central Pollution Control Board realized this opportunity of using cement kilns as an alternative incinerator and has allowed some cement plants for conducting operational trials under controlled conditions and supervision.

ICPE Team has discussed this prospect of using various plastics waste in cement kilns with National Council for Building Materials (NCB), Ballabgarh, Haryana. NCB and ICPE propose to work together to develop this application in India.

Railway Sleepers from Waste Plastics

These environmentally friendly and cost-effective products are finding ready acceptance in the marketplace. As an alternative to wood ties, these plastic sleepers have the potential of saving millions of trees and utilizing millions of pounds of waste plastics from



landfills. The sleeper is not affected by chemicals, termites, fungus, rotting, or other problems usually associated with wood products. In addition, lab tests conservatively project a lifecycle of at least fifty years, so maintenance costs are practically non-existent.

EU Confirms that the Most Widely Used Plasticisers are Safe

News Item

The EU has confirmed that two of the most widely-used plasticisers are not classified as hazardous and pose no risks to either human health or the environment from their current use.

The publication in the European Union Official Journal of the outcomes of the EU risk assessments for Di-'isononyl' phthalate (DINP) and Di-'isodecyl' phthalate (DIDP) marks the end of a 10-year process of extensive scientific evaluation by regulators and provides confirmation of safety for users across Europe.

"After such resounding regulatory conclusions from the European Union, downstream users can continue to use DINP and DIDP with the utmost confidence" said Dr. David Cadogan, Director of the European Council for Plasticisers and Intermediates (ECPI).

Following the recent adoption of EU legislation with regard to the marketing and use of DINP and DIDP in toys and childcare articles, the risk assessment conclusions published in the Official Journal clearly states that there is no need for any further measures to regulate the use of DINP and DIDP.

The rigorous EU risk assessments, which include a high degree of conservation and built-in safety factors, have been carried out by France (rapporteur), the European Chemicals Bureau, member states and under the strict supervision of the European Commission, provide a clear scientific evaluation on which to judge whether or not a particular substance can be safely used.

The outcome of the risk assessment for the lesser-used specialty plasticiser, DBP, has also been published in the EU's Official Journal. Following the assessment, measures are to be taken within the framework of the IPPC Directive (96/61/EC) and the Occupational Exposure Directive (98/24/EC).

Reflecting on the wider implications of the results for producers and users, Dr. Cadogan commented "Once the REACH legislation enters into force, the conclusions of the risk assessments and the body of research that underpin them will be of great assistance to both producers and users of these substances."

Phthalates are the most commonly used plasticisers in the world. They are a family of substances that have been in use for more than half a century, primarily to make polyvinyl chloride (PVC) soft and flexible. They bring benefits to many products used in important industrial, commercial, institutional, and consumer products. These include underground and underwater cables, electrical wiring, building and construction materials, underbody automotive protective coatings, medical applications, institutional and household flooring.

Further information on the risk assessments, copies of the Commission Recommendation and Communication from the Official Journal, and copies of the risk assessment reports and summaries can be obtained from the DINP Information Centre and DIDP Information Centre web sites:

http://www.dinp-facts.com/RA
and
http://www.didp-facts.com/RA

For further information please contact:

Tim Edgar
European Council for Plasticisers and Intermediates
Avenue E Van Nieuwenhuyse 4,
B-1160 Brussels, Belgium

Biodegradable Plastics

Brief Report of MoEF Meeting held on 12th May, 2006

Definitions of Biodegradable Plastics:

MoEF desired to finalise the definition part of the Agenda. However, it was brought to the notice of MoEF that the matter is under preparation (draft stage) at BIS and this can be finalised at BIS meeting only. A brief status on the standardization process taken up at BIS was brought to the notice of the members. MoEF desired the draft to be made very quickly. BIS representative indicated that the shortest time that a BIS Specification took was 6 months for a reasonably easy subject matter (drinking water in pouches). However, as biodegradable plastics involve lot of scientific explanations, etc., it may take longer time. BIS indicated that in case of urgency BIS could adopt the ISO Specification on the subject immediately without any change.

On this, ICPE Representative indicated that there is a stipulation in the BIS protocol that unless the testing protocols are available in the country, no BIS Standard could be adopted for any product. BIS Representative also supported this. On this, CIPET Representative indicated that the testing protocols could be implemented in many of the CIPET laboratories within the country, timeframe could not be ascertained though.

MoEF, CPCB and DCPC desired to become members in the BIS Committee for making biodegradable plastic standards. BIS Representative advised them to write to BIS officially for this purpose and they could be included in the Committee.

Specific Areas of Application:

ICPE strongly advocated that biodegradable plastics should be encouraged in specific applications like mulch films / nursery bags, etc., and not for general carry bags application. The Representative from Earthsol Products maintained that the biodegradable plastics should be used for making carry bags also and they requested Government to offer subsidies for popularising biodegradable plastics. ICPE Members requested MoEF to amend the Delhi Act on use of biodegradable plastics for the collection of hospital waste and food waste.

(No assurance, however, was available from MoEF on this.)

Coloured Containers:

MoEF wants to do away with any pigments for plastic containers which will be used for packaging of food or food products. This proposal was objected to by ICPE. On a pointed question by MoEF on ICPE's view on the subject, ICPE reiterated its stand on the subject saying that coloured containers are required for branding, codification and in some cases protection also. The BIS specifications are available for pigments to be used for such coloured plastic containers. However, MoEF still maintained that it was facing problem to control the use of non-standard pigments for making containers which are used for packaging of food and food products. However, ICPE brought it to the notice of the members that coloured containers are used across the world for this purpose. Approved pigments should be allowed to continue to be used and strict action should be taken against the use of non-standard pigments.

MoEF decision would be known on a later date.

ICPE Website on NIC Server

ICPE Website is now also hosted on NIC Server, which is under the Ministry of Environment and Forest.

The Website has been modified making it userfriendly with inclusion of more useful information, division into proper categories.

Log on to: **www.icpeenvis.nic.in**

ISO Standards on Degradable Plastics

1.	ISO 14851:1999 ISO 14851:1999/ Cor 1:2005	Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium – Method by measuring the oxygen demand in a closed respirometer
2.	ISO 14852:1999 ISO 14852:1999/ Cor 1:2005	Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium – Method by analysis of evolved carbon dioxide
3.	ISO 14853:2005	Plastics – Determination of the ultimate anaerobic biodegradation of plastic materials in an aqueous system – Method by measurement of biogas production
4.	ISO 14855-1:2005	Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions – Method by analysis of evolved carbon dioxide – Part 1: General method
5.	ISO 15985:2004	Plastics – Determination of the ultimate anaerobic biodegradation and disintegration under high-solids anaerobic-digestion conditions – Method by analysis of released biogas
6.	ISO 16929:2002	Plastics – Determination of the degree of disintegration of plastic materials under defined composting conditions in a pilot-scale test
7.	ISO 17556:2003	Plastics – Determination of the ultimate aerobic biodegradability in soil by measuring the oxygen demand in a respirometer or the amount of carbon dioxide evolved
8.	ISO 20200:2004	Plastics – Determination of the degree of disintegration of plastic materials under simulated composting conditions in a laboratory-scale test
9.	ISO/DIS 14855-2	Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions – Method by analysis of evolved carbon dioxide – Part 2 Gravimetric measurement of carbon dioxide evolved in a laboratory-scale test
10.	ISO/DIS 17088	Specifications for compostable plastics

American Standards for Testing Material on Degradable Plastics

ASTM D5951-96 (2002)	Standard Practice for Preparing Residual Solids Obtained After Biodegradability Standard Methods for Plastics in Solid Waste for Toxicity and Compost Quality Testing
ASTM D5210-92 (2000)	Standard Test Method for Determining the Anaerobic Biodegradation of Plastic Materials in the Presence of Municipal Sewage Sludge
ASTM D5271-02	Standard Test Method for Determining the Aerobic Biodegradation of Plastic Materials in an Activated-Sludge-Wastewater-Treatment System
ASTM D5988-03	Standard Test Method for Determining Aerobic Biodegradation in Soil of Plastic Materials or Residual Plastic Materials After Composting
ASTM D6340-98	Standard Test Methods for Determining Aerobic Biodegradation of Radiolabeled Plastic Materials in an Aqueous or Compost Environment
ASTM D6691-01	Standard Test Method for Determining Aerobic Biodegradation of Plastic Materials in the Marine Environment by a Defined Microbial Consortium
ASTM D6776-02	Standard Test Method for Determining Anaerobic Biodegradability of Radiolabeled Plastic Materials in a Laboratory-Scale Simulated Landfill Environment
ASTM D6692-01	Standard Test Method for Determining the Biodegradability of Radiolabeled Polymeric Plastic Materials in Sea water
ASTM D6954-04	Standard Guide for Exposing and Testing Plastics that Degrade in the Environment by a Combination of Oxidation and Biodegradation
ASTM D6400-99	Specification for Compostable plastics

Technical Meet on Waste Incineration Technologies

18th-19th April, 2006 – New Delhi

FICCI had organised a Technical Meet on Waste Incineration Technologies during 18th-19th April at New Delhi.

This two-day meet was designed to provide various techno-managerial aspects relating to identification and segregation of incinerable waste generated, their handling and storage, various technological options available for thermal destruction of these wastes, the regulatory/legal aspects relating to management of incinerable wastes, selection of appropriate technology/equipment as per specific waste characteristics operational issues, measurement & analysis of pollutants from incineration of waste, etc.

The Salient Points of the presentation and discussions are given below:

• Incinerator design and operation depends upon the type of waste to be incinerated.Non-adherence to these two basic principles caused failures of various incineration activities in the 80's raising doubt about the effectiveness of this process itself. However, subsequent adoption of proper design and appropriate operation after careful analysis of the waste, have again brought back the reliability of incineration as one of the best options of hazardous waste treatment.

• The primary objective of incineration is hazardous waste treatment. Energy recovery and obtaining any other benefit, should not hinder this primary objective.

• Cement kilns are considered as very good option for acting as an incinerator for certain types of hazardous waste. CPCB encourage use of cement kilns for such activity.

• Plastics as part of municipal waste goes for incineration in a facility near Chandigarh. It has been acknowledged by the facility that without plastics, the calorific value is very low and cost of operation is higher.

• CPCB have given permission to 4 cement plants on experimental basis for using various hazardous waste as fuel. Results are encouraging. There are 170 cement plants (kilns) in the country, which can use hazardous waste as fuel. This would help the national economy also, as the requirement of dedicated incinerators could come down.

Some of the topics discussed during the Meet

- **Overview – Waste Incineration in India**
  Dr. B. Sengupta, Member Secretary, CPCB, Govt. of India
- **CDM opportunities through Waste Management Sector**
  Mr. Srikanta K. Panigrahi, Director (Environment), Planning Commission and DNA Member, Govt. of India
- **Trends in Thermal Waste Treatment Technologies**
  Prof. Rakesh Mehrotra, Delhi College of Engineering
- **Incinerable Waste Streams**
  Dr. I. Haq, Addl. Director, CPCB
- **Environment Compliance & Legal Aspects – Guidelines for Waste Incineration, Regulatory/Policy Issues & Permitting Aspects**
  Mr. N. Sateesh Babu, Env. Engineer, CPCB
- **Waste Incineration using Rotary Kiln Incineration Technology, etc.**
  Mr. Sudheer Basargekar, Thermax
- **Design and Construction of Common Hazardous Waste Incineration Facility & Handling & Storage Aspects of Incinerable Waste**
  P. N. Parameswaran, BEIL
- **Liquid Waste Incineration Technologies**
  Mr. V. Lakhshman, Ramky Group
- **Pyrolytic and Twin Chamber Incineration Systems**
  Mr. K. K. Khanna, Nika Engineering Pvt. Ltd.
- **Air Pollution Control Systems & Devices Suitable for Waste Incinerators**
  Mr. P. D. Patel, Paramount Limited
- **Contaminants of Concern – Measurement & Analysis of Air Emissions from Waste Incineration**
  Dr. Pius Kurian, SCS India Pvt. Ltd.
- **Opportunities for Power Generation from Waste**
  Mr. Ashwani Kumar, Jubilant Organosys Limited
- **Case Study Presentation**
  Mr. Tulshidas Dange, Bayer Crop Science Limited

For details contact: www.ficci.com

Sustainable Development and Waste Management

Ajit Kumar Jain,
Senior IAS Officer and Senior Advisor, Solid Waste Management Cell,
All India Institute of Local Self-Government (AIILSG)

High rate of population growth, declining opportunities in the rural areas and shift from stagnant and low paying agriculture sector to more paying urban occupations, largely contribute to urbanisation. The cities have grown haphazardly showing tell tale signs of saturation of services, infrastructure and employment potential. This manifests in congestion, inadequate water supply and sanitation, urban poverty and environmental degradation and poses a challenge to urban planners and citizens alike. The priority assigned to urban environmental issues has traditionally been low, resulting in substantial damage to human health and reduced productivity, development. Cities are considered as the growth engines but growth bereft of environmental concern is self-defeating.

The unexpected immigration has also caused the burgeoning of slums, and the growth of squatter and informal housing all around the rapidly expanding cities of the developing world. In many cities, the rapid population growth has overwhelmed the capacity of the municipal authorities to provide even basic services. Millions of people in cities in the developing countries cannot meet their basic needs of shelter, water, nutrition, sanitation, health and education. Thus urban poverty becomes a characteristics feature of urbanization in the twentieth century. Cities are harnessing the environmental resources at a furious pace, taking their ecological footprints far beyond their geographical limits. Pollution of all sorts is rampant leading to deep degradation of the urban environment. Sustainability of the cities in the developing countries with all the above constraints has become a big question mark and has rightly been placed at the focal point of the millennium agenda.

Balancing developmental needs with the limitation of natural resource base will be a key parameter in the struggle for survival. This will be a common denominator particularly in water supply, sanitation, air quality and solid waste management. Conceptually the contours of the city growth can be economic growth potential.

Examples of rapidly depleting assets include depleted groundwater, collapsing fisheries, CO_2 accumulation in the atmosphere, and deforestation. It is a demand of time that we understand our basic requirements, dependency on resources and sustainability on the life support systems that would be the determinant of our very existence. This integrity takes us to the concept of "Sustainable Development".

Sustainable Development

The most widely known definition of sustainable development comes from the Brundtland Commission, which defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Cities are increasingly becoming the magnets for new residents flooding in from rural areas. Globalisation, at the same time, is having a significant effect on cities, forcing them to compete for international business with other cities, worldwide and within their own countries. As a result, the sustainability of cities is under pressure. Decision-makers at all levels are faced with the task of how to resolve urban problems – from drinking water to waste management, from housing and transportation to the preservation of urban green space. At the same time the cities will need to become more aware of the impact that their consumption patterns have on other regions and ecosystems.

Urbanisation and Waste Generation

Urbanisation directly contributes to waste generation, and unscientific waste handling causes health hazards and urban environment degradation. Municipal Solid Waste (MSW) is defined to include refuse from the households, non-hazardous solid waste, discarded by the industrial, commercial and institutional establishment, market waste, yard waste and street sweepings which are collected by the municipal authorities for disposal. MSW is only a relatively small fraction of all the solid waste that is generated in an advanced economy. Municipal Solid Waste Management, broadly deals with post-consumer waste, in prevention, treatment, recycle, reuse and disposal.

Most developed European countries introduced legal regulations on waste management only in the second half of the nineteenth century. This nearly coincides with the population explosion in Central Europe, which led to the growth of big cities. It was also during this time that the scientific evidences showed that epidemics, for example, 1932 cholera epidemic of London, were related to overpopulation and hygiene issue. Waste management was regarded as the prevention of spread of diseases by removing rotting waste.

Health and Environment Impacts

Some of the adverse environmental impacts of unscientific handling and indiscriminate dumping of the solid waste are:

- Ground water contamination by the leachates generated by the waste dumps.
- Surface water contamination by the runoff from the waste dumps.
- Foul odour, pests, rodents and wind blown litter in and around the waste dumps.
- Generation of the inflammable gas (methane) within the waste dumps resulting into fires at the landfill and smoke and smog around.
- Release of green house gases such as carbon dioxide and methane.
- Bird menace above the waste dumps affecting air traffic.
- Epidemics through stray animals and other diseases vectors.
- In large agglomerations of the developing countries, inadequate waste management is the cause of serious urban population and health hazard.

However, the health and environment implications have not been fully realised by the governments or the civil societies in the developing countries. It is only in the last decade, or so, that these concerns have been shared globally, which has coaxed the national governments to adopt the agenda of environment protection in the overall goal of minimising its impact on the environment in an economically and socially sustainable way is a challenge for the coming decades.

Sustainable Solid Waste Management

The conventional approach of solid waste management has been to fulfill the removal of the solid discards from the immediate vicinity of the human settlements. This resulted in the mechanized systems of collection and transportation of waste in the industrialised countries and the landfills to bury the waste. In the later part of the twentieth century, it was realized that the societies will not be able to master the waste avalanche. The publications of the limits of Growth of the Club of Rome in 1975 made it clear that the natural resources, the consumer age depend on, were not unlimited and that the waste management had to change its focus from "efficient removal" to waste avoidance, minimisation and recycling options with higher priority.

MSW contains organic waste, plastics, papers, glass, metal and inert substances. Carbon and nitrogen-based organic waste from kitchen, market and abattoir is source of rich organic manure or energy. Plastics, papers, glass, metals are recycled into new products. Debris can be recycled and earth and insert waste used as landfill cover. This helps conserving natural resources and also generates employment. Promotion of waste recycling sector and providing that with an institutional support can, therefore, be in tune with the goals of sustainable development.

Waste Management and Poverty

Environmental degradation impacts the poor most severely. The urban poor, who do not have a fair access to public health and sanitary services in the city are subject to extremely unhygienic conditions in their settlements and periodic outbreaks of water and air borne epidemics. Driven by the compulsion of a object poverty, many of them are involved in waste picking and recycling through an informal chain of scrap dealers and recycling industry. While the scrap dealers have an access to the recyclable waste of the industry and commercial establishment, they depend on the rag pickers for retrieving recyclable waste from the households. In the absence of source segregation, the waste pickers collect the recyclables from the garbage bins.

Studies carried out in Delhi (Shrishti) and by the SNDT/ UNDP/ILO in Pune (2001) indicate that the rag pickers come from the lowest economic rung and are driven into this work by the compulsions of extreme poverty. They settle in the slums and get bonded with the scrap dealers and recyclers and thrive on the income derived from the most unsanitary and inhuman circumstance. They neither share the technical efficiency nor the skills of the higher-level players involved in the process with appropriate legal protection of the organized sector.

The rag pickers can be instrumental in the collection and processing of organic waste also, within the localities. Organised groups of rag pickers can be trained and given logistic support for decentralized waste management.

This may reduce the transportation and landfill requirement. This has been tried successfully in the cities like Hyderabad, Chennai, Vellore, Nagpur, Mumbai and Ahmedabad. Several initiatives to involve the recyclers in the solid waste management have been successfully taken in many other developing countries. In Bogota, Columbia, rag pickers called 'card boarders' have been organized into waste recycling cooperatives. With the help of the non-governmental agencies, these cooperatives have formed a 'National Recyclers Association' representing over 50,000 waste collecting families. The cooperatives have ensured minimum wages to the waste collectors. They have set up their own company for selling recyclable waste material and have provided daily care and health cover to their members. The UNCHS studies of 1993 and 1995 indicate that if waste recycling and reprocessing is fully developed, the sector could employ around 2 per cent urban population.

The report of the World Commission on Environmental and Development (1987) advocates the principle of resource conservation in solid waste management and to make more effective use of their waste as resources and underlines the need to work with the urban poor for sustainable development of the cities. The approach is legitimized by the Global Agenda 21, which set the framework for the current dialogue on the solid waste management and social aspects of urban environment.

Community Participation

Community participation becomes paramount in an innovative and sustainable approach to Municipal Solid Waste Management. Increasingly, local governments in the developing countries are encouraging community participation. More active engagement of the civil society is visible in many countries and states in India in the areas of slum improvement or slum sanitation, water distribution and solid waste management. The community in such cases is providing services, which traditionally is the monopoly of the state or the municipal bodies. Such participation, though informal in the beginning has been recognized in many cases by the official set up. However, no institutional arrangement is yet in place, whereby community participation could be readily facilitated and legalized within the statutory frameworks. In India, civic engagement is an imperative of the political decentralization processes initiated by the 74th Constitutional Amendment Act 1993. The Constitution now provides for the ward committees for taking the municipal administration closer to the community.

To achieve the objective of sustainability it is necessary to establish systems of solid waste management, which harmonise the technical requirements with the objectives of environment protection and the needs and interests of different stakeholders especially the urban poor. These systems, in other words, should be appropriate to the particular circumstances and the problems of the city and locality. The improvement and upgradation of the solid waste management in the cities, on these lines, will require training, sensitization and other stakeholders. As the city population increases and its economic profile changes, the quantity of waste and the resources requirement to manage it will increase. Given their financial limitations and competing demand of other services, the urban local bodies may find it challenging to raise and sustain additional allocations for this sector. Thus waste minimisation and a community-based waste management seems the only sustainable way to manage the waste.

Recycled Plastic Lumber

A deck, chair or even railroad ties made out of plastic? Why not just use wood? A brief look at what plastic lumber has to offer illustrates the tremendous advantages plastic lumber has over traditional hardwood.

We all are familiar with the problems associated with traditional hardwood. Many of us dislike the idea of building a deck, for instance, simply because of its high maintenance costs. Those that do build decks for their homes are all too familiar with the problems of pressure-treated wood. Warping, splintering, rotting, cracking and degrading are all common characteristics of traditional hardwood. To protect their lumber, people resort to expensive and time-consuming repainting and resealing. Yet, this does not guarantee that the lumber is 100% protected and will certainly not prevent the local insect population from making a brand new home of a new deck. The problems of traditional pressure treated lumber not only bring headaches to consumers but to businesses and industry as well.

Plastic Railroad Ties

For example, the railroad industry replaces approximately 14 million wooden ties a year out of the nearly 700 million ties used annually and this number is growing. It is estimated that replacement and installation of new wooden ties, which only last an average of seven years and as little as three, costs the railroad industry over a billion dollars a year. Since 1994, the Army Corps of Engineers, Rutgers University, Earth Care Products, Conrail and Norfolk Southern have been

working on a project using recycled-content plastic railroad ties as an alternative to traditional wood ties. The railroad ties market is huge since each tie requires 200 pounds of plastic – equalling 1,200 bottles! At Conrail's Altoona, PA train yard ten 100-per cent recycled ties were intermingled with wood ties in October 1995. The plastic ties, performance so much impressed the company that in 1996, they installed six more plastic railroad ties on the main line between Pittsburgh and Philadelphia.

Additionally, the Association of American Railroad's Transportation Technology Center located in Pueblo, Colo, tests trains almost 24 hours a day and now has 25 plastic railroad ties in place along the toughest part of the training loop with no signs of deterioration.

Internationally, the use of plastic lumber for railroad ties is not a new concept. Japan, for instance, uses composite ties made from virgin materials – foamed polyurethane with a continuous glass reinforcement, which help the trains run quieter.

The appeal for recycled-content plastic railroad ties is due to the fact that wooden railroad ties – like decks – need regular maintenance and eventually need replacing.

Plastic Lumber's Qualities

Other positive characteristics of plastic lumber are the facts that, unlike wood, it will not:

- rot,
- crack,
- warp,
- or splinter.

In fact, plastic lumber is:

- denser than wood,
- virtually maintenance free,
- long lasting (50 years plus, depending on the application),
- stain resistant,
- graffiti-proof,
- waterproof,
- UV resistant,
- aesthetically pleasing (most plastic lumber has a wood-grained finish),
- impervious to insects,
- and, is not affected by exposure to most substances.

Plastic lumber also:

- works with any deck fastener,
- requires no painting or sealing (plastic lumber is available in almost any color and some wood-composite plastic lumber can be painted as if it were wood),
- and, provides a good shock-absorbing surface for pedestrian traffic, such as runners and hikers.

What Exactly is Plastic Lumber and What Does it Do?

There are a wide variety of different types of plastic lumber available. The base product is made of recycled plastic: 100%

recycled High-Density Polyethylene (HDPE). HDPE is used to make anything from shampoo and detergent bottles, to milk jugs. Some plastic lumber is made entirely of HDPE, which comes in a variety of molded-in colors. For instance, the adirondack chair pictured below is made from 240 recycled plastic milk jugs. Other types of plastic lumber use composites, which consist of a mixture of recycled HDPE with wood fibers, rubber, fiberglass, or other plastics. Depending on the brand and the application, plastic lumber composites are available for those needing a stronger material, or for those wanting a long-lasting alternative to wood, but with the paintability of traditional hardwood lumber.

Plastic lumber can also hold nails approximately 90% better than wood and, screws 50% better than wood. Engineers estimate that the workable life of plastic lumber is anywhere from 15-20 years in underwater marine applications and well over 50 years in construction applications such as decks for houses. The real edge plastic lumber has over traditional hardwood is that home owners may never have to maintain or replace a deck again, while railroad engineers can drastically reduce their maintenance costs. Municipalities can also substantially reduce their costs by installing and building plastic lumber-based park benches, trash receptacles and boardwalks that will last decades, instead of a few years.

Environmental Benifits

Plastic lumber, made of recycled plastic, is a high quality product that is both an environmentally friendly and economically viable alternative to traditional hardwood lumber, which is often injected with chemicals to ward off impending insect attacks. Plastic lumber, on the other hand, contains no hazardous chemicals and cannot leak or contaminate the soil. Additionally, serious worries about deforestation and the role trees play in helping prevent global warming, are issues of concern for both the consumer and the building industry. Therefore, using plastic lumber rather than hardwood has remarkable practical advantages as well as these significant environmental advantages.

Uniform Design Guidelines

Although plastic lumber has not been approved yet for load-bearing applications, testing is under way (and it can, however, be used almost anywhere hardwood is). In fact, the American Society for Testing and Materials (ASTM) now has uniform design guidelines for the outdoor use of plastic lumber that give manufacturers more confidence in the lumber's performance properties. Before these standards were established, plastic lumber producers tested their products as they saw fit. Eventually, ASTM would like to set up a grading system that allows users to know the difference between lumber that can be used for decks and, for instance, lumber that has the strength to hold railroad ties together and carry the weight of a speeding locomotive. Beyond its obvious use in construction, plastic lumber can also be used in making:

- marine applications (it will not rot, is resistant to marine borers and does not need to be treated with preservatives),
- docks,
- boardwalks,
- flooring for containers (it is not affected by exposure to most substances),
- truck beds,
- all-weather furniture,
- fencing,
- and, anything where plastics' numerous and beneficial characteristics can be applied.

The Growing Market

The annual market for pressure-treated lumber is extremely large indeed and will continue to grow. In the United States alone it is estimated at about $10 billion ($4 billion for decks in houses). Growth in the plastic lumber industry has accelerated rapidly in the last couple of years, both in terms of sales and in the stock value of companies that manufacture this exciting new product. A 1996 figure has the industry's annual growth rate at around 40% for years preceding 1996. Industry, government and consumers are finding plastic lumber to be a worry free, long-lasting alternative to traditional hardwood, a superior product and an ideal substitute that also benefits the environment. Overall, by giving new life to used plastics, plastic lumber can help extend the useful life of applications that traditionally have relied on wood as their main ingredient.

Do Not Litter.
Keep Your Environment Clean.

- **Segregate and Throw Waste Only in Waste Bins.**
- **Use Two Bins – One for Wet Waste, One for Dry Waste.**

Plastics, Metals, Paper …
Can be recycled into useful products.

Waste Food and other Biodegradable Waste.
Can be composted into manure.

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