

Thiagarajar College of Engineering, Madurai-15

Department of Chemistry



Environmental Information System - ENVIS

Thematic Centre for Plastic Waste Management



NEWS LETTER

Volume I - Issue 1: April - June 2018

Plastic
Waste
Management



Initiative by MoEF&CC ENVIS towards
sustainable development



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Funded by:

Ministry of Environment, Forest
& Climate Change, Govt. of India





Chairman Message



THIAGARAJAR COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to Anna University)

MADURAI - 625 015

T. KANNAN

Chairman & Correspondent

10.10.2018

MESSAGE

Green Skill Development Programme is a unique initiative by Dr.R. Vasudevan and his team at our College to instill awareness amongst the participants on the scope that exists in the area.

The Trainees could become Environmental Managers and be self employed. They will be able to earn a decent revenue and spread the much needed awareness about environmental upkeep. This in turn will further the Government goal towards Swachh Bharat.

I wish the endeavour all success.

T. Kannan
Chairman & Correspondent



Proud Moment



**Padma Shri
Dr.R. Vasudevan**

Our Coordinator Received Padma Shri Award from Honorable President of India, for his contribution towards the research and development in Science and Technology.

Director Desk:



PRINCIPAL

Dr. V. Abhikumar

Providing a healthy and clean environment for our generations is a challenge that we need to address today. This is my personal goal as I believe it is a concern for most of the people living in this country or, as a matter of fact, around the world. TCE ENVIS centre for Plastic Waste Management realizes the government's goals and objectives to provide the society with a healthier and cleaner environment. Within

our capacity as an educational institution, we have adopted a strategic approach to be actively involved in implementing the government objectives, which is also my personal objective, through our centre for plastic waste management.

We reiterate our commitment in protecting the environment by offering advanced technology and sustainable products & services in waste management. The objective of this division is also to contribute to sustainability of the environment in the country and the world we live in.

Together, we could leave a better world for generations ahead

Coordinator Desk:

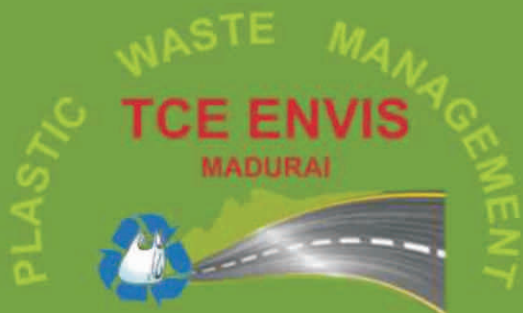
At the outset we wish to thank the Ministry of Environment, Forest & Climate Change, Government of India for selecting the Thiagarajar College of Engineering, Madurai, Tamil Nadu as an ENVIS Centre (Resource Partner) for Plastic Waste Management. It is a great opportunity to bring out the Importance of Plastics, the most important Engineering Material being used in most of the house hold application. At the same time, the Non-biodegradable property of the Plastic and the wrong garbage culture create problem for the disposal of the waste plastics. It is a great duty of the centre to bring out on one side the Importance of plastics and on the other side the various research being carried out at various places to find solution for Plastic Pollution. Our centre is indebted to the government in the task and will become successful. Our government's policy like Swachh Bharat & Make in India will help us to carry out our work efficiently.

Website: www.tceenvvis.in
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TCE ENVIS, Thiagarajar College of Engineering,
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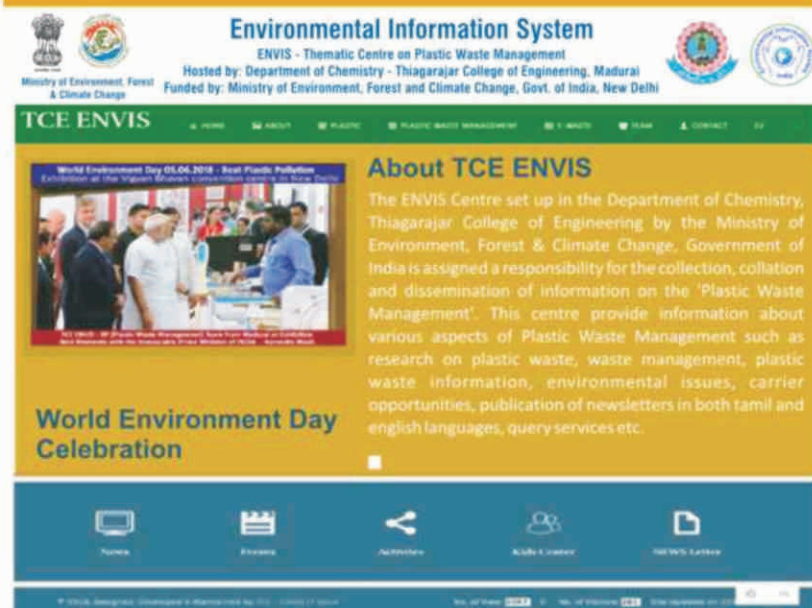
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Our Web Look: www.tceenvvis.in



SAVE THE EARTH



Polyethylene Terephthalate (PET):

Typically used to make bottles for soft drinks, water, juice, mouthwash, sports drinks and containers for condiments like ketchup, salad dressing, jelly and jam, PET is considered safe.

One study that looked at 63 brands of bottled water produced in Europe and Canada found concentrations of antimony that were more than 100 times the typical level found in clean groundwater (2 parts per trillion).

It also found that the longer a bottle of water sits on a shelf in a grocery store or your refrigerator the greater the dose of antimony present. It is believed that the amount of antimony leaching from these PET bottles differs based on exposure to sunlight, higher temperatures, and varying pH levels.

Brominated compounds have also been found to leach into PET bottles. Bromine is known to act as a central nervous system depressant, and can trigger a number of psychological symptoms such as acute paranoia and other psychotic symptoms.

High Density Polyethylene (HDPE):

HDPE, which is considered a low-hazard plastic, is often used for milk, water and juice bottles, as well as bottles for cleaning supplies and shampoo. It's also used to make grocery bags and cereal box liners. HDPE (like most plastics) has been found to release estrogenic chemicals.

In one study, 95 percent of all plastic products tested were positive for estrogenic activity, meaning they can potentially disrupt your hormones and even alter the structure of human cells, posing risks to infants and children. In this particular study, even products that claimed to be free of the common plastic toxicant bisphenol-A (BPA) still tested positive for other estrogenic chemicals.

Polyvinyl Chloride (PVC):

PVC plastic can be rigid or flexible, and is commonly found in bags for bedding, shrink wrap, deli and meat wrap, plastic toys, table cloths and blister packs used to store medications.

PVC contains toxic chemicals including DEHP, a type of phthalate used as a plastics softener. phthalates are one of the groups of "gender-bending" chemicals causing males of many species to become more female. These chemicals have disrupted the endocrine systems of wildlife, causing testicular cancer, genital deformations, low sperm counts and infertility in a number of species, including polar bears, deer, whales and otters, just to name a few.

Scientists believe phthalates are responsible for a similar pattern of adverse effects in humans as well. If your home contains soft, flexible plastic flooring, such as vinyl or those padded play-mat floors for kids (often used in day cares and kindergartens, too), there's a good chance it is also made from toxic PVC. PVC flooring has been linked to chronic diseases including allergies, asthma and autism.

Low Density Polyethylene (LDPE):

Another plastic that is considered a low hazard, LDPE is used in bags for bread, newspapers, fresh produce, household garbage and frozen foods, as well as in paper milk cartons and hot and cold beverage cups. While LDPE does not contain BPA, it may pose risks of leaching estrogenic chemicals, similar to HDPE.

Polypropylene (PP):

PP plastic is used to make containers for yogurt, deli foods, medications and takeout meals. While polypropylene is said to have a high heat tolerance making it unlikely to leach chemicals, at least one study found that PP plastic were used for laboratory studies did leach at least two chemicals.

Polystyrene (PS):

Polystyrene, also known as Styrofoam, is used to make cups, plates, bowls, take-out containers, meat trays and more. Polystyrene is known to leach styrene, which can damage your nervous system and is linked to cancer, into your food. Temperature has been found to play a role in how much styrene leaches from polystyrene containers, which means using them for hot foods and beverages (such as hot coffee in a polystyrene cup) may be worst of all.

Other:

This is a catch-all designation used to describe products made from other plastic resins not described above, or those made from a combination of plastics. It's difficult to know for sure what types of toxins may be in #7 plastics, but there's a good chance it often contains BPA or the new, equally concerning chemical on the block in the bisphenol class known as Bisphenol-S (BPS).

BPA and BPS are endocrine disrupters, which means they mimic or interfere with your body's hormones and "disrupts" your endocrine system. The glands of your endocrine system and the hormones they release are instrumental in regulating mood, growth and development, tissue function, metabolism, as well as sexual function and reproductive processes.

Some of the greatest concern surrounds early-life, in utero exposure to bisphenol compounds, which can lead to chromosomal errors in developing fetus, causing spontaneous miscarriages and genetic damage. But evidence is also very strong showing these chemicals are influencing adults and children, too, and leading to decreased sperm quality, early puberty, stimulation of mammary gland development, disrupted reproductive cycles and ovarian dysfunction, cancer and heart disease, among numerous other health problems.

Hazard Levels of the Plastics

 PET or PETE Polyethylene Terephthalate	MODERATE HAZARD Plastic breaks down after multiple uses allowing anatomy to seep into liquids.
TYPICALLY USED FOR:	
 Soft Drinks  Water  Sports Drinks  Ketchup  Salad Dressing	
 HDPE High Density Polyethylene	LOW HAZARD
TYPICALLY USED FOR:	
 Milk Containers  Cosmetics  Shampoo  Dish Soap  Plastic Bags	
 PVC Polyvinyl Chloride	HAZARD Endocrine disruption.
TYPICALLY USED IN:	
 Cleaner bottles  Toys  Shower Curtains  Tablecloths  Deli Meat Wraps	
 LDPE Low Density Polyethylene	LOW HAZARD
TYPICALLY FOUND IN:	
 Dry Cleaning Bags  Bread Bags  Newspaper Bags  Produce Bags  Garbage bags	
 PP Polypropylene	LOW HAZARD
TYPICALLY FOUND IN:	
 Pill Bottles  Bottle Caps  Straws  Yogurt Tub  Margarine Tub	
 PS Polystyrene	HAZARD Styrene can leach from polystyrene. This can lead to nervous system damage and cancer.
TYPICALLY REFERRED TO AS STYROFOAM & USED IN:	
 Cups  Plates  Take-Out Containers  Coolers  Packing Peanuts	
 OTHER	HAZARD Leaches BPA which causes endocrine disruption and reproductive toxicity.
TYPICALLY FOUND IN:	
 Reusable Water bottles  Soup Cans  Baby Bottles  Oven-Baking Bags  Custom Packaging	
This is a catch-all category that describes packages made from plastics and resin not covered in the six standard categories.	

Image Source: commonfolk.en *io9.gizmodo.com

Applications of Plastic

**PP**

(Polypropylene)

PP has high resistance to electricity and is useful for electronic components. It retains its shape even after a lot of torsion, bending, and/or flexing.

Made from propylene.

Used in- Microwave containers, bottles, surgical and examination gloves, containers for sweet-meats

**PET**

(Polyethylene Terephthalate)

PET is recognized as a safe, non-toxic, strong, transparent, lightweight, inert material that is 100% recyclable. Doesn't contain Bisphenol-A (BPA), heavy metals, phthalates or carcinogens.

Made using terephthalic acid and monoethylene glycol.

Used in- Water and soda bottles, food packaging, medicine bottles, pillows

**PS**

(Polystyrene)

PS is a naturally transparent thermoplastic which is non-toxic and odorless.

This is made from styrene. It can also be made in its expanded (lightweight) version.

Used in- Disposable cups, protective packaging applications, insulations, plastic food boxes

**HD-PE**

(High Density Polyethylene)

HD-PE is recyclable and acts as an effective barrier against moisture. It leaves no harmful emissions during its production or during its use by the consumer.

Made from ethylene and comonomers.

Used in- Oil/Shampoo bottles, garbage bins, household storage containers, carry bags

**All Other plastics****Example 1****PC**

(Polycarbonate)

PC is an incredibly useful plastic due to its transparency and high impact resistance. It is a lighter alternative to glass and a natural UV filter, so it is often used in eyewear.

This is made using Bisphenol A (BPA).

Used in- Plastic lenses in eyewear, CDs and DVDs, electrical chargers, baby feeding bottles, anti-riot shields

**Example 2****ABS**

(Acrylonitrile Butadiene Styrene)

ABS is an opaque thermoplastic and an amorphous polymer with high recycling rate. This is a blend of 3 different polymers and is a very tough polymer.

Used in- Keys on a computer keyboard, LEGO toys, water pumps, car dashboard

**PVC**

(Polyvinyl Chloride)

PVC is the most commonly used thermoplastic polymer with good tensile strength, high density and resistance to chemicals and alkalies. Versatile as can be made into rigid as well as flexible articles.

Made from vinyl chloride.

Used in- Blood bags, electrical wires, medical tubing, disposable cups for hot beverages

**LD-PE**

(Low density Polyethylene)

LD-PE is tough, flexible and relatively transparent with excellent resistance to acids, bases and vegetable oils. It is one of the most recycled plastic.

Made from ethylene and branched comonomers.

Used in- Milk cartons, pocket combs, floor tile, carry bags





Environmental issues surrounding plastics often cause confusion. In this section we have attempted to provide rational, scientific information about current environmental concerns regarding plastics.

Plastics / plastic bags are harmful to plants & the soil: ????

- Plastics protect plant life in multiple ways
- Plastics prevent massive deforestation by offering wood substitutes. eg. Furniture, building materials, crates
- Plastic pipes are used extensively in Irrigation & Water Management
- Flood Irrigation, Sprinkler Irrigation, Micro Irrigation (Drip/Trickle) etc.

China uses One million tonnes of PE in agricultural application.

Plastics are not recyclable: ????

Plastics are 100% recyclable via various routes :

- Mechanical recycling : Plastics can be recycled several times into economically useful low cost products eg. Footwear, mats, sewer pipes etc.,
- Waste plastics are also recycled without sorting into synthetic lumber / wood products like rails, fencings, posts, benches and landscaping products.
- Plastics can be thermally recycled / incinerated to recover energy
- Plastics can be chemically recycled to recover monomer for reuse.

In India we already recycle 60% of plastics from both Industry and urban waste streams Vs world average of 20-25%.

Plastics are toxic and are not safe for usage: ????

Plastics are used worldwide safely for personal care products, packaging of food & medicine, in-vitro medical applications and for child care products.

- Toothbrush, toothpaste tubes, shampoo bottle
- Milk pouch, edible oil container, ice cream pack
- Blister packing - tablets and capsules
- Medical disposables - IV bags, blood bags, gloves, Heart valve, hip joint, Toys, diapers

Food and drugs authorities worldwide permit use of different plastics in various applications. Industry needs to adhere to prescribed standards.

Plastic bags contain plasticizers: ????

- Plastic bags are made from Polyethylene (PE) which is a polymer of pure Carbon & Hydrogen. The material by itself is soft in nature. No plasticizers are used / required for any Polyethylene application including Poly Bags.
- The campaign that Plastic bags contain plasticizers is a malicious canard
- Plasticizers are used only in PVC Products.

Plastic bags contain titanium dioxide and lead based components which are toxic & Dyes used in coloured bags cause severe health hazards: ????

- Most of the pigments used for making bags are organic in nature. Use of lead or cadmium based compounds does not arise at all.
- The inorganic pigments used in plastics do not contain lead or cadmium.
- Organic pigments which are used are compatible with the polymer to get bonded.
- They cannot leach out.

Industry has accepted to use natural unpigmented carry bags for food contact applications. Recycled bags will be coloured (using BIS approved pigments) for other applications.

This is plastic age. Plastics otherwise polymers have found their uses in many fields like packaging, electrical and electronically, fertilizers, agriculture, toys and engineering materials, domestic appliances, building materials and so on. Ten metric tons is the expected consumption for 2017 and it will rise to 20 Metric tons in 2020. Today plastics have become common man friend. It occupies all the essential things in their life like furniture's, plates, etc. The most important application or use of the polymeric materials is their use in packaging industry as carry bags, tea cups, sheets and films, multi layered films and thermocols. This occupies 35 % to 40 % of the total plastics consumed every year. The polymers used for the manufacturing of packing materials are polyethylene, polypropylene and poly styrene. PVC is used in the manufacturing of wires, electrical tube, flex etc. These packing materials once used are thrown away into the environment / solid waste as waste materials. These materials get collected in places like water canals, rivers and mostly it will mix with the municipal solid waste (nearly 9 %). This results in water clogging, creating stagnation of sewage water and poor hygienic conditions. Moreover plastics are not bio degradable. The accumulation of waste plastics at various corners is an eye shore. The presence of waste plastics in the MSW also contaminates the organic waste available in the MSW, which is used for manure conversion. Thus plastic waste had become a major cause for the environmental pollution.



INDIA'S PLASTIC CONSUMPTION
IS A TENTH OF US'S

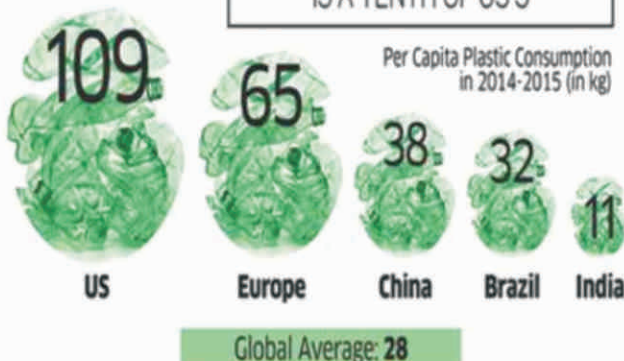


Image Source: www.economicstimes.indiatimes.com

TOP 10 PLASTIC WASTE GENERATORS

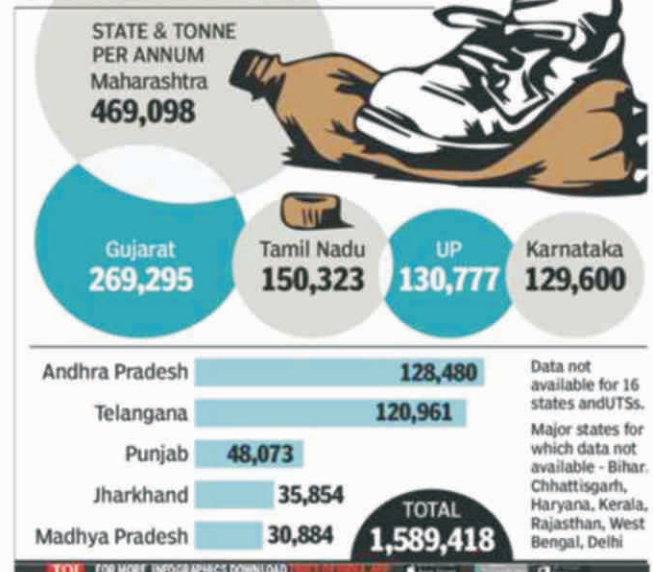


Image Source: www.timesofindia.indiatimes.com

Government does not have any clue to avoid this pollution; rather they are planning to ban the use of plastics. Plastic manufacturing is a major industrial development of our country, in which more than 10 crore peoples are engaged. More over the plastic industry comes under the subsidy industrial scheme of the government. Hence the banning of use plastics will result in a major economical disorder in the country. To avoid this situation the government had taken various steps to reduce the use of plastics like increasing the thickness of carry bags, creating awareness to reduce the use of plastic material, recycling of recyclable waste plastics and reuse of waste plastics. So the banning of plastics will not be solution for plastic pollution. Finding solution to plastic pollution is the need of the hour.

Today the technological development both in electrical and electronic products has resulted in the production of e waste having larger toxic compounds. Their disposal is also needed to be attended too. The problems we face is needed to be attended through appropriate technology way so that the benefit can reach the common man.



Reuse of waste plastic in road construction is a suitable solution for the disposal of waste in an eco friendly and thus avoiding the pollution created by the plastics in the environment. Presently the waste plastics are either land filled or incinerated. Both the processes are non technical and it will affect the environment in near future. In this context since the project of plastic road laying avoids land filling and incineration of waste plastics, it is considered as an effective process for the disposal of waste plastics.

Scientifically plastics are the byproduct obtained from petroleum refineries and hence they are hydrocarbons only. Bitumen is also byproduct obtained from petroleum distillation. Hence there should be compatibility between plastics and bitumen and also with other products from petroleum distillation. This behavior was tested and proved technically. Attempts were made to modify bitumen by dissolving plastics in bitumen. This was partly successful but we could dissolve only lower percentages of plastic (1 % to 3 %) in bitumen. Moreover the scaling is also very difficult and the process involves high costing. Hence there is a need for another alternative method. A newer method has been developed by coating waste plastics over hot stone aggregate and uses the same for road construction. Here the consumption of waste plastics is high (10% to 15%). This method is patented in 2002 by Dr. R. Vasudevan. This technology was also coded by the Indian Road Congress in 2013(IRC-SP-98-2013). Using this technology more than 50, 000 Kms of road has been laid in India.

For a 1 Km length road of width 3.75 m we need one ton of plastics. India has 41 lakhs Kms of roads. If all the roads are converted/made to plastic tar road we need more than 100 lakh tons of waste plastics and practically India does not have this much waste plastics. We have only 16 lakhs tons of waste plastics only.

The performances of the roads laid were also studied under the guidance of Central Pollution Control Board, New Delhi. The results obtained were highly encouraging. Moreover the use of waste plastics in this technology is high and we can use 10 % to 15 % of waste plastics to the weight of bitumen.

Further works helped to develop other products like PLASTONE blocks a substitute for paver blocks. This product consumes a large amount of waste plastics. Plastone blocks can be used as road side paver block. The Plastone blocks manufacturing process also helps in the reduction in the use of cement, sand and water, since the process use waste plastics as a binder. Hence by using these technologies almost all the plastic waste available in the country can be reused and the disposal of waste plastics will no longer be a problem.

Moreover the waste plastics which were thrown to the streets will get a value addition. The use of waste plastics in the present project directly creates a demand for waste plastics in the market. Already in many states the self help group and some other NGOs are been involved in the process of collection waste plastics. They collect and shred the waste plastics and sell it to the concerned authorities for Rs 20 to 25 per Kg. This becomes a good employment.

The government is also taking measures under Swachh Bharat, which has become handy to collect the waste plastics. A system is to be developed to collect the waste plastics, shredding and construction of road. Cooperation from the engineers and the contractors is very much needed. If the system works well, the problem of disposal of waste plastics is almost solved.

Image Source: www.economictimes.indiatimes.com

**AROUND 60% OF INDIA'S
PLASTIC WASTE IS RECYCLED**

**Total Plastic Waste
Generated Every Day**

**15,342
tonnes**



The present project also insists in the practice of good garbage culture among the public. The project can become success if the segregation of waste plastics at source is practiced in all over the country. When the waste plastics mix with the MSW, the segregation becomes a tough job. The project also suggest various possibilities in collecting the waste plastics at source, like two bin system, awareness camps for the public and own your ownership technique. Awareness camps and lectures are being organized to educate the school students to motivate them and help to collect the waste plastics at the source. It is partly successful too. The roads constructed using this technology was well appreciated both by the government and in the private sector. In India almost 11 states had implemented this technology. The government is using the PMGSY scheme found for laying plastic roads on rural road sector. The Central Pollution Control board had published guidelines for laying plastics road in the year 2006 itself. This method is patented in 2002 by Dr. R. Vasudevan. This technology was also coded by the Indian Road Congress in 2013(IRC-SP-98-2013). Using this technology more than 50, 000 Kms of road has been laid in India.



Project Overview:

Plastics are always common man's friend. It finds its use in every field and the consumption of plastics increases day by day. Nearly 50% of the plastic consumed is used for packing. The most used plastic materials for packing are carry bags, cups, thermocoles and foams. These materials are made from polymers like Polyethylene, polypropylene and polystyrene. (The tubes and wires are made out of poly vinyl chloride)

These materials, once used are thrown out or littered by us more because of wrong culture. They mix with Municipal Solid Waste. As they are non-biodegradable, the disposal is a problem and they cause social problems contributing for environmental pollution as they are disposed either by burning or by land filling.



Yet these packing materials (either mono layer or laminated poly layers made out of poly ethylene, poly propylene and poly styrene) can be easily used for various uses like road construction and block making, without affecting the environment. (Poly Vinyl Chloride is not used –note) and it is the best way to dispose the waste plastics.

These plastic materials when heated to around 120°C to 150°C, they melt and in their molten state they can be used as a binder. Only if they are heated to temperature more than 250°C they may decompose producing gaseous products which results in air pollution. Coating molten plastic over granite stone can be done around 150°C and the coating helps to bind with bitumen strongly resulting in better mix for road construction and the quality of the stone also improves by closing the voids. PVC is not used due to its toxic nature. Plastics waste (Carry bags, cups, thermocoles and foams) is shredded into small pieces (between 1.6mm – 2.5mm). The granite stone is heated to around 170°C. The shredded plastics waste is added to the stone. It get melted and coated over stone in just 30 seconds. Then the bitumen is added and mixed. The mix is used for road construction. From rural roads to National High ways all types of roads can be laid using this technique.

Image Source: www.unnatisilks.com



Waste plastics like carry bags, disposal cups, thermocols, multi layer films and polyethylene and polypropylene foams can be used without segregation and cleaning. The process needs no new machinery and it is in situ process. The overall consumption of bitumen is less by 10 to 15% and thus the cost is reduced. By laying 1 Km single lane plastic road, 10 lakhs carry bags are consumed with a saving of 1 ton of bitumen (Rs 40,000). It also helps to avoid the entry of 3 tons of CO₂ in the atmosphere, if it is otherwise disposed by burning. Value addition to waste plastics is being created. Use of pavement scrap waste for plastic tar road reduces the cost by 50%.

Plastic tar road has double strength, compared to ordinary bitumen road. It can withstand both heavy load and heavy traffic. It is not affected by rain or stagnated water. And hence no pot hole is formed. There is no rutting and raveling. The life of the road is not less than seven years and there is no need for maintenance expenditure. Performance studies of the plastic tar road were carried out as per Central Road Research Institute specification and the results are very good. It has been published by CPCB and NRRDA as monographs.



A comparative study for 25mm thickness SDBC-10mm

Material	Plain bitumen process	Plastic-tar road
60/70 Bitumen	30 kg	27 kg
Plastic Waste	-	3 kg



Monitoring of test roads were carried out using structural evaluation, functional evaluation and conditional evaluation studies. Generally all the roads laid over a period from 2002 to 2006 are performing well. The results obtained for these roads helped to conclude that these roads are performing very well in spite of their age. Under the similar conditions most of the bitumen roads are not performing well at all.

These roads have not developed even small cracking and a pothole. The roads were distributed over the different localities of Tamil Nadu exposed to various environmental conditions like temperature, rainfall, etc., yet the roads are performing well.

Reuse of road scrap in road laying is an important find. Normally when the road is laid the existing top layer scraped out and fresh layer of road is laid, to avoid the increase in the height of the road. The scrap is usually disposed as waste. In our lab we have developed a modified process for the reuse of scrap in road laying. The scrap is reused by mixing scrap and fresh mix in 50 – 50 %. Polymer coated aggregate can be used in the process of preparation of the fresh mix. By this process 1. We do not waste the scarp, 2. We use only 50 % of the raw materials and hence the cost is reduced by 50 %. Moreover the road level is not altered. This technology works very well and was already implemented in National Highways.

Plastic Waste Per Day in 2010-2011



Image Source: www.greensutra.in

We have also developed a cold mix road laying process using emulsion and plastic coated aggregate and this can be used for laying roads in colder regions, where heating of aggregate is not done easily.

More other products like polymer modified bitumen roofing sheets, corrosion resistant reinforced steel bars for construction purpose are also been developed under this project. All the products use waste plastics as a binder.

Thus the problem created by the waste plastics has been addressed by the project called "Utilization of Waste plastics in the construction of flexible pavement".

Under the project the following recognition had been achieved since 2002...

1. In 2002 the patent for the project waste obtained
2. CPCB approved the project in the 2005
3. NRRDA - National Rural Road Development Agency has issued guidelines for laying plastic road in rural areas in the year 2006.
4. Ministry of Environment and Forest had published in their gazette notification for laying plastics road in forest areas- 2008.
5. Indian Road Congress published the coding for road laying using dry process - IRC- SP- 98- 2013.
6. A review on the plastic tar road was published by CIPS- in 2015.
7. The project fetched the inventor - The TECH icon of India - award in 2015- presented by Hon. Prime minister of India.
8. Environmentalist award - " Maharana Uday Sing Award - 2017" presented by Mewar Foundation, Udaipur.
9. Series of TEDx lecture has been delivered in Goa, Mumbai and Chennai.

Image Source: www.thenewecologist.com

Recycling

By the Numbers



544,000

Trees saved if every household in the United States replaced just one roll of virgin fiber paper towels (10 sheets) with 100% recycled ones.



20 million

Tons of electronic waste thrown away each year. One ton of scrap from discarded computers contains more gold than can be produced from 10 tons of gold ore.



315 kg

Amount of CO₂ not released into the atmosphere each time a metric ton of glass is used to create new glass products.



\$160 billion

Value of the global recycling industry that employs over 1.5 million people.



79 million tons

Amount of waste material diverted away from disposal in 2005 through recycling and composting.



5%

Fraction of the energy it takes to recycle aluminum versus mining & refining new aluminum.



9 cubic yards

Amount of landfill space saved by recycling one ton of cardboard.



51.5%

percentage of the paper consumed in that was recovered for recycling in 2005.



98% : Percentage of glass bottles in Denmark that are refillable.
98% of those are returned by consumers for reuse.

Top 5 Recycling Countries



Switzerland 52%



Austria 49.7%



Germany 48%



Netherlands 46%



Norway 40%

PLASTONE BLOCK – A PRECAST STRUCTURE MADE WITH WASTE PLASTICS AND STONE AGGREGATE AND ITS USE IN TOILET CONSTRUCTION

**Dr. R. Vasudevan, Dr. A. Ramalinga Chandra Sekar
and Mr B. Sundarakannan,
Thiagarajar College of Engineering, Madurai.**

India, a country where the sanitation in rural areas is needed to be developed to a large scale. The urban development is being carried out all over the country in a planned manner and we also succeed in those schemes. The status of sanitation in rural development is a big task before us for the coming years. Since we are a highly populated country and also we holds larger population in the rural areas, the improvement of sanitation is becoming a very difficult task for us. The improvement of sanitation includes many issues like proper drainage systems, proper drinking water supply and proper toilet facilities. Among these, the proper toilet facility is the important sanitation problem we face in the rural areas. This should be taken into account and should be managed immediately; this has created more and more hygiene problems for the villagers.

The poor toilet culture followed, i.e. open area in rural areas results in many health hazards to the people living in the villages. The ill effect of the toilet culture is studied country wide and a report says that the 99% of the villages in India does not have proper toilet facilities at their place. In spite of government plans and actions, we could not achieve the criteria due to so many problems. The first and the most important solution is creating awareness among the village people. The government is doing awareness camps among the villagers. The problem is, still we are not able to achieve the concept of giving hygienic toilets for the people in the village.

The second problem is the cost factor and the funding provided by the government for the construction of toilets. So the need of the hour is to develop newer design and newer materials for the

construction of IHHL for the village people at very low cost which can be afforded by the people as well as by the government.

The present research is for the construction of IHHL to the rural people in a low cost budget. This research also aims at promoting support to the poor families by developing some income through waste management, to provide job opportunities to the poor people. Our research is different in a way that, in our research we propose new techniques for the easy disposal of solid waste produced in the rural areas and to use the waste plastics available in the solid waste for the construction of structure of the IHHL.

A material called as PLASTONE – prepared using waste plastics and stone was developed in our laboratory. This prefabricated PLASTONE can be used in the construction of structure of the IHHL. The waste plastics available in the solid waste of the particular area can be segregated and used as binder with the stone aggregate in the preparation of PLASTONE, which is an effective substitute for bricks and cement blocks and this also costs less. This process can also be done in situ and no external industry is involved. The main advantage is that the rural people can use their own waste in their area for the preparation of the PLASTONE and they can use the same for the construction of toilets. This process results in not only in the reduction of the cost of construction of IHHL but also in the easy disposal of solid waste available in the village. In a nut shell our research aim is to provide the technology of using PLASTONE in the construction of toilets at a cheaper cost and as well as a method for the easily disposal of waste plastics.

Novelty involved in the Product

- Use of waste plastics as a binder – new technique
- Structural blocks manufactured using solid waste materials and waste plastics
- New effective technique for the disposal of waste plastics in a large scale

- First technology to utilize multi layered films of waste plastics. Special properties of PLASTONE block with high compression strengths, malleability and ductility

Utility:

- The main objective for the construction of IHHL at low cost will be achieved by using this project
- Solution for easy disposal of waste plastics can be arrived using the finding of the project
- Achieving rural hygienic sanitation can be brought about by following the methods provided by the project. The project also opens number of areas, to implement this technology in the clean India scheme

Scalability:

- Plastone, the product outcome of the project has been very handy and important structural material which solves the problem of disposal of waste plastics and many other solid wastes.
- Plastone can consume all filmy waste plastics both mono layered and multi layered packaging covers
- Plastone when used for the construction of low cost toilet structures throughout India, the disposal of waste plastics no longer a problem.
- Swachh Bharat aims at clean India and indirectly to clean the waste. Waste plastics used here and the technology is ours, "Made in India".
- The other raw materials used is solid wastes like granite, ceramics, lime stone and concrete debris and this helps to solve disposal of solid waste by making the product namely Plastone.
- Plastone blocks are made without using bitumen, sand, cement and water.
- Plastone is made up of waste plastics and other solid waste materials only.
- Hence Plastone is a new find to solve the problem of disposal of very many wastes in one stroke.
- The project can be scaled up to all places of our country , since for the manufacture of PLASTONE we use locally available waste plastics and stone aggregate and this process is also eco friendly and in situ. No external industries are involved.

Environmental Friendliness:

- The technology of using PLASTONE in the construction of toilets at a cheaper cost and as well as a method for the easily disposal of waste plastics.
- We propose new techniques for the easy disposal of solid waste produced in the rural areas and to use the waste plastics available in the solid waste for the construction of structure of the IHHL.

Affordability:

Cost Analysis:

- The cost analysis for the construction of toilets structure using Plastone blocks was calculated and the details are given below
- A comparative cost analysis between the toilet structures constructed using rational method and using Plastone blocks was also given here.

Rate for the construction of 4ft X 4ft X 7ft – Toilet structure. Using Plastone Block – Rs 7556.00

- Total number of Plastone blocks required of size 2 X 1 for the construction of above said toilet structure is 49 blocks. Amount of waste plastics required is 156.00 Kgs. Amount of Aggregate required is 294.00 Kgs

Sl. No.	Type of Material	Amount Required in Kg	Cost in Rs	Total in Rs
1.	Waste Plastics	156	156x9=1248	1248.00
2.	Aggregate	294	294x1=294	294.00
3.	Fuel energy	2	2x57	114.00
4.	Labour	NA	400x3 = 1200	1200.00
5.	Fixing Frame	NA	2700	2700.00
6.	Sheet Laying and Sheet cost	NA	2000	2000.00
			Total	7556.00

Using traditional method (Cement Wall Structure):

S.No.	Type of Expenses	Total in Rs.
1.	Earth work and PCC structure	3000.00
2.	Brick Work for 2	4000.00
3.	Brick Work for 4.5 ft and 7 ft height	9000.00
4.	Plastering all over	3000.00
5.	Sheet laying and sheet cost	2000.00
6.	Cement and Sand	6000.00
		27000.00

- The expenses for IHHL construction with Plastone structures is very low, when compared with traditional methods.

Images of PLASTONE BLOCKS

Plastone Blocks



LIME STONE



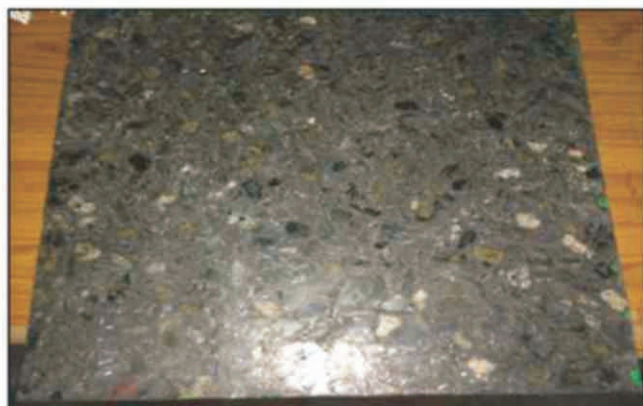
RED OXIDE



CERAMIC WASTE



PLASTONE PET



Images of Toilets constructed using Plastone Blocks





WASTE MANAGEMENT Guidelines from Central Pollution Control Board (New Solid Waste Management Rules, 2016 on April 8, 2016):

- (i) Every Waste Generators shall segregate waste and store separately and hand over to Municipal workers or authorized waste pickers.
- (ii) Ministry of Environment, Forest & Climate Change shall constitute 'Central Monitoring Committee' to monitor and review every year.
- (iii) MoUD shall frame National Policy on SWM and coordinate with States/UTs, provide technical guidelines, financial support, training to local bodies, etc.
- (iv) Departments of Fertilizers & Chemicals shall assist in market development for city compost and make available to companies (3/4 bags compost: 6/7 bags Fertilizers).
- (v) Ministry of Agriculture shall make flexible Fertilizer Control Order, promote utilization of compost, testing facility for compost and issue guidelines.
- (vi) Ministry of Power shall fix tariff of power generation from W-T-E project and ensure distribution through companies.
- (vii) MNRE shall facilitate infrastructure for waste-to-Energy plants and provide subsidy.
- (viii) Secy- Incharge, UD (state/UT) shall prepare State Policy/Strategy, adopt 3- Rs, coordinate for state planning, identification of common/regional landfills, notify guidelines of buffer zones.
- (ix) District Collector/Magistrate shall facilitate identification of landfill site, quarterly review the performance of local bodies.
- (x) Secretary, Panchayats: same as Secy. UD at Panchayat level.
- (xi) CPCB shall coordinate with SPCBs/PCCs for monitoring and Annual Reports, formulation of standards, review new technologies, prepare guidelines for buffer zones restricting from residential, commercial and construction activities areas; and inter-state movement of waste.
- (xii) Local Authority/Panchayats shall prepare SWM plan with time line and its implementation, segregate, adopt 3-Rs, material recovery, processing/disposal of Waste, user fee and levy spot fine.
- (xiii) SPCBs/PCCs shall monitor, issue authorization and regulate.
- (xiv) Manufacturers/Brand owners shall facilitate collect back wastes of their products and provide pouch for packaging sanitary wastes, etc.
- (xv) Industry (cement, power plant, etc.) shall use RDF within 100 km.
- (xvi) Operator of facilities shall follow guidelines/standards.



Stall at Vigyan Bhavan Delhi:

At New Delhi, On 19 February 2018, Dr. Harsh Vardhan, Minister of Environment, Forest and Climate Change, and Erik Solheim, United Nations Under-Secretary-General and Head of UN Environment, jointly announced that India will be hosting the global World Environment Day celebrations on 5 June 2018.

India is the global host of 2018 World Environment Day which will take place on June 5, 2018. With "Beat Plastic Pollution" as the theme for this year's edition, the world is coming together to combat single-use plastic pollution.

WED Festival is a celebration of our unique environment with live performances, wholesome food, sustainable stall holders, a fun kids program, live art, innovative displays, community and environment groups to meet and learn from, and more activities.

As a part TCE ENVIS Team had exhibited the recycled plastic products to support the theme "Beat Plastic Pollution" from 01.06.2018 to 05.06.2018 at Vigyan Bhavan, New Delhi.

Asia Media Summit 2018



The 15th Asia Media Summit (AMS) 2018 was hosted by the Ministry of Information and Broadcasting, Government of India, jointly with the Indian Institute of Mass Communication (IIMC), New Delhi and Broadcast Engineering Consultants India Limited (BECIL), from 10th -12th May, 2018 in New Delhi. Union Minister for Information & Broadcasting and Textiles, Smt. Smriti Zubin Irani presided the function as the Chief Guest of the Summit on 10th May. Our TCE ENVIS Co-ordinator Dr. R. Vasudevan (Padma Shri Awardee) took part at Asia Media Summit and handled a session on Sustainable development Stories on Plastic Waste Management.

World Environment Day 05.06.2018 - Beat Plastic Pollution Exhibition at the Vigyan Bhavan convention centre in New Delhi



**TCE ENVIS - RP (Plastic Waste Management) Team from Madurai at Exhibition
Best Moments with the Honourable Prime Minister of INDIA - Narendra Modi.**

Outlook - Sustainable Plastics: Issues, Challenges and Remediation

On May 18, two of South Delhi's massive shopping malls, played host to a symposium on probably the most abundant and the least thought of materials in the modern world-plastic. The event was an initiative of the Outlook group's 'knowledge series' and played host to a diverse group of people from all over the country: experts in the field, government leaders and agencies and various other stakeholders.

The symposium was inaugurated by Vijay Sampla, Minister of State for Social Justice and Empowerment and the key note address was given by P. Raghavendra Rao, secretary, Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers. While Sampla talked about his own experience with recycling waste, Rao gave the necessary perspective on the Indian plastic industry, a point further elaborated by MD of ONGC Petro Additions Limited.

An insightful part of the event was the address by Padma Shree awardee Rajagopalan Vasudevan, dean of the Thiagaraj College of Engineering, Madurai. Vasudevan has been successful in providing an important solution to the country's plastic woes-by using plastic waste in the construction of roads. He mentioned the advantages his 'polymer blended bitumen roads' have over other roads which are more durable in comparison to other roads and also water resistant. Vasudevan's ideation in the lab started as an independent, solution-based program and has, over the years, caught the government's eye.



India Eye International Human Rights Observer: Think Environment



The India Eye International Human Rights Observer (IHRO) commemorated the World Environment Day on 5th June. Deliberating on issues concerning the environment. The event "Pollution Explosion: Threat to Environment" was held at the India Islamic Cultural Centre on 5th June.

Union Minister of State for Health and Family Welfare Ashwini Kumar Choubey was the chief guest. Leading environmentalists and prominent personalities was felicitated.

The List includes Rajya Sabha MP Vijay Darda, M.C. Mehta, Rajagopalan Vasudevan, Mahamandaleshwar Martandpuri ji Maharaj, Anil Prakash Joshi, and Nila Madhab Pandan. Talking about the event. Sharma said: "Despite all our efforts, we continue to reel under the threat of pollution. We have not been able to achieve even 1% of the purpose. Entire world is celebrating world environment day this year. The theme for this year is 'Beat the Plastic' and India is the host country. We all must resolve to the make our mother Earth clean from pollution." "As the pollution levels are increasing, there is a question mark on whether this Earth will be livable or not in the days to come. Today it's late, tomorrow it will be disaster," Sharma added.

India Eye IHRO has been spreading awareness to protect the environment, especially among the students.



Madurai is an energetic, ancient city on the Vaigai River in the South Indian state of Tamil Nadu. Its skyline is dominated by the 14 colorful gopurams (gateway towers) of Meenakshi Amman Temple. Madurai is a city in Tamil Nadu, India. It was the capital of the earlier Pandyan Kingdom.

Meenakshi Amman Temple, Ayiram Kal Mandabam (Hall of Thousand Pillars) are some of the important tourist places in Madurai.

Madurai always considered to be a good pilgrim center. Tourists from various part of the country and world are coming to madurai and enjoying a historical excellence.

Thiagarajar College of Engineering (TCE) is a government-aided autonomous institution located in Madurai, Tamil Nadu, India. It is affiliated to Anna University, Chennai. It is one of several educational and philanthropic institutions founded by philanthropist and industrialist Karumuttu Thiagarajan Chettiar.

Thiagrajar College of Engineering, Madurai Spread across 143 acres, The institution and hostels are located near Thirupparankundram on the outskirts of Madurai, 8 kilometres south-west of the city of Madurai. With the motto of "Duty is Life".



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The ENVIS Centre at Department of Chemistry, Thiagarajar College of Engineering funded by the Ministry of Environment, Forest & Climate Change, Government of India is assigned a responsibility for the collection, collation and dissemination of information on the 'Plastic Waste Management'. This centre provide information about various aspects of Plastic Waste Management such as research on plastic waste, waste management, plastic waste information, environmental issues, carrier opportunities, publication of newsletters in both tamil and english languages, query services etc.