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PLASTIC WASTES AND ITS MANAGEMENT: ANALYSIS AND CASE STUDIES

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Abstract

Plastic seems all pervasive and unavoidable. Since the 1960s our use of plastic has increased dramatically, and subsequently, the portion of our garbage that is made up of plastic has also increased from 1% of the total municipal solid waste stream (household garbage) to approximately 13.Plastic products range from things like containers and packaging (soft drink bottles, lids, shampoo bottles) to durable goods (think appliances, furniture and cars) and non-durable goods including things from a plastic party tray to medical devices. Sometimes marked with a number and a chasing arrow, there is an illusion that all plastics are recyclable, and therefore recycled. But there are a number of problems with this assumption. While use and consumption of plastic is increasingly high, doubts about viable options for reuse, recycling and disposal are also on the rise. Complications such as the increasing number of additives used alter the strength, texture, flexibility, colour, resistance to microbes, and other characteristics of plastics, make plastics less recyclable. Additionally, there is very little market value in some plastics, leading municipalities to landfill or incinerate plastics as waste. Another major concern about plastics in the waste stream is their longevity and whether or not they are truly biodegrade. It is estimated that most plastics would take 500-1000 years to break down into organic components. Because of this longevity and the low rate of recycling, much of our plastic waste ends up in landfills or as litter. Some of this plastic waste makes its way via rivers and wind to the ocean. Garbage barges, and the trans-continental transport of recyclable materials also lead to an increasing amount of plastics in our oceans and waterways.

Keywords:-Plastic Wastes, Harmful Effects, Pollution, Recycle, Replication

Introduction

Plastic products have become an integral part of our daily life as a result of which the polymer is produced at a massive scale worldwide. On an average, production of plastic globally crosses 150 Million tonnes per year. Its broad range of application is in packaging films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household and industrial products, and building materials.It is estimated that approximately 70% of plastic packaging products are converted into plastic waste in a short span. Approximately 9.4 million TPA plastic waste is generated in the country, which amounts to 26,000 TPD2 . Of this, about 60% is recycled, most of it by the informal sector. While the recycling rate in India is considerably higher than the global average of 20%3 , there is still over 9,400 tonnes of plastic waste which is either landfilled or ends up polluting streams or groundwater resources. While some kinds of

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plastic do not decompose at all, others could take up to 450 years to break down. The figure captures per capita plastic consumption in FY 2014-15.Plastics are not inherently bad, and they have many redeeming ecological features. Many of the techniques we utilize in our designs involve targeted use of plastic products. Their durability and low maintenance reduce material replacement, their light weight reduces shipping energy, their formulation into glue products allows for the creation of engineered lumber and sheet products from recycled wood, and their formulation into superior insulation and sealant products improves the energy performance of our structures.

Harmful Effects of Plastics

Plastic is versatile, lightweight, flexible, moisture resistant, strong, and relatively inexpensive4. Those are the attractive qualities that lead us, around the world, to such a voracious appetite and over-consumption of plastic goods. However, durable and very slow to degrade, plastic materials that are used in the production of so many products, ultimately, become waste. Our tremendous attraction to plastic, coupled with an undeniable behavioral propensity of increasingly over-consuming, discarding, littering and thus polluting, has become a combination of lethal nature.The disposal of plastics is one of the least recognized and most highly problematic areas of plastic's ecological impact. Ironically, one of plastic's most desirable traits: its durability and resistance to decomposition, is also the source of one of its greatest liabilities when it comes to the disposal of plastics. Natural organisms have a very difficult time breaking down the synthetic chemical bonds in plastic, creating the tremendous problem of the material's persistence. A very small amount of total plastic production (less than 10%) is effectively recycled;the remaining plastic is sent to landfills, where it is destined to remain entombed in limbo for hundreds of thousands of years, or to incinerators, where its toxic compounds are spewed throughout the atmosphere to be accumulated in biotic forms throughout the surrounding ecosystems.

Groundwater And Soil Pollution

Plastic is a material made to last forever, and due to the same chemical composition, plastic cannot biodegrade; it breaks down into smaller and smaller pieces5. When buried in a landfill, plastic lies untreated for years. In the process, toxic chemicals from plastics drain out and seep into groundwater, flowing downstream into lakes and rivers. The seeping of plastic also causes soil pollution and have now started resulting in presence of micro plastics in soil.

Pollution in Oceans

The increased presence of plastic on the ocean surface has resulted in more serious problems. Since most of the plastic debris that reaches the ocean remains floating for years as it does not decompose quickly, it leads to the dropping of oxygen level in the water, severely affecting the survival of marine species. Materials like plastic are non-degradable which means they will not be absorbed and recycled. When oceanic creatures and even birds consume plastic inadvertently, they choke on it which causes a steady decline in their population. The harmful effects of plastic on aquatic life are devastating, and accelerating. In addition to suffocation, ingestion, and other macro-particulate causes of death in larger birds, fish, and mammals, the plastic is ingested by smaller and smaller creatures (as it breaks down into smaller and smaller particles) and bio accumulates in greater and greater concentrations up the food chain—with humans at the top.

Plastic Waste Generation in India

According to the reports for year 2017-18, Central Pollution Control Board (CPCB) has estimated that India generates approximately 9.4 Million tonnes per annum plastic waste, (which amounts to26,000 tonnes of waste per day), and out of this approximately 5.6 Million tonnes per annum plastic waste is recycled (i.e. 15,600 tonnes of waste per day) and 3.8 Million tonnes per annum plastic waste is left uncollected or littered (9,400 tonnes of waste per day) Out of the 60% of recycled plastic7:

- 70% is recycled at registered facilities
- 20% is recycled by Unorganized Sector
- 10% of the plastic is recycled at home.

While these stats are 38% higher than the global average of 20%, there is no comprehensive methods in place for plastic waste management. Additionally, there is a constant increase in plastics waste generation. One of the major reasons for this is that 50% of plastic is discarded as waste after single use. This also adds to increase in the carbon footprint since single use of plastic products increase the demand for virgin plastic products.

Plastic Waste Management

Types of Plastics

The Society of the Plastics Industry, Inc. (SPI) introduced its resin identification coding system in 1988 at the urging of recyclers around the country. The seven types of plastic include:

1. Polyethylene Terephthalate (PETE or PET)
2. High-Density Polyethylene (HDPE)
3. Polyvinyl Chloride (PVC)
4. Low-Density Polyethylene (LDPE)
5. Polypropylene (PP)
6. Polystyrene or Styrofoam (PS)
7. Miscellaneous plastics (includes: polycarbonate, polylactide, acrylic, acrylonitrile butadiene, styrene, fiberglass, and nylon)

Reuse

Reuse is a step up from recycling. It diverts plastic and takes pressure off the recycling services. In fact, reuse is the middle-man between reduce and recycle, and some would be surprised at how many opportunities for reuse there really are.One can reuse plastic-produce bags for sandwiches, plastic grocery bags for small trash bags, and re-use plastic silverware. Most people skip this step and go directly to recycling, but reusing plastics can reduce the demand for new plastics to be created.For instance, since refillable plastic containers can be reused for many times, container reuse can lead to a substantial reduction in the demand for disposable plastic and reduced use of materials and energy, with the consequent reduced environmental impacts.

Recycle

Recycling and re-utilization of waste plastics have several advantages. It leads to a reduction of the use of virgin materials and of the use of energy, thus also a reduction of carbon dioxide emissions.

Benefits of Recycling:

- Reduces Environmental Pollution

- Energy savings : 40 - 100 MJ/kg (depends on the polymer)
- Economic Benefits
- Reduces demand for virgin polymer
- Preferred to Land Filling
- Generates Employment
- Reduces depletion of Fossil fuel reserves

Difficulties in Recycling:

- Hard to separate from non-plastics (no 'magnet' equivalent)
- Differing composition of plastic resins means they are largely incompatible
- Degradation of polymer chains on recycling
- Recycled polymer is of lower quality than virgin polymer.
- Most waste plastics films specially thin plastics films have limited market value, therefore effort is not spent in collecting them
- Identification of reuse and recycling opportunities
- Markets for Plastics; Lack of Infrastructure
- Low value of recovered Plastics
- Subsidies for recycling program

A number of factors can complicate the practice of plastics recycling, such as the collection of the plastics waste, separation of different types of plastics, cleaning of the waste and possible pollution of the plastics. A further complicating factor is the low-value nature of most of the products that can be manufactured from recycled plastics. Reusing plastic is preferable to recycling as it uses less energy and fewer resources, however recycling plastic takes less energy than making plastic from raw materials.It has been observed, to reduce bad effects of waste plastics, it is better to recycle and re-utilize waste plastics in environment-friendly manners. In addition to reducing the amount of plastics waste requiring disposal, recycling and reuse of plastic can have several other advantages, such as:

- Conservation of non-renewable fossil fuels – Plastic production uses 8% of the world's oil production, 4% as feedstock and 4% during manufacture
- Reduced consumption of energy
- Reduced amounts of solid waste going to landfill
- Reduced emissions of carbon-dioxide (CO2), nitrogen-oxides (NOx) and Sulphur-dioxide (SO2).

Case Study: Hyderabad- Use of Plastic Pavement Block

India's first dog park is not just a haven for dog lovers, but also a glimmer of hope for environmentalists fighting for a plastic-free world. In a first, the 4,000 sq. ft. pavement right outside the park has been constructed outof 1,500 recycled plastic tiles. Installed by GHMC and Hyderabad-based start-up Bamboo House India, these tiles are an eco-friendly alternative that offers a practical solution to the growing menace of plastic.

"Urban cities today are plagued with the problem of waste-management and as social entrepreneurs we consider it as an opportunity to produce sustainable yet profitable products," says Prashant Lingam, co-founder Bamboo House India. These tiles are a smart

investment option for the government as they do not have to be replaced every six months thus saving a lot of money. These tiles are strong, long-lasting and comparatively cheap too, he points out. Currently installed on a pilot basis, each tile weighs up to 300 grams and is made out of 600 polybags. Besides being fire-proof and damage-free, these have been designed for percolation of water and thereby ensure better ground water table recharge.

GHMC West Zone Commissioner Harichandana says the civic body had been looking for solutions to deal with waste in general and wants very little trash to end up in its dumpyards. With these tiles we are not only getting a cost cut, but also ensuring that our environment is not negatively affected. This project is picking up and we are soon going to see several pavements like these across Hyderabad," she says. The figure shows one such recycled footpath.

Interestingly, this is not the only eco-friendly installation by Bamboo House India. Only two months ago, the parking shelter at Miyapur Metro Station was replaced by a unique house made completely out of recycled plastic waste. But why chose plastic over conventional steel shelters? "Because they are cheaper and cooler," avers Prashant. Bamboo House India produced and installed one plastic house for just Rs 1.5 lakh whereas a regular steel shelter would have cost twice. And because they used 'trash' like tetra packs, bottle caps and poly bags as raw materials, they ended up producing a heat-proof, water- proof, fire-proof and damage-free house at a minimum cost.Not only this, Hyderabad has made Recycle Bins out of Plastic Pet Bottles, Plastic Bags, Shampoo Bottles & Toothpaste Packets. Each Bin consists of 30kgs of Plastic.In total, there are 775 no of bins installed in one zone and 23,500 Kgs of Total Amount of Plastic Waste has been used.

Case Study: Go Green Initiative of Tetra Pak

Tetra Pak India has come up with 'Go Green' initiative thereby encouraging recycling of cartons. It has partnered with McCann Health India for its campaign 'Cartons le aao, classroom banao' (bring cartons and build a classroom), which encourages consumers to adopt green practices by depositing used paper-based Tetra Pak cartons for recycling at collection centres. Such cartons can be used to make desks, notepads, exam pads and even roofing sheets for the less privileged. The initiative is in line with its efforts to raise awareness and encourage recycling of used cartons and a part of its on-going flagship programme 'Go green with Tetra Pak.'Since the beginning of the Go green campaign in 2010, 1.8 million cartons have already been collected and recycled and 250 school desks have been provided to schools for the lesser privileged through this campaign. The campaign is a multi-city one and the first leg in Mumbai has been undertaken in collaboration with retail chains Reliance Fresh, Reliance Smart and Sahakari Bhandar and with NGO RUR Greenlife, a Mumbai-based environment organisation at the forefront of promoting recycling.To take the campaign message to Mumbaikars across the city, Tetra Pak has also tied up with the Dabbawala association as part of the campaign.

Case Study: Conversion of PET bottle waste into textile Products

A Petro- Chemical company has taken an initiative to collect the PET bottle waste from all over India and convert it into textile products. It has tied up with 150 vendors in India to provide PET bottle bales for processing into textile products.The company is installing RVM (Reverse Vending Machines) at various locations such as Malls, Exhibition Centres, School/ Colleges and Temples/ Pilgrimage Places, for collection of PET bottle waste and

creating awareness among citizens to use the PET bottles responsibly. These collected bottles are recycled and used to make fabrics for bags, T-shirts and garments in composition with natural fibres like cotton, wool etc.The company uses 4 R model which includes the concept of 'Replace' along with the existing 3R model (Reduce, Reuse and Recycle). It has replaced natural raw materials with used PET bottles and for every 8000 PET bottles recycled, one full barrel of Oil is saved.The wet colouring process in the product of Polyester staple fibre into dry one with no Pollution. Elimination of wet dyeing from process also eliminates all the associated pollution. The process of using dry dyeing is an advantage to environment.

Henceforth, every bag or T shirt made from PET bottles:

1. Reduces the usage of water by 1400 Litres
2. Redeems 8 waste PET bottle from the land-fill
3. Reduces pesticide usage by over 50%
4. Reduces carbon foot-print by 32%

This eco-friendly process of conversion of PET bottles to bags/textile products is based on zero waste concept, uses renewable energy, prevents sewage pollution, reduces consumption of bags and creates green environment.

Reverse Vending Machine (RVM):

Machine specification

- Dimension in Inch:72" (H) x 38" (W) x 32" (D)
- Dimension in Ft: 6 Ft (Height) x 3.1 Ft (Width) x 2.66 Ft (Breath)
- External 17" Led Screen for coupon management and branding.
- Dual cylinder hydraulic compression.
- 220 V Single Phase Motor, 50 HZ, 1.5 kW
- Internal coupon printer.
- Collection bin with capacity to collect 15kg of crushed plastic
- Sensors to detect bottles with auto stop functionality
- Wi-Fi/3G network operations with remote software access.
- Galvanized sheets with carbon steel load bearing component

Case Study: Plastic to Alternate Fuel

ACC Limited is India's foremost manufacturer of cement and concrete. ACC's operations are spread throughout the country with 16 modern cement factories, more than 40 Ready mix concrete plants. Since inception in 1936, the company has been a trendsetter and important benchmark for the cement industry in many areas of cement and concrete technology. ACC has a unique track record of innovative research, product development and specialized consultancy services. The company's various manufacturing units are backed by a central technology support services center - the only one of its kind in the Indian cement industry. Gagal Cement Works is one of cement plants in ACC Group.

Green Soldiers from Gagal Cement works launched first project titled 'Making Gagal Plastic Free'. Segregation is the essence of effective waste management and hence, a workshop was organized for the stakeholders.All colony and local village residents were invited for a discussion

on the strategy. Green Soldiers team was trained on the ways to segregate the plastic waste. The Green Soldiers team collected about 53 Tonnes of plastic waste, which was successfully co-processed in Gagal cement kiln.

Project Details:

The plastic waste collected from the villages, colony and plant premises were weighed at the weighbridge each week after the collection drive. The drive started with collection of 50 kgs/week, which is presently recording approximately 2 Tonnes of collection per week. This gave a clear indication that the stakeholders were increasingly becoming more aware about segregation and concerned about their environment.

Result of the Project and Replication Potential:

The initiative can be replicated across other industries and companies countrywide, as well as at a global level. The beauty of the initiative is that, keeping the ideas intact, the projects can easily be moulded to suit the climate, topography and biodiversity of any area across the world. Our natural resources are getting scarce by the minute and alternate fuels such as bio-charcoal / plastic are an excellent way to alleviate this paucity of non-renewable energy sources.

Conclusion

Plastics are inexpensive, lightweight and durable materials, which can readily be moulded into a variety of products that find use in a wide range of applications. As a consequence, the production of plastics has increased markedly over the last 60 years. However, current levels of their usage and disposal generate several environmental problems. Around 4 per cent of world oil and gas production, a non-renewable resource, is used as feedstock for plastics and a further 3–4% is expended to provide energy for their manufacture. A major portion of plastic produced each year is used to make disposable items of packaging or other short-lived products that are discarded within a year of manufacture. These two observations alone indicate that our current use of plastics is not sustainable. In addition, because of the durability of the polymers involved, substantial quantities of discarded end-of-life plastics are accumulating as debris in landfills and in natural habitats worldwide. Recycling is one strategy for end-of-life waste management of plastic products. It makes increasing sense economically as well as environmentally and recent trends demonstrate a substantial increase in the rate of recovery and recycling of plastic wastes. These trends are likely to continue, but some significant challenges still exist from both technological factors and from economic or social behaviour issues relating to the collection of recyclable wastes, and substitution for virgin material.

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