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PLASTICS WASTE AS OPTIONAL FUEL

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Abstract - This research examined at the problems of plastic waste on land and in the ocean, as well as other ways to deal with it. This was done because too much plastic waste is being made, which could be used to meet the energy needs of industry. In this study, it was found that dumping plastic waste on land hurts the quality of the soil. On a site where plastic garbage was dumped, the levels of phosphorus and potassium were discovered to be higher than normal. This indicates that the trash disposal has caused the site's soil to lose its nutritional value. There was not a significant difference between the levels of heavy metals in samples of sea water and soil. This may be due to precipitation, high tide, low tide, wind speed, and the current at the ocean floor. To determine what type of energy may be extracted from plastic waste, the gross calorific value of several types of recycled plastics numbered 1 through 7 was determined to range from 5,500 kCal/kg to 11,500 kCal/kg. This indicates that the potential energy of plastic trash is comparable to that of pet coke and coal (about 8,500 and 4,500 kCal/kg, respectively). The gross calorific value of plastic garbage indicates that it could be a more efficient energy source than pet coke for meeting energy demands.

This plastic is co-processed in an effort to use it as an alternative fuel in a cement plant. Throughout the process, the fuel, plastic, and clinker produced with and without plastic waste are measured. Specific heat through co-processing demonstrates that the specific heat for clinkerization increases by approximately 755 kCal/kg of clinker when plastic waste and pet coke are used as fuel, compared to when only pet coke is utilised as fuel. The computation of specific heat demonstrates that there was no negative change in the quantity of heat required. This indicates that clinkerization was successful. This heat need has not increased significantly, thus it might be utilised alongside pet coke as an alternative fuel.

During co-processing, the emissions from the stack were also monitored. This indicates that there were no significant changes and that the emissions were within the prescribed levels. The standard is 0.1 ngTEQ/Nm3, however the air concentration of Dioxin and Furan was 0.019 ngTEQ/Nm3.

Key Words: **Plastic Waste, Soil Sample , Calorific Value, Pet Coke , Research, Fuel etc**

1.INTRODUCTION

Plastic has been used in a lot of different ways, like in carry bags, industrial tools, food packaging, and so on. Because of this, the amount of plastic waste has increased by an extremely large amount due to the rise in population and use of plastic. The problems got worse because most plastic doesn't break down very quickly.

The main goal of the study is to find other ways to get rid of plastic waste so that the bad effects of plastic waste can be lessened. Plastic waste can be used as an alternative fuel in a lot of manufacturing industries, especially steel and cement.

1.1GLOBAL SCENARIO OF FUEL

According to the Carnegie-Tsinghua Center for Global Policy, India is the world's largest consumer of pet coke. Pet coke is a carbon-based solid fuel that produces 11 percent more greenhouse emissions than coal when burned. The Federation of Indian Chambers of Commerce estimates that by 2020, the manufacturing sector will use 22 million tonnes (MT) of plastic annually, up from 13.4 MT in 2015. Nearly fifty percent of this is single-use plastic.

In manufacturing industries, a substantial amount of fuel, primarily Pet coke or Coke, is used. The calorific value of these fuels ranges between 7,000 and 8,000 Kcal, which is the amount of energy required to transform a solid into a liquid. This fuel, either from crude oil or coal mines, satisfies the energy requirements of this process.

1.2WHAT MADE OF PLASTIC

Plastic is made of different kinds of organic synthetic or processed materials that are mostly high-molecular-weight thermoplastic or thermosetting polymers. It can be made into filaments, objects, films, bags, or containers. Plastic is one of the most common and useful materials on earth, but it is also one of the most harmful and long-lasting pollutants, which is hurting the world's fragile ecosystems. The oceans and all the life in them may be the ones that are hurting the most.

2.PLASTICS AND ITS TYPES

Plastics are commonly being categories in two major fields:

1. Thermoset plastics

When plastic cooled and hardened, it kept its shape and couldn't go back to how it was before. These are hard, long-lasting, and stiff. Thermosets are always used for car parts, plane parts, tyres, and so on. Thermoset is a type of plastic that includes polyurethanes, polyesters, epoxy resins, and phenolic resins.

2. Thermoplastics:

Plastics that get soft when heated and then go back to their original shape are easy to shape into films, fibres, and packaging. Polyethylene (PE), polypropylene (PP), and polyvinyl chloride are all examples of thermoplastics (PVC).

Common

Polypropylene is also used a lot to make tubes, battery cases, bottles, bags, filaments, and many other things.

2.1 PLASTIC WASTE AND ITS ENVIRONMENTAL CHALLENGES

According to the MoEF&CC rule on managing plastic waste, the term "plastic waste" refers to any plastic that is thrown away after it has been used or after it has served its purpose. Plastic waste takes a long time to break down because of its chemical structure, and getting rid of it is even harder. Plastic waste is very common because it is cheap and has a lot of uses in everyday life. This means that a lot of plastic waste is made.

2.2 HOWTO REDUCE THE LOAD OF PLASTIC WASTE

Plastic Waste Management: Plastic waste management is the process of getting rid of, controlling, or reducing the amount of waste from the time it is made until it is thrown away. It also includes collecting, moving, treating, and getting rid of plastic waste, as well as keeping an eye on and regulating the process.

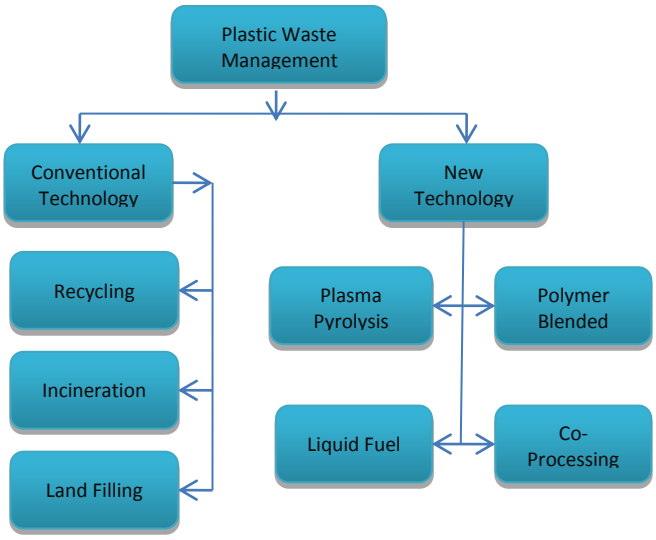


Fig1.1

2.3 Plastic Waste Management Flowchart

A. **Conventional Technology:** These are the techniques that can be used as a disposable method at the chemical, physical, and biological level. People have been using this type of technology for a long time to cut down on the amount of plastic waste.

- **Plastic Waste Recycling:** It is the process of getting back different kinds of plastic so that they can be used to make different things, but not in their original form. These recycled products are made by reusing plastic to make a wide range of new items, most of which can't be recycled again.
- Steps in the recycling of plastic:
- In order to get rid of plastic waste, every piece of plastic needs to go through five different steps. So that more processing could be done to make different kinds of goods.
- Sorting: In this step, plastics that can't be recycled and plastics that can be recycled are separated from plastics that are needed. Plastics are separated by brand and type so that they can be fed into a shredding machine.
- Washing: Once the plastic waste has been sorted, it needs to be washed well to get rid of contaminants, labels, dirt, and adhesives. This makes the finished product made from recycled plastic better and better.
- Shredding: Once the plastic waste has been washed, it should be put on different kinds of conveyor belts, such as screw conveyors, belt conveyors, and so on, which then go through shredders. These kinds of

shredders can break up plastic trash into small pieces that can then be recycled into other things.

- Plastics: How to Identify or Sort Them:
- Shredded plastic can be easily analysed in the right way to test the plastic pieces so that uniformity of plastic waste can be secured through quality and class assessment.
- Extruding: In this process, shredded plastic is melted in different ways, which lets it be shaped into small pellets that can be used to make different kinds of plastic.

Processes or methods of Plastic Recycling

- **Heat Compression:** This type of method for recycling plastic waste is mostly used because it can recycle all kinds of plastic at once, which is in high demand. In this, plastic waste that hasn't been sorted or cleaned is mixed together in big containers that shake the whole thing up. The main benefit of this method is that the pieces of plastic that are recycled don't have to match up.

Monomer: This method of processing not only cleans plastic, but also cleans used plastic to make a new polymer. With a detailed and accurate monomer recycling process method, most of the problems with recycling plastic waste can be solved. This method shows how to reverse the polymerization process so that the same type of condensed polymer can be used again. .

3.IMPORTANCE AND RELEVANCE OF THE STUDY

To turn plastic resin into plastic bottles, you always need a source of energy. Plastic resin was heated and poured into a mould. The mould was then heated and bottles were made. About 8 percent of a plastic bottle's carbon footprint is made during this last stage of production.

About three pounds of CO2 are released when about one pound of PET (polyethylene terephthalate) plastic is made. The carbon footprint of a bottle is made up of the production of plastic resins and the transportation of bottles. Studies have shown that a 500-ml bottle of plastic water has a total carbon footprint of about 82.8 grammes of carbon dioxide.

4.Literature Review

4.1 PLASTIC WASTE A GLOBAL STUDIES AND VIEWS

4.1.1Hanna Ritchie and Max Roser's 2018 article "Plastic Pollution" shows how plastic pollution affects the economy, the environment, and people's health. The article makes it clear that the world's plastic production was only 2 MTPA in 1950. Since then, it has grown by a factor of 200 every year, reaching 381 MT in 2015 and still going up by a factor of 200 every year. The study also showed that the packaging and building and construction industries are the main sources of plastic waste.

Hanna and Max also wrote in an article that most plastic waste comes from countries that are already wealthy. In the same article, Jambeck et al. (2015) tried to figure out how much plastic was actively being dumped into the oceans around the world in 2015. The data in Jambek's article suggest that, in 2015, plastic waste is mismanaged in China more than anywhere else in the world.

S.No.	Details Study	References	Understanding obtained
1	Plastic Pollution	Hanna Ritchie and Max Roser (2018)	• Global status of problem • Challenges & Impacts
2	Negative Impact of Plastic Waste	CPCB 2015 study report	• Impact on soil and water • Problems of land fill method
3	Plastic Waste legislation	Plastic waste management rule 216	• Scope made by policies • Standards/guideline to be followed on plastic waste
4	Plastic Waste as Alternative Energy: Plastic oil	Arif Setyo (2018)	• Plastic oil generation • Challenges /problems /benefits of solution
5	Plastic Waste Handling and its Influence on Household Waste Incineration	Paolo Fornaseri (2014)	• Plastic waste segregation and different methods • Environmental problem and benefit of solutions
6	Sustainable Plastic Waste management	Case study of thane municipal corporation	• Challenges in the waste management • Initiatives as a solution of problems

5.Methodology

1. The investigation will be conducted in stages dependent on its scope.
2. The following procedures are proposed for completing the dissertation:
3. An examination of the impact of plastic garbage on the quality of soil and marine water.
4. In this step, an analysis will be conducted to determine the effects of the weathered plastic. In this study, heavy metals will be analysed, and the results will be compared to the quality of soil in areas devoid of plastic debris.
5. The waste yard of the municipality or nagar-palika will be sampled for contaminated soil, and additional samples will be taken 3 kilometres away from the dump yard.
6. In the same manner, samples of the ocean will be collected approximately 2 metres from the shore and 3 kilometres from the shore.
7. To determine the calorific value, we will gather samples of several types of plastic garbage. Co-processing criteria include the amount of plastic garbage accessible in the yard, its calorific value, and other variables. The calorific value of the fuel and the amount of clinker produced for the day are then used to calculate how much heat is required to produce one tonne of clinker in a cement factory where plastic waste is utilised as an alternative fuel.
8. During the co-processing of plastic trash, isokinetic sampling will be utilised to examine the emissions of a pollutant. As required by law, this emission is assessed at the raw mill and kiln stack, which is a primary source of emissions, to determine how they affect environmental air quality.

5.1PHASE-I: SOIL AND WATER QUALITY ANALYSIS

5.1.1 Water Sampling:

1. The study began with an investigation of the effects of plastic trash on the quality of soil and water, followed by the selection of sampling locations. In the chronological order, the study occurred following the wet season. Gujarat's Jafarabad taluka was selected as the location for the dump. According to the 2011 Indian Census, the population of the area is 27,167. The landfill is around 2–3 kilometres from the city centre. Occasionally, earth is utilised to level the landfill site. The next sample is collected around three kilometres away from the landfill.
2. Similarly, a sample of seawater was collected 20 metres from the coast, which may be where plastic debris enters the ocean via surface runoff. The usual sea water was collected three kilometers from the coast.
3. The first sample is obtained from the dump site by excavating approximately 1 metre below. This sample was also collected, identical to the sample collected at the landfill. The sample is collected in separate, 500-gram-capacity plastic bags from both locations.
4. In the same manner, seawater was collected 20 metres from the shore and 1 metre deep near the city. The seawater was collected at a depth of one metre, three kilometres from the coast. Each water sample was placed in its own one-liter plastic bottle.
5. The water samples that will be analysed for the presence of heavy metals were collected by adding 5 ml of nitric acid per litre of sample water.

6. CONCLUSIONS

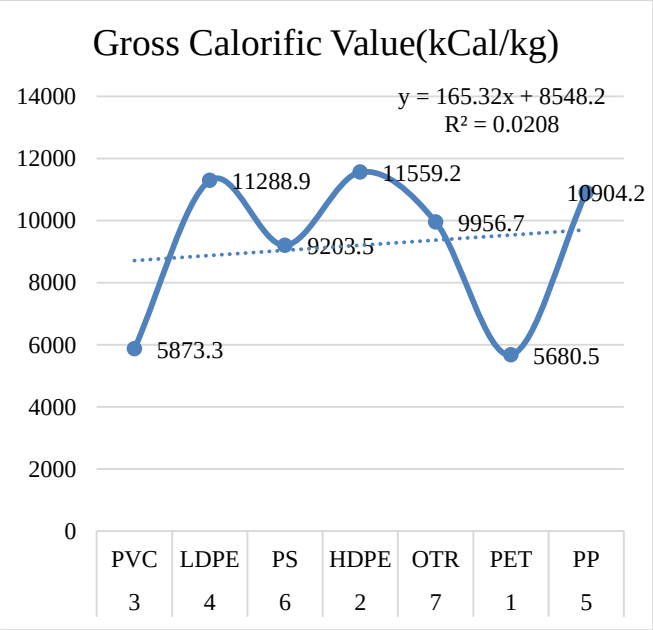
- According to research of plastic trash, its impacts on the environment, such as on the air, water, and soil, demonstrate that the use of plastic is the greater issue. People's continued use and production of plastic waste, which makes life difficult for people, is creating significant changes. Here are the study's findings as presented in the dissertation: -
- When the consequences of plastic trash were examined at a dump for plastic garbage in Gujarat's Jafarabad taluka, it was discovered that phosphorus and potassium levels in normal soil samples were higher than in samples from dumpsites. This indicates that garbage disposal has made the soil at dumpsites less nutrient-rich.
- However, the soil in the vicinity of the landfill exhibited a greater concentration of nitrogen and chloride ions.
- The most plausible explanation is that garbage that has been abandoned or buried decomposes in the environment, thereby producing chemicals with various properties, like nitrogen, methane, chloride, phosphate, etc.

- A accumulation of discarded garbage containing numerous microplastics and a loose soil profile that allowed a great deal of water to pass through led to a high organic and inorganic material retention.

- It has been shown that the chemicals, colours, stabilisers, and fillers in the many types of plastic items can seep into the soil and seawater when plastic garbage is dumped. To safeguard the quality of the soil and water in the ecosystem, it is urged that individuals dispose of less plastic garbage.

- There was not a significant difference between the levels of heavy metals in samples of sea water and soil. This may be due to precipitation, high tide, low tide, wind speed, and the current at the ocean floor.

- Based on their recycle number, various types of plastic garbage are analysed to determine their gross calorific value. This is done in order to determine the possible energy range, and the result is unexpectedly superior.



- According to the statistics presented in the graph above, recycle waste numbers 1 and 3 have a lower calorific value than other recycle waste numbers, although their values are still closer to coal's.

- Specific heat is calculated to be approximately 755 kCal/kg of clinker with co-processing, as opposed to 753 kCal/kg of clinker without co-processing. This means that a cement factory will require higher specific heat to produce clinker. This indicates that plastic trash might be used in place of pet coke to produce clinker in a cement plant, despite the fact that the heat requirements do not vary significantly.

- If plastic trash is burned in a cement kiln, the resulting emissions will meet the CPCB/MoEF&CC emission guidelines for co-processing, according to an analysis of air quality based on stack emissions.

- The primary reason is that the temperature in the cement kiln is maintained at approximately 1,300 degrees Celsius, which breaks down the complex and hazardous chemicals into simpler components that are easy to dispose of. As dioxin and furan are the most harmful gases, they are produced by the combustion of plastic garbage. In contrast to the standard of 0.1 ngTEQ/Nm3, the concentration of emissions was only 0.019 ngTEQ/Nm3.

- When waste plastic is co-processed in a cement kiln, it will have a significant impact on the nation's waste management. The Indian cement sector, which is one of the most energy-efficient in the world, is also leaning toward embracing alternative fuels. Co-processing garbage will tackle two issues simultaneously: it will make it easier to dispose of waste and it will reduce carbon emissions overall.

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BIOGRAPHIES

Nirmal Kumar Sahu is a Research Scholar of M. Tech, Department of Civil Engineering Jagannath University Jaipur.

Professor (Dr.) Bharat Nagar is working as a HOD in Department of Civil Engineering, Jagannath University Jaipur since last 13 years. He has worked in various engineering colleges and industries in Rajasthan & has total experience of more than 19 years. He has written 4 books and more than 60 research papers in various reputed International and National Journals. His area of interest is Environmental Assessment, Concrete application, and Earthquake Engineering etc.

Hemant Agrawal is working as an Assistant Professor and M.tech Coordinator in Department of Civil Engineering, Jagannath University Jaipur. Graduated from Rajasthan Technical University, Kota with honor's in 2014. He is honored with a gold medal in M. tech and has published 13 papers in International and National Journals & 3 in National Conference. He has more than 8 years of teaching experience. His area of interest is Structure analysis, Concrete application etc.