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TECHNOLOGIES FOR CONVERSION OF PLASTIC WASTE INTO FUEL

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Abstract: In the present world due to urbanization and industrialization, huge amounts of plastic are generated every year. Hence the disposal methods and management of plastics like burning them in the open air cause hazardous problems in the atmosphere. Though there have been numerous attempts of technologies to repossess plastics, it primarily emits greenhouse gases and the usage of power for the entire recycling process is high rise. Plastic to fuel conversion is a promising technology that has the potential to reduce the amount of plastic waste in the environment and provide an alternative source of fuel. Hence the Pyrolysis technique is one of the nature-friendly attempts to convert plastic to inflammable gas. But this is a process that needs high energy for the anaerobic decomposition of plastic in the presence of the catalyst and at very high temperatures. To minimize the consumption of excess energy nature, renewable technologies are taken in to provide extreme temperature levels to enable pyrolysis. This technology is converting plastic waste into fossil fuel through decomposition.

Keywords: Urbanization, Hazardous, greenhouse gases, pyrolysis, anaerobic, Fossil fuel.

I. INTRODUCTION

India is one of the world's largest consumers of plastic, generating a significant amount of plastic waste every day. According to a report by the Central Pollution Control Board (CPCB), India generates around 26,000 tons of plastic waste every day, of which only 60% is collected and recycled. The rest of the plastic waste ends up in landfills, rivers, and oceans, causing environmental pollution and health hazards. In addition to this, the Indian government has also implemented the plastic waste management rules, 2016, which provides a framework for the regulation and management of plastic waste in the country. The rules impose restrictions on the manufacture, sale, and use of plastic bags, cups, and other single-use plastic items.

Plastic has been widely used in the last 30 years but was invented in 1860. With the increase in the population, the use and production of plastic waste are increasing at a high rate to meet global demands. Over 3.4 billion metric tons of plastic are produced every year in India but only 30% of plastic is recycled, remaining plastics are dumped into landfills. Plastics have become vital to today's world due to their light weight, durability, energy efficiency, modifiable, and flexibility.

Plastic is made of a long chain of a molecule called polymers. Polymers are made by when naturally occurring substances such as crude oil or petroleum are transformed into other substances with completely different properties. Plastic includes various elements such as Carbon, hydrogen, chlorine, and sulphur and has natural organic materials such as cellulose, coal natural gas, and crude oil. Plastic polymers can be made into granules, powders, and liquids as raw materials for plastic products. Polycondensation and Polymerization are two different processes for the production of polymers. Polycondensation is a chemical condensation for producing a polymer by linking single or multiple kinds of monomers to form long chains and polymerization which generates thick, viscous substances as resins that are employed to make plastic products. Plastic waste contributes significantly to the problem of waste management as plastics are the non-biodegradable nature of polymers.

Therefore, we need to look for more profitable alternatives to increase the decomposition of plastic waste into new and useful products. So, new technologies are used for the conversion of waste plastic into fuel-based products. The conversion of plastic waste into fuel is a form of energy recovery, and it involves a process called pyrolysis. Pyrolysis is a chemical process that involves heating plastic waste in the absence of oxygen to break it down into smaller molecules, which can then be condensed into liquid fuel. The process can produce various types of fuels, such as gasoline, diesel, and kerosene.

It can be performed using various types of reactors, including batch, semi-continuous, and continuous systems. The process is typically conducted at high temperatures ranging from 300 to 800°C. The exact temperature and duration of the process depend on the type of plastic waste being used and the desired end product. While converting plastic waste into fuel can help reduce the amount of waste sent to landfills and generate energy, it is not a perfect solution. The process

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requires significant energy inputs, and the fuel produced may not be of high quality or suitable for use in all applications. Furthermore, there are concerns about the environmental impact of the process, such as emissions of greenhouse gases and toxic air pollutants.

Catalytic depolymerization is a process that involves breaking down plastic waste using a catalyst, which is a substance that speeds up a chemical reaction. The process typically involves heating the plastic waste with a catalyst at high pressure, which breaks it down into smaller molecules. These smaller molecules can then be processed into a variety of fuels, including diesel, gasoline, and jet fuel. Gasification is a process that involves heating plastic waste in the presence of oxygen, which converts into a gas. The gas can be cleaned and processed into a variety of fuels, including hydrogen, methane, and synthetic natural gas. Each of these methods has its own advantages and disadvantages, and the choice of method depends on various factors, including the type of plastic waste being processed, the desired end product, and the available resources. Plastic to fuel conversion is a promising technology that has the potential to reduce the amount of plastic waste in the environment and provide an alternative source of fuel.

Overall, while the conversion of plastic waste into fuel is an innovative and promising technology, it should be viewed as one of several possible solutions to the plastic waste problem. Reducing the use of single-use plastics, improving waste management infrastructure, and promoting circular economy principles are all crucial to addressing the plastic waste problem.

II. RELATED WORK

Several pyrolysis plants have been installed in India over the last 20 years to convert plastic waste into fuel. Here are few examples:

1. The Gujarat Pollution Control Board(GPCB) established a pyrolysis plant in 2005 in the city of Ahmedabad. The plant had the capacity to process 10 tons of plastic waste and convert t into diesel fuel.
2. A company called Envirogreen Technologies installed a pyrolysis plant in 2011 in the city of Hyderabad. The plant had the capacity to process 10 tons of plastic waste per day and convert it into fuel.
3. In 2016, a company called Agile Process Chemicals LLP started a pyrolysis plant in the city of Pune. The plant had the capacity to process 10 tons of plastic waste per day and convert it into fuel oil.
4. In 2018, a company called Akinori India Pvt Ltd. installed a pyrolysis plant in the city of New Delhi. The plant had a capacity to process 1000kg of plastic waste per day and covert it into fuel.

III. METHODOLOGY

With the knowledge of present technology in plastic waste management, all the equipment are designed for a specific task. The conversion of plastic waste into fuel involves a process called pyrolysis, which is a thermal degradation process that breaks down the plastic waste into smaller molecules in the absence of oxygen. The methodology for converting plastic waste into fuel typically involves the following

- The plastic waste is sorted and cleaned to remove any non-plastic materials such as paper, metal, and glass. This is important because non-plastic materials can damage to the pyrolysis equipment and reduce the quality of the end product.
- The plastic waste is shredded into small pieces to increase its surface area, which makes it easier to heat and break down the pyrolysis process. The shredded plastic waste is fed into a pyrolysis reactor, which can be condensed into liquid fuel.
- The gaseous products of pyrolysis are condensed into liquid fuel using a cooling system. The fuel can be further purified using distillation and other refining processes.
- The fuel is stored and distributed for use in various applications, such as heating and power generation. It's important to note that the methodology for converting plastic waste into fuel can vary depending on the type of plastic waste being used and the desired end product.

Different pyrolysis reactors, operating conditions, and refining processes can be used to optimize the process and improve the quality of the end product.

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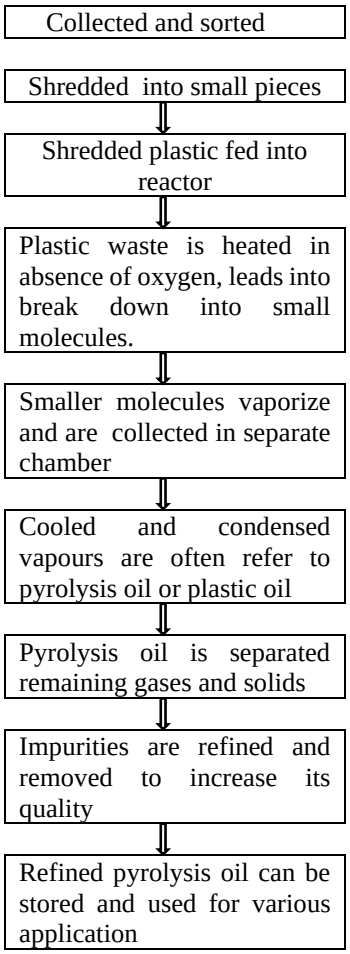

IV. ADVANTAGES AND APPLICATIONS

Advantages

- Volume of the waste is significantly reduced (<50– 90%) Solid, liquid, and gaseous fuel can be produced from the waste
- Storable/transportable fuel or chemical feedstock is obtained
- Environmental problem is reduced
- Desirable processes as energy is obtained from renewable sources like municipal solid waste or sewage sludge
- The capital cost is low\
- Ability to handle unsort and dirty plastic
- Heavy oil which has a heating value ＞10000kcal/L

Application

- Fuel from plastic waste can be used as industrial heating energy.
- Alternative energy as fuel for diesel engines.
- Airline industries, helicopter.
- Heavy transportation.

V. CONCLUSION

The implementation of modern technologies can improve so many opportunities for the recycling and management of waste in the city. The plastic-to-fuel conversion technique can develop a new idea, and detect the source of diesel for the country. Diesel oil for heavy engines can be replaced by the use of plastic liquid fuel in the aspect of technical and

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economical is compared and found that can be replaced. Though plastic fuel provides lower engine performance, the amount of plastic waste is enormous and that is processed to reduce the environmental problems. Mainly, the engine needs to be modified to follow the combustion condition of plastic fuel. As a result, around 100-150 ml of plastic liquid fuel is obtained per kg of plastic waste from the developed pyrolysis unit.

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