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Thermo Fuel from Waste Plastic.

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A B S T R A C T

Waste plastic disposal and excessive use of fossil fuels have caused environment concerns over the world. Both plastics and petroleum derived fuels are hydrocarbons that have the elements of carbon and hydrogen. Plastic molecules are distinguished from LPG, petrol, and diesel fuels by their longer carbon chains. Therefore, it is possible to transform waste plastic in fuels. All around the world companies and individuals are started to create fuel from waste plastic. The reuse of plastic could potentially keep vast amount of plastics out of landfills and out of oceans. Over 400 billion pounds of recently developed plastic is manufactured each year and roughly 36% of that is only once use and thrown away. As so miniature plastic is recycled, we need to reframe plastic waste as an underused resource vs. landfill destined. If all plastic waste made it into the landfill, it would confidently be mined in future, but recently all plastic waste does not make into our landfills. We need to stop contaminating our oceans with plastic before it is too late, and start collecting all plastics suitable for this new easy technology, a technology that is available now. The primary goals of this research were to gain a comprehensive understanding of plastic pyrolysis processes and to enhance the production of diesel range products through optimization. The technology employed is relatively straightforward: plastic materials are shredded and subjected to heat in an oxygen-free chamber, a process called pyrolysis, typically at temperatures ranging from 350 to 400 degrees Celsius. As the plastics are heated, the resulting gas is extracted and frequently recycled to provide fuel for the machine. The fuel is then distilled and strained. Because the whole process takes place inside a vacuum and the plastic is liquified - not burned, minimal to no resultant toxins are released into the air, as all the gases are reused to fuel the machine.

For this technology, the type of plastic you transform the fuel is important. Burning pure hydrocarbons like polyethylene (PE) and polypropylene (PP) results in the production of a fuel that undergoes clean combustion. But burn PVC (Polyvinyl chloride), and large amount of chlorine will corrode the reactor and contaminate the environment

Keywords: Thermo fuel, Waste Plastic.

1. Introduction

Plastics have become in important part in today's world. Due to their light-weight durability, energy efficiency with a faster rate of production and design flexibility, these plastics are employed in entire breadth of industrial and domestic areas. Plastic are non-degradable polymers of mostly containing carbon, hydrogen and some others elements such as chlorine, nitrogen, etc…Due to its non-biodegradable nature. The plastic waste contributes significantly to the problem of municipal waste management.

- Plastic are natural and synthetic materials.
- They are created by chemically changing natural substances or are synthesized from inorganic and organic raw material. On the basis of their physical characteristics, plastics are usually divided into three types as thermosets, elastomers and thermoplastics.
- These groups vary primarily with respect to molecular structure, which determines their differing thermal behavior.

In this process, waste plastic is transformed into thermofuel through a series of steps. Firstly, the plastics are shredded and then subjected to heat in an oxygen-free chamber, referred to as pyrolysis, at approximately 400 degrees Celsius. As the plastic undergoes heating, the resulting gas is separated and frequently recycled to provide fuel for the machine itself. The fuel is subsequently distilled and filtered. Since the entire process occurs within a vacuum and the plastic is liquefied rather than burned, the release of harmful toxins into the air is minimized or eliminated. This is due to the reuse of all gases and sludge to fuel the machine, ensuring a more environmentally friendly approach.

2. Literature Review

Companies and individuals worldwide are increasingly engaging in the production of fuel derived from waste plastic. Given the low rates of plastic recycling, with only 8% in the U.S., 15% in Western Europe, and even less in developing countries, this innovative approach has the potential to prevent substantial quantities of plastic from ending up in landfills and oceans. The annual manufacturing of over 500 billion pounds of new plastic includes approximately 33% that is used once and then discarded. Due to the limited recycling of plastic, it is crucial to change our perspective on plastic waste, considering it as an underutilized resource rather than destined for landfills. While all plastic waste would eventually be extracted if it were all deposited in landfills, currently not all plastic waste reaches this destination. According to the United Nations, plastic constitutes approximately four-fifths of the total waste accumulated in the world's oceans. It is imperative that we take action to cease the pollution of our oceans with plastic before it becomes irreversible, and instead focus on collecting all suitable plastics for this relatively straightforward technology, which is already available.

The process involved in this technology is relatively straightforward. It begins with the shredding of plastics, followed by heating them in an oxygen-free chamber known as pyrolysis, typically to a temperature of around 400 degrees Celsius. As the plastics are heated, the gas is separated and often recycled to provide fuel for the machine. The resulting fuel is then distilled and filtered. Since the entire process occurs within a vacuum and the plastic is melted rather than burned, there is minimal to no emission of harmful toxins into the air. This is because all the gases and sludge produced during the process are reused to fuel the machine, ensuring an environmentally friendly approach.

The success of this technology relies on the selection of the appropriate plastic type for conversion into fuel. Burning pure hydrocarbons like polyethylene (PE) and polypropylene (PP) results in a relatively clean-burning fuel. However, burning polyvinyl chloride (PVC) leads to the release of large amounts of chlorine, which can corrode the reactor and cause environmental pollution. The combustion of PETE (polyethylene terephthalate) releases oxygen into the oxygen-deprived chamber, thereby slowing down the process. Additionally, PETE is efficiently recycled at recycling centers, making traditional recycling a preferable option for this plastic type. HDPE (high-density polyethylene) used in jugs and LDPE (low-density polyethylene) found in bags and films are essentially forms of polyethylene and can be utilized as fuel as well, although the resulting fuel may be slightly more polluting due to its thicker and heavier composition. However, with further processing, even HDPE can be transformed into a cleaner diesel fuel.

2.1 Authors & their Works:

- **S.M. Al-Salem (2009):** The article titled "Recycling and recovery routes of plastic solid waste (PSW): A review" provides an overview of recent advancements in the recycling and recovery of plastic solid waste. The focus is primarily on waste derived from polyolefinic sources, which constitute a significant portion of our daily single-use plastic products. The review delves into four distinct treatment routes for PSW: primary (re-extrusion), secondary (mechanical), tertiary (chemical), and quaternary (energy recovery) schemes and technologies. Each of these routes is described and discussed in detail, highlighting their respective processes and technologies involved in the recycling and recovery of PSW.
- **S.V.S. Rao (2010**): The article titled "Treatment of Plastic Waste by Melt Densification- Operational Experience at CWMF" presents the operational experience of melting various types of plastic waste using a Melt Densification Unit (MDU). The plastic wastes discussed in the study include polythene sheets and bottles, HDPE pipes and cans, PVC shoe covers, and neoprene gloves. Using the MDU, approximately 47 cubic meters of β-γ contaminated plastic wastes and 18 cubic meters of α contaminated plastic wastes were melted. The volume reduction achieved varied between 2.5 and 30, depending on the initial bulk density of the material. Importantly, the study found that the radioactivity levels in the off-gases were consistently below detectable limits, indicating the effectiveness of the process in managing potential radiation hazards associated with the plastic waste treatment.
- **Mochamad Samsara (2013):** The study titled "Fuel Oil Production from Municipal Plastic Wastes in Sequential Pyrolysis and Catalytic Reforming Reactors" investigated the production of fuel oil from municipal plastic wastes using sequential pyrolysis and catalytic reforming processes. The research findings indicate that the type of feedstock significantly influences the yields and quality of the resulting liquid and solid products. In comparison to biomass and low rank coal, the pyrolysis of municipal plastic waste generated solid products with higher heating values. As a result, these solid products can be effectively used either by blending them with biomass and coal or as standalone fuel sources. The study highlights the potential of municipal plastic waste as a valuable feedstock for fuel oil production, offering an alternative and sustainable approach for energy generation.
- **M. Punčochářa (2012):** The paper titled "Development of process for disposal of plastic waste using plasma pyrolysis technology and option for energy recovery" outlines an exceptionally efficient non-incineration thermal process. This method utilizes extremely high temperatures within an oxygen-limited setting to completely break down plastic waste into syngas. Syngas consists of simple molecules such as CO, H2, and a small amount of higher hydrocarbons. The process outlined in the paper provides a promising method for the treatment of plastic waste while enabling energy recovery. This innovative approach offers a sustainable solution for the disposal of plastic waste, minimizing environmental impact and harnessing the potential energy stored in the waste materials.
- **WiwinSriningsih (2014):** The study titled "Fuel Production from LDPE Plastic Waste over Natural Zeolite Supported Ni, Ni-Mo, Co, and Co-Mo Metals" focused on the hydrocracking process of LDPE plastics for fuel production using bi-functional catalysts. The researchers systematically investigated the efficiency of the process. The study identified a natural zeolite, specifically obtained from Sukabumi, which exhibited a mordenite type crystalline structure. By utilizing this technology, the conversion of plastic waste into fuel is anticipated to

significantly mitigate environmental pollution, promote sustainable land use, and enhance energy storage capabilities. The findings highlight the potential of utilizing natural zeolite-based catalysts for sustainable fuel production from LDPE plastic waste, offering promising prospects for waste management and energy utilization.

- **Onwughara Innocent Nkwachukwu (2007):** The article titled "Issues of Roadside Disposal Habit of Municipal Solid Waste, Environmental Impacts and Implementation of Sound Management Practices in Developing Country Nigeria" explores different waste management options and emphasizes the integration of waste management practices. The study discusses the waste management hierarchy, which presents a range of options for effective waste management. The environmental impacts of these options, focusing on health and social effects, are thoroughly examined. The article suggests the implementation of legislation pertaining to Extended Producer Responsibility (EPR). This concept emphasizes the responsibility of manufacturers to take back their products, particularly when remanufacturing and reuse options are available. The aim is to ensure the adoption of sound management practices in waste management within Nigeria, a developing country. By promoting the involvement of manufacturers in the responsible management of their products, the article proposes a comprehensive approach to waste management, addressing environmental concerns and fostering sustainable practices in Nigeria.
- **Young Koo Park (2013):** The study titled "Release of Harmful Air Pollutants from Open Burning of Domestic Municipal Solid Wastes in a Metropolitan Area of Korea" aimed to assess the impact of irregular open burning on the air quality in the local region. The researchers conducted tests to determine the emission levels of harmful substances from the combustion of various types of domestic municipal solid waste (MSW), such as paper, wood, and plastics. Additionally, a brief survey was conducted among residents and local government officials to gather information on waste disposal practices. The survey revealed that over 10.6% of households in the metropolitan area resorted to irregular burning as a means of waste disposal. The study sheds light on the detrimental effects of such practices on air quality and highlights the need for improved waste management strategies to mitigate the release of harmful pollutants into the atmosphere.
- **M.P.Joshi (2013):** The study titled "Solid Waste Management on Dumping Ground in Mumbai Region – a Study" examines the current status of solid waste management practices at dumping grounds in the Mumbai region. The study also proposes methods and strategies to address the existing challenges. It emphasizes the importance of taking urgent steps in order to reduce water, air, and soil pollution, as well as the associated health hazards. By implementing effective waste management measures, such as improved waste segregation, recycling, and waste-to-energy technologies, the study suggests that it is possible to control and mitigate the negative environmental and health impacts caused by improper waste disposal. The findings of the study emphasize the urgency and significance of adopting sustainable waste management practices in the Mumbai region to safeguard the environment and public health.
- **Chika Muhammad (2015):** The research study titled "Catalytic Pyrolysis of Waste Plastic from Electrical and Electronic Equipment" focused on the pyrolysis process of plastic waste derived from waste electrical and electronic equipment (WEEE). The study specifically examined the pyrolysis of plastic waste obtained from equipment containing cathode ray tubes (CRTs) as well as plastic waste from refrigeration equipment. The research findings indicate that the pyrolysis of these plastics results in the production of a predominantly oil-based product, which primarily consists of styrene. The study highlights the potential for utilizing catalytic pyrolysis with zeolite catalysts to convert waste plastic from WEEE into a valuable aromatic oil, with styrene being the predominant component. This research contributes to the understanding of plastic waste management and offers insights into potential avenues for resource recovery from electronic waste.

3. Design

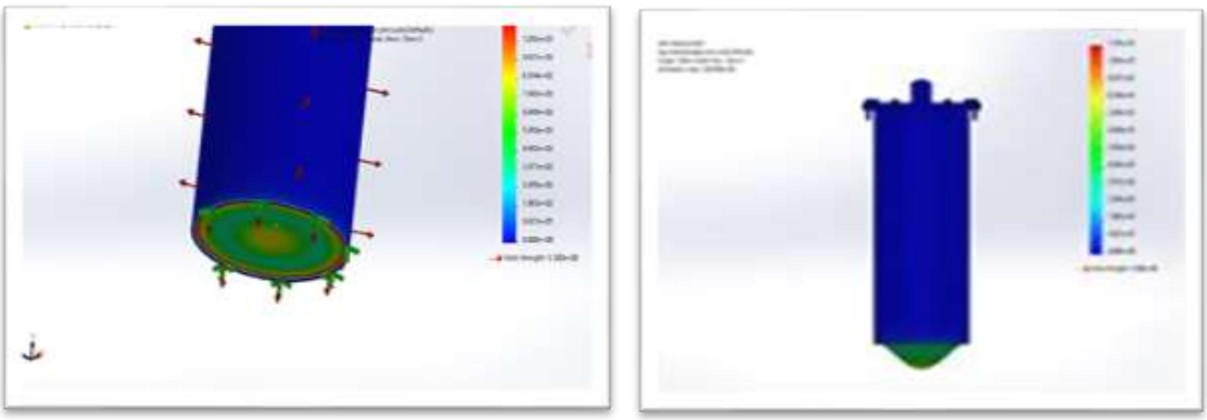

Fig.3.1. Analysis of Heating Chamber.

Fig.3.2. Model Of Thermofuel from Waste Plastic

4. Conclusion

The production of thermofuel from waste plastics is one of the preferable technique to save the nature profitably. From 1kg of raw plastic waste we can extract up to 700gm of fuel & after distillation we will produce petrol, diesel, kerosene, naphtha, carbon & other contents separately. One of the notable advantages of this project is that it offers a connection to existing fuel sources. As a result, we can confidently conclude that our project will serve as a cornerstone in preserving the environment and acting as a sustainable source of thermo-fuel.

- Thermo-fuel is extracted from the waste plastic .
- This thermofuel is related same as to the fuel used currently.
- The residue remains after burning the fuel , the carbon can be used for making of wax, black inks , etc.
- By burning 1 kg of plastic waste, the machine can easily yield 650-700 ml of diesel.
- By converting plastic waste into fuel, we can lessen atmospheric carbon dioxide (CO_2) emission by 70% and burn 1kg of plastic waste to produce around 2 kg of CO_2.

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