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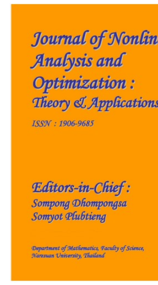

CONVERSION OF PLASTIC WASTE INTO LIQUID FUEL

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ABSTRACT:
This Project describes the various technologies are being developed to overcome the drawback of plastics, namely, their non-biodegradability. [1] Though work has been done to make futuristic biodegradable plastics, there have not been many conclusive steps towards cleaning up the existing problem. Recycling waste plastics into reusable plastic products is a conventional strategy followed to address this issue for years.[2,3] However this technique has not given impressive results as cleaning and segregation of waste plastics was found difficult. Over a 100 million tones of plastics are produced annually worldwide, and the used products have become a common feature at overflowing bins. Plastics is placed in a landfill, it becomes a carbon sink, Incineration, blast furnace, gasification are not much appreciated solution to the problem, as toxic gases are produced and their cost of production is quite high. Pyrolysis of waste plastics[4] into fuel is one of the best means of conserving valuable petroleum resources in addition to protect the environment. This process involves catalytic degradation[5] of waste plastic into fuel range hydrocarbon i.e. petrol, diesel and kerosene etc. A catalytic cracking process[6] in which waste plastic were cracked at very high temperature, the resulting gases were condensed to recover liquid fuels. Type of plastics also effect the rate of conversion of into fuel and the results of this process are found to be better than other alternate methods which are used for the disposal of waste plastic.
Keywords:*waste plastics, thermal degradation, pyrolysis, catalyst degradation.*

1. INTRODUCTION
Until now, utilisation of plastic materials in modern human life is increasingly widespread and cannot be avoided, and this results in plastic production globally increasing annually from various industries and households, and experiences progression and innovation[7]. Plastic materials have advantages such as its light weight, transparency, strong and cheap manufacturing process. Used plastics will be discharged into an environment that ends in the land fill or ocean[8]. Based on data, Indonesia ranks second in the world of contributors of plastic waste ending up in the sea which reached 187.2 million tons after China's 262.9 million tons .in the mortar mixture, increasing the compressive strength of the mortar[9]. Many developing countries are trying to develop alternatives

to cement from locally available raw materials, such as agricultural and industrial waste and coconut shell ash[10]. For example: Materials such as rice husk ash (RHA), fly ash (FA) have proven to be economical as partial replacements for cement[11]. These materials can be used as a cement replacement with a content up to 40%. Rice straw ash is pozzolanic and meets the minimum requirements of ASTM Classes N, F, and C for pozzolans, making it suitable for use as a replacement for Portland cement[12]. The compressive strength of RSA cement motors was found to be slightly higher than that of ordinary Portland Pyrolysis is a decomposition process of long-chain hydrocarbon (polymer) molecules into smaller sizes (monomer) with the use of high heat (450–800 ºC), in a shorter duration and a condition with the absence of oxygen , generating products in form of carbon, as residues and volatile hydrocarbons which can be condensate as fuel and non-condensible as gaseous fuel [13]. The reaction of this polymer is a weak bond chain and is damaged by increasing temperature, followed by the formation of the free radical propagation stage[14]. These free radicals will then separate again to form smaller ones which produce more stable compounds[15] . These smaller free radicals produce stable compounds in the form of paraffin compounds, isoparaffins, olefins, naphthenes and aromatics with the general reaction mechanism for plastics thermal degradation as explained by .

Pyrolysis of waste plastics PP has been investigated by many researchers who discovered liquid pyrolysis products to be similar to crude oil[16] . However, its products show the presence of ash and wax from raw materials, which reduces the quality , and the result of condensate analysis using Gas chromatography (GC-MS-FID) consisting of c7-c30 with a maximum peak in c9[17] . An analysis of the derived gases and oils indicated that pyrolysis gave a mainly aliphatic composition consisting of a couple of hydrocarbons (alkanes and alkenes)[18].

The liquid fuel obtained from the pyrolysis process cannot be directly used as fuel, due to the presence of impurities (ash) and wax from the feedstock , hence, the pyrolysis product is used in reducing the ash and wax content in fuel products[19]. The purification of the pyrolysis products was conducted using distillation bubble cap tray column which reduces the ash and wax content in fuel products. Moreover, used for separate the pyrolysis product has based on different boiling points[20]. This review therefore focuses on the effect of temperature on the pyrolysis results which have been integrated with the bubble cap distillation column[21]. This is carried out by utilising the heat from the reactor to separate the liquid product in a vacuum condition which minimises the oxygen entering the reactor[22]. However, in vacuum conditions, organic vapour leaves the reactor faster, thereby reducing vapour residence time and shifting evaporation to lower temperature areas, thus reducing the average vapour temperature[23]. This establishes a more favourable mass transfer condition, and obtains the highest liquid yield[24] . The obtained liquid product is analysed of physical characteristics to determine the specific type of product and compare fuel oil with the fossil[25].

2. MATERIALS USED

A. *LDPE Plastic*

LDPE – LOW DENSITY POLYETHYLENE is a type of plastic commonly used in a vast array of everyday items. It is classified by the recycling symbol number 4[26] . Here's a closer look at LDPE plastic waste and it is known for its flexibility, strength, and low melting point. It's generally clear or white in color[27]. LDPE (Low-Density Polyethylene) plastic waste shows promise as a potential source for creating plastic fuel! Here's why LDPE is a good candidate for this process[28].

B. *Chemical Breakdown*

LDPE has a simpler chemical structure compared to other plastics[29]. This makes it easier to break down LDPE molecules into smaller hydrocarbon chains which are the building blocks of fuel through a process called pyrolysis[30].

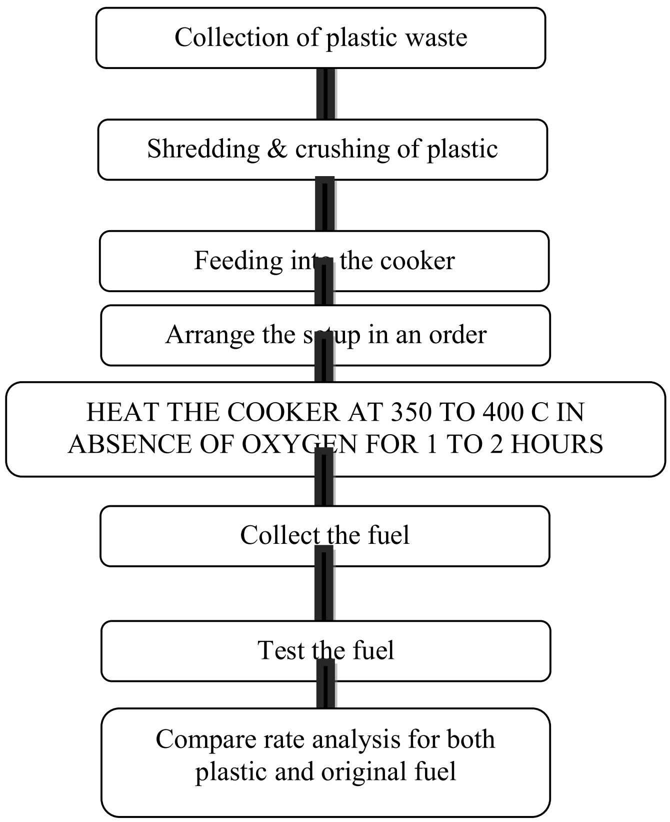
C. *Conversions Rates*

Research indicates that LDPE can achieve high conversion rates during pyrolysis, meaning a significant portion of the plastic waste can be transformed into usable fuel[31]. Studies suggest conversion rates exceeding 80% for LDPE compared to HDPE (High-Density Polyethylene) [link to pyrolysis research on HDPE and LDPE[32]..

D. Waste Management Solutions

LDPE waste generation is substantial, with plastic bags and wraps being a significant contributor[33]. Utilizing LDPE for fuel production can divert a portion of this waste stream from landfills and offer a potential alternative to fossil fuels volume[34].

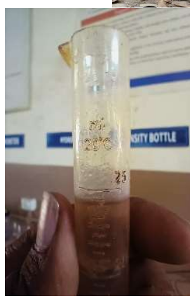
3. METHODOLOGY

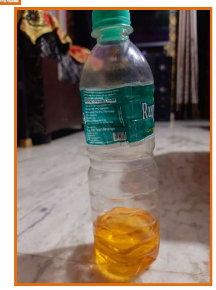


PROCEDURE

- Collect waste plastics and separate that clean and recyclable.
- Shredding of waste plastics to reduce volume of its. Shredded plastics is treated in a cylindrical reactor at temperature of 300ºC – 350ºC.
- Plastics waste further cracked in absence of oxygen without adding any catalyst , resulting the vapour are condensed from water cool condenser and collected in receiver.
- Then liquid fuel fractionates to get diesel, kerosene, petrol etc.
- Gases produced are toxic, corrosive with non toxic gases. For example hydrogen chloride, hydrogen sulfide etc is toxic and non toxic is butanes, methane, ethane and propylene.
- So all the gases are treated from this process before it discharge into atmosphere.
- After process remove the formed carbonous substance or residue in reactor to work as insulator for maintaining the efficiency of process.
- After several hours collect the sample of fuel from the substance of plastic and test the sample of fuel by lightening the fire.





3.1 Tests

1. **Filter paper test**
   Put 2 or 3 drops of fuel on the filter paper. If the pertrol is adultered, it will leave a stain on the filter paper in 5 min, because petrol evaporates very faster by comparing with another fuels.
2. **Flammability test**
   Flammability testing determines how easily a material or product will ignite or burn when exposed to fire or heat. It also measures the level of oxygen needed to sustain combustion, the rate of flame propagation, and the toxicity of smoke.
3. **Test on motorcycle**
   Motorcycles are designed to run on specific octane grades of fuel. we can find the recommended octane rating in our motorcycle's by owner's manual. Because pyrolysis fuel can contains some octane and hydracarbon properties were same as normal fuels.


4. RESULTS

Table–1:Results for the ldpe plastic and its output

INPUT	QUANTITY(Kg)	Rate per kg(Rs)	Amount Rs	Type of fuel	Amount of fuel collected(%)
PLASTIC	3.5	50	50	OIL	25%
LABOUR	-	-	5	-	-
SERVICE	-	-	2	-	-
CHARGE	-	-	3.5	-	-
TOTAL	3.5		60.5		60.5*.25=15.125

5. COMPARISON

Comparison of both plastic fuel and original fuel.
Properties of plastic fuel contains

Table 2 : Properties

Properties	LDPE
HIGHER HEATING VALUE (MJ/Kg)	41.2
KINEMATIC VISCOCITY (mm^2/s)	6.9
DENSITY (g/cm^2)	0.85
FLASH POINT (°C)	<30
SULPHUR CONTENT (mg/kg)	-

Table 3 : properties of petrol and dieselcontains

Properties	petrol	Diesel
HIGHER HEATING VALUE (MJ/Kg)	44-46.2	41.2
KINEMATIC VISCOCITY (mm^2/s)	7	6.9
DENSITY (g/cm^2)	0.74	0.85
FLASH POINT (°C)	-43	>62
SULPHUR CONTENT (mg/kg)	10	15

6. RATE ANALYSIS

Table–4:Rate analysis for plastic petrol

INPUT	QUANTITY(Kg)	Rate per kg(Rs)	Amount Rs	Type of fuel	Amount of fuel collected(%)
PLASTIC	2	50	50	OIL	12%
LABOUR	-	-	5	-	-
SERVICE	-	-	2	-	-
CHARGE	-	-	3.5	-	-
TOTAL(Rs)	2		60.5		60.5*.12=7.26

7. CONCLUSION

Plastic pyrolysis is an attractive option for the plastic waste as many authorities and countries globally call for a ban of several plastic categories from the market due to failure of the conventional methods of plastic waste control to address environmental pollution due to plastic wastes[35]. The process, however, still faces a number of limitations particularly with respect to the collection, separation, sorting, and cleaning operations and the high cost of power and transportation[36].

Pyrolysis generally produces fewer toxic products as long the process is well designed and the process conditions controlled appropriately[37]. However, the process has notable issues surrounding some toxic byproducts from plastics like polyvinyl chloride, which requires proper feedstock selection[38,39]. Another challenge is that the liquid fuel from plastic pyrolysis is not a perfect fit for many engineered applications mainly because of the relatively high sulphur content[40], which can be addressed though further treatment and blending with commercial-grade oil products. Other than liquid pyrolysis oil, a hydrocarbon-rich gas.

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