

Improvement of the Characteristics of the Fuel obtained from Waste Plastic

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Abstract - Now-a-days plastic is widely used in various forms due to their light weight, durability and design flexibility. Plastic is non-biodegradable and is therefore very harmful and leads to pollution. Thus a method to convert waste plastic into value added fuel is being discussed here. By conducting this work the characteristics of the plastic fuel namely density, viscosity, specific gravity, flash point, fire point, cloud point, and pour point are significantly improved by 0.12%, 1.22%, 0.28%, 9.52%, 12.5%, 4.16% and 3.84% respectively. The new values of the characteristics of the plastic fuel obtained are very similar to those of the petrol and diesel. Thus, we can say that we can use this plastic fuel in petrol and diesel engines without any specific modifications in the engine. By this, two problems that is problem of waste plastic and shortage of fuel are being tackled simultaneously.

INTRODUCTION

Plastics are large molecules called polymers, which are composed of monomers. Plastics that we use for fuel production is mainly polyethylene. Since plastic is made by polymerization so we convert it back into its original form by de-polymerization. The plastic waste is not only present on earth in form of landfills but also floating in oceans. The prices of fuel are increasing as the reserves are depleting very rapidly. So, scientists are bound to think for some alternate of conventional fuel. Thus, in this regard fuel from waste plastic serve their need as it sorts out the fuel crisis and also helps in saving environment by using the waste in a fruitful manner.

LITERATURE REVIEW

Parishwang Piyush¹ (2016) Plastic is made from petroleum in a chemical process that combines smaller molecules into a large chain like molecule. By pyrolysis we convert plastic, the long hydrocarbon chain back into smaller hydro-carbon chains of diesel, kerosene, etc.

Amol B Gunjal² (2017) Plastics pose a great threat to the environment in form of pollution so methods to convert this plastic in useful fuel are being found out worldwide.

Vikas Mukhraiya³ (2015) Statics show that approximately 10% of the waste plastic is recycled, 25% is incinerated (destroyed by burning) and the remaining 65% is dumped in landfills.

Sudhir Kumar J⁴ (2012) Plastics are generally made up of different elements such as carbon, hydrogen, chlorine, sulphur. Plastics are macromolecules which can be shaped according to our need by the application of desired amount of heat and pressure.

Vilas Watwe⁵ (2014) Plastics can be converted to value added fuel by the method of pyrolysis. Both type of plastics i.e. High Density Polythene (HDP) and Low Density Polythene (LDP) can be converted into fuel.

Rajaram T Karad⁶ (2017) Pyrolysis is the heating in the absence of oxygen. Temperature generally lies in the range of 110-300°C. The process is carried out for around 30 minutes to one hour.

OBJECTIVE

The objective of the work is to convert waste plastic into value added fuel; with improved characteristics. Now-a-days plastic has become a great problem as it leads to pollution of land and water both. By this work we can also contribute to the 'Swatch Bharat Mission' started by our honorable Prime Minister.

WORKING PRINCIPLE

Pyrolysis is basically made from two words 'pyro' and 'lysis' that means breaking in presence of heat. It takes place in absence of oxygen. In this process molecular breakdown of the molecules of large size into smaller molecules occurs in the presence of heat. Because of the generated vibrations, the molecules get stretched and are shaken to such an extent that molecules get broken down into smaller molecules.

METHODOLOGY

In this method firstly the waste plastic is send to the melter where it gets melted. Then this melted plastic is send to the extrusion machine where the larger molecules or the macro molecules are stretched to such a limit that they get converted into smaller units that is micro molecules. Now these micro molecules of plastic are send to the pyrolysis reactor where it gets heated in absence of oxygen at about a temperature of 300°C for around one and a half to two hours. The power supplied in the reactor is 2500 Watt. Now this liquid is send to the catalytic reactor where the reaction takes place in presence of the zeolite catalyst. Now the liquid is send to the condenser unit from where mixed oil and fuel gas gets separated. This mixed oil is now send to the fractionating tower from where different grades of fuel namely diesel, petrol, heavy oil etc. are obtained.

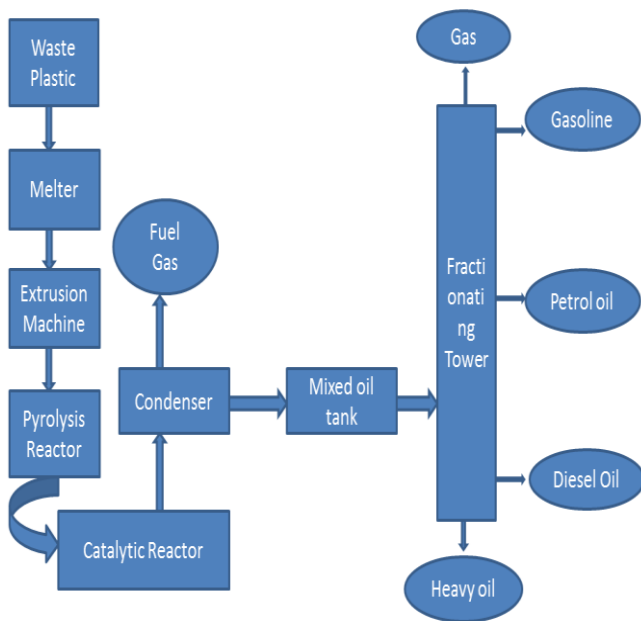


Fig -1: Schematic diagram of the process

OBSERVATION TABLE

Comparison of plastic fuel, petrol and diesel oil.

Table -1: Comparative study of plastic fuel, petrol, diesel.

Fuel Properties	Fuel from Waste	Petrol	Diesel
Density	727.22 kg/m ³	711-737 kg/m ³	820-900 kg/m ³

Viscosity	0.662 poise	1.5-4 poise	1-3.97 poise
Specific Gravity	0.708	0.82	0.81-0.96
Flash Point (°C)	23	22	26
Fire Point (°C)	27	25	29
Cloud Point (°C)	Below 2.3	1-3	2.5-4
Pour Point (°C)	-5 to -25	-4 to -20	-2 to -12
Colour	Light yellow, transparent	Brown, transparent	Blue

RESULT AND DISCUSSION

By heating the closed combustion chamber with a heater of 2500 watt and in a temperature range of 250-350°C we get approximately 530 ml fuel oil; when we heat it for two hours. The values of the characteristics of the fuel obtained are density:727.22 kg/m³, viscosity:0.662 poise, specific gravity:0.708, flash point:23°C, fire point:27°C, cloud point: below 2.3 and pour point:-5 to -25. Thus by using 9ml of this fuel in 100cc Honda Passion Pro bike it runs bike for 1 minute at an average speed of 47 km/hr.

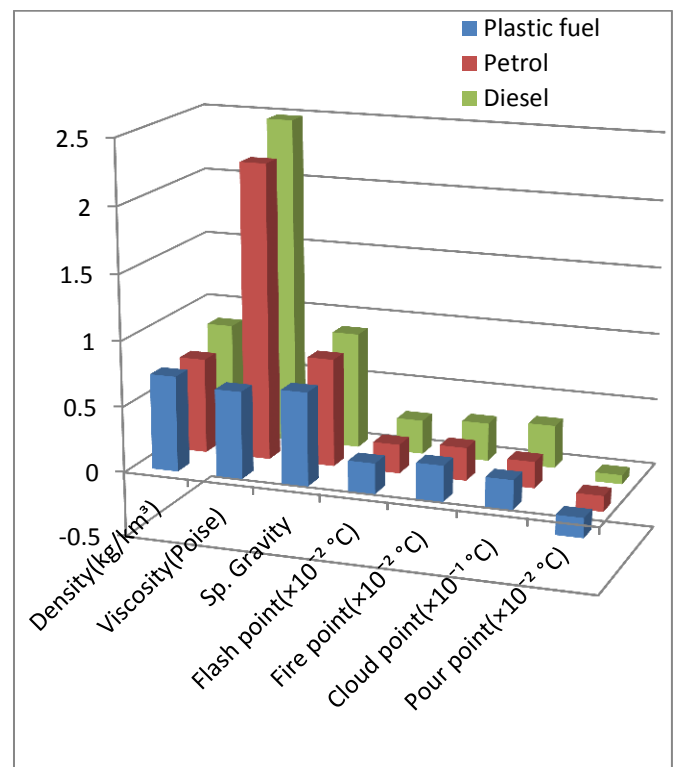


Chart -1: Comparison between characteristics of plastic fuel, petrol and diesel

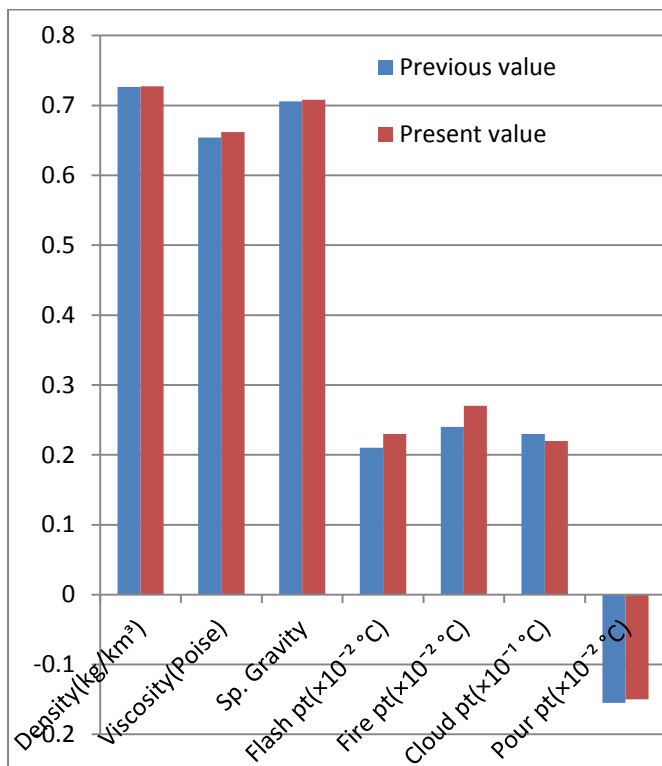


Chart -2: Comparison between previous and current values of the characteristics of the plastic fuel

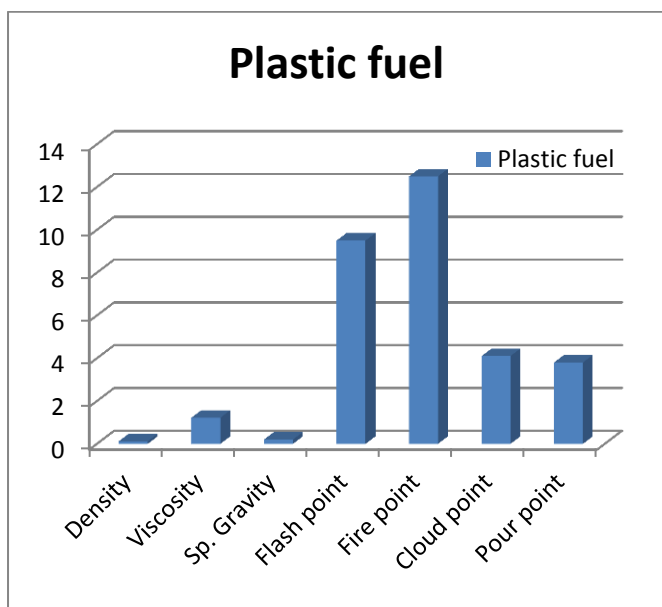


Chart -3: Percentage improvement in the characteristics of the plastic fuel

CONCLUSION

The produced fuel shows similar characteristics with petrol and diesel. There is improvement in various properties of the fuel namely density by 0.12%, viscosity by 1.22%, specific gravity by 0.2%, flash point by 9.5%, fire point by 12.5%, cloud point by 4.1% and pour point by 3.8%. Thus it can be used as a substitute of petrol and diesel without any specific modifications in the engine.

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