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PYROLYSIS PLANT & BLOOM CAR

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***Abstract*— Waste plastic disposal and excessive use of fossil fuels have caused environment concerns in the world. Both plastics and petroleum derived fuels are hydrocarbons that contain the elements of carbon and hydrogen. The difference between them is that plastic molecules have longer carbon chains than those in LPG, petrol, and diesel fuels. Therefore, it is possible to convert waste plastic into fuels. The main objectives of this study were to understand and optimize the processes of plastic pyrolysis for maximizing the diesel range products, and to design a continuous pyrolysis apparatus as a semi-scale commercial plant. Pyrolysis of polyethylene (PE), polypropylene (PP), and polystyrene (PS) has been investigated both theoretically and experimentally in a lab-scale pyrolysis reactor. The key factors have been investigated and identified.High reaction temperature and heating rate can significantly promote the production of light hydrocarbons.Liquid fuel i.e. hydrocarbon fuel obtained from four different types of waste plastics low and high density polyethylene (LDPE and HDPE), polypropylene (PP) and polystyrene (PS) were carried out in a reactor stainless steel system. Each of the plastics has different chemical and physical properties so the experiments were carried out individually for each of them. Simple thermal degradation was used to melt the plastics at temperature ranging from 120 to 400 0C.Vapor condensation form the melted plastics produced the liquid hydrocarbon product. The hydrocarbon fuel which is produced is used for running the bloom car which is to be running at a maximum efficiency then other car**.

Index terms- **Waste plastic, fuel, ldpe, hdpe, pp, ps, hydrocarbon, liquefaction, condensation, Bloom Car, Bloom energy, Bloom box, Bloom box fuel cell, implementation in india.**

I. INTRODUCTION

The disposal of waste plastics has become a major environmental problem all over the world.

USA, Europe and Japan generate about 50 million tons of post consumer plastic waste

material. Saudi Arabia is one of the major producers of plastic in the world with total

production capacity of around six million metric tons per year. The amount of plastic wastes in

Saudi Arabia is about 15-wt% in the composition of domestic municipality waste. The number of

landfill sites is decreasing. Also landfilling could result in plastic additives such as phthalates and

various dyes polluting ground water. Incineration is an alternative to landfill disposal of plastic

wastes, but this practice could result in the formation of unacceptable emissions of gases such as nitrous oxide, sulfur oxides, dusts, dioxins and other toxins. The option of secondary recycling or mechanical recycling, which is the reprocessing of plastic waste into new plastic products with a lower quality level, is not showing any signs of growth in the recycling industry. Tertiary recycling, this returns plastics to their constituent monomers or to their higher value hydrocarbon feed stock and fuel oil, is gaining momentums an alternative method. Tertiary recycling includes all those processing which attempt to convert the plastic wastes to basic chemicals by the use of chemical reactions such as hydrolysis, methanolysis and ammonoloysis for condensation polymers and to fuels with conventional refinery processes such as pyrolysis, gasification, hydrocracking, catalytic cracking, coking and vis breaking for addition polymers excluding PVC. Pyrolysis and catalytic conversion of plastic is a superior method of reusing the waste. The distillate product is an excellent fuel and makes Thermo Fuel one of the best, economically feasible and environmentally sensitive recycling systems in the world today. Thermo Fuel diesels can be used in any standard diesel engine, trucks, buses, trains, boats, heavy equipment and generators.

Suitable Plastic Material for Treatment

As a rule of thumb, approximately 950ml of oil can be recovered from 1kg of plastics such as Polyolefin's including Polyethylene (PE) and polypropylene (PP), or polystyrene (PS).

Although not suitable, the process can nevertheless tolerate small quantities of plastics containing heteroatom's. Heteroatom's are atoms other than carbon and hydrogen such as chlorine, sulphur and nitrogen. Since heteroatom's are heavier than the light elements such as carbon and hydrogen these increase the density of the plastic. This can be used as a guide to which plastics are suitable for Thermo Fuel. A rough rule of thumb is to take a representative sample of the flaked waste plastic and add it to a jar of water. If more plastic floats than sinks then the plastic scrap is acceptable feedstock for Thermo Fuel. The floatable fraction represents mainly polyolefin's (that is polyethyleneand polypropylene) and expanded polystyrene. Polyolefin's give the best yield of distillate due to their straight-chain hydrocarbon structure.

Polystyrene is beneficial in the mix since it contributes aromatic character to the distillate and improves the pour point properties (that is, the low-temperature viscosity properties).

Typical Examples of Waste Plastics for the Thermo Fuel Process

Thermo Fuel can process commingled and miscellaneous waste plastics such as:

1. plastic packaging scrap from material recovery/sorting facilities
2. oil and detergent bottles
3. off-cuts/trimming from nappy production,
4. mulch film and silage wrap,
5. mixed post-consumer plastics,
6. caps/labels/rejected bottles from bottle recycling operations.
7. commercial stretch and shrink wrap.

Pyrolysis

Pyrolysis is a process of thermal degradation in the absence of oxygen. Plastic waste is continuously treated in a cylindrical chamber and the pyrolytic gases condensed in a specially designed condenser system to yield a hydrocarbon distillate comprising straight and branched chain aliphatics, cyclic aliphatics and aromatic hydrocarbons. The resulting mixture is essentially equivalent to petroleum distillate. The plastic is pyrolised at 370ºC- 420ºC and the pyrolysis gases are condensed through a distillation tower to produce the distillate.

The essential step in the pyrolysis of plastics involves:

1. Purging oxygen from pyrolysis chamber.
2. Evenly heating the plastic to a narrow temperature range without excessive temperature variations.
3. Pyrolising the plastics.
4. Catalytic conversion of the gases to specific carbon chain lengths.
5. Managing the carbonaceous char by-product before it acts as a thermal insulator and lowers the heat transfer to the plastic.
6. Careful condensation and fractionation of the pyrolysis vapours to produce fuels of excellent quality and consistency.

Removal of sulphurs and residual contaminants

Pyrolysis of Plastics

The system consists of continuous plastics infeed system, pyrolysis gasification chamber, catalytic converter, condensers, gas scrubber, centrifuge, oil recovery line, off-gas cleaning. Waste plastics are loaded via a hot-melt infeed system directly into main pyrolysis chamber.

The chamber can generally be filled within 2 hours.

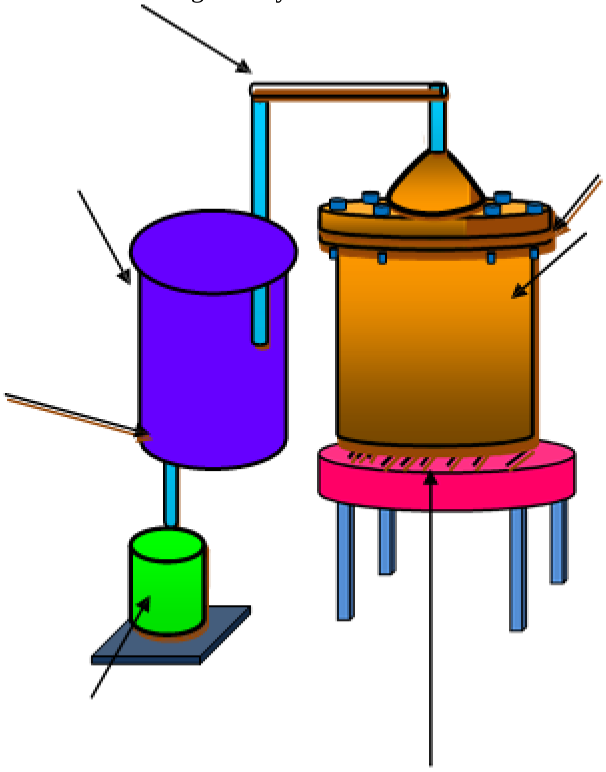


FIG - PYROLYSIS PLANT

When the chamber temperature is raised, agitation commences to even the temperature distribution and homogenise the feedstocks. Pyrolysis then commences to the point of product gasification. Non-plastic materials fall to the bottom of the chamber. The gas goes through the catalytic converter and is converted into the distillate fractions by the catalytic cracking process. The liquid distillate then passes into the operating tank after cooling in the distillation tower. From the operating tank, the product is sent to a hydro-cyclone to remove contaminants such as water or carbon. The cleaned distillate is then pumped to the quality tank, then to the storage tanks.

OUTPUT FUEL PROPERTIES:

The typical mass balance output from one ton of mixed polyolefin plastic entering the process is approximately 82% hydrocarbon distillate, 4% char, 4% losses in the desulphurization process,

4% losses of non-condensable gases and 6% which is captured and displays similar properties to commonly available .white spirit. or degreaser. The non-condensable gases from the Thermo Fuel plant are passed through a water scrubber and then fed back into the natural gas flow to the thermal oxidiser, which heats the unit, meaning there are minimal net hydrocarbon emissions The hydrocarbon fraction in turn comprises approximately 75% distillate cut and 25% paraffin material. The paraffin fraction is continuously cracked after the first condenser until it reaches the desired chain-length range and then added to the primary fuel stream.A comparison of the distillate produced from a commingled plastic mix compared with regular diesel has been conducted by gas chromatography, and shows excellent similarity between Thermo Fuel and refinery produced diesels.

Uses. The produced distillate is designed to operate in any diesel engine.

Cetane. A key indicator of diesel is the Cetane Number which is analogous to the octane rating for petrol. Cetane is a measure of the ignition delay, that is, the time between injection into the cylinder and the moment of auto-ignition. This is most significant in relation to low-temperature startability, warm-up, and smooth, even combustion. Distillates with a higher cetane rating show increased power and superior performance characteristics. Ideal diesel will have a high proportion of hydrocarbon chains that are length C16 are known as hexadecane which is the proper chemical name for cetane. Thermo Fuel produced diesel has a cetane number in the range of 57, similar to or higher conventional diesel, which averages 51-54.

Sulphur. Fuels produced from 100% clean plastic feedstocks will reflect extremely low sulphur levels, generally under 10 ppm, well under current Australian and international requirements. The system can be adjusted to further reduce sulphur levels as regulatory limits come into force. It is important however, to recognise that certain contaminants will deliver trace amounts of sulphur into the system.

There are two types of sulphurs in potential contaminants, organic and in-organic, both of this can be removed within the Thermo Fuel system process.

Lubricity. Finally, it is important to emphasise that Thermo Fuel fuel is extremely high in lubricity. In diesel engines some components, including fuel pumps and injectors, are lubricated by the fuel, so good lubricity is key element in reducing wear on these parts.

APPLICATION OF FUEL PRODUCED.

BLOOM CAR

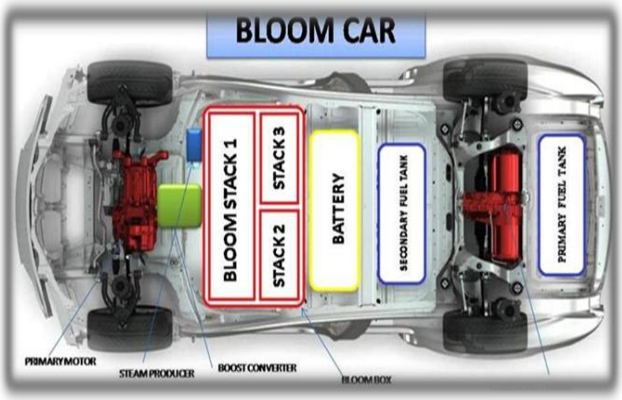
(SELF FUEL AND OXYGENPRODUCING CAR)

Our project is to emitt oxygen from automobile with neglegeable amount of carbondioxide.Using the combination of bloom boxes using them in different stages we can lead oxygen to emitt through the exaust pipes.

Most of the dangers of such a high operating

WORKING LAYOUT OF BLOOM CAR.

temperature are harnessed, but it still causes some hindrances when it comes to efficient operation. examine the potential developments made by Bloom Energy, compare the Bloom Box to other SOFCs as well as competing sustainable energy technologies, analyze the advantages and disadvantages of the Bloom Box, and ultimately determine whether the Bloom Box can compete with other green technologies. It also compares the Bloom Box to other off grid electricity options



II. CONCLUSION

Thermofuel is a truly sustainable waste solution, diverting plastic waste from landfills, utilizing the embodied energy content of plastics and producing a highly usable commodity that, due to its cleaner burning characteristics, is in itself more environmentally friendly than conventional distillate.

III. HIGHLIGHTS

- High-density polyethylene grocery bags were pyrolysis to alternative diesel fuel.
- Saturated aliphatic paraffin comprised most of the fuel composition (96.8%).
- Nearly all fuel properties were within ASTM D975 and EN 590 diesel specifications.
- Derived cetane number and lubricity were superior to conventional diesel fuel.
- Plastic derived diesel is suitable as a blend component for petroleum diesel fuel.
- To emitt oxygen from automobile with neglegeable amount of carbondioxide.Using the combination of bloom boxes using them in different stages we can lead oxygen to emitt through the exaust pipes

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