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Extraction of Biodiesel from Non-Biodegradable Plastic

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Abstract: *High oil prices are growing concerns of this century, thus extraction of biodiesel from a nonbiodegradable substance is a boon to the society. The major available non-biodegradable substance in the society is plastic. The thermal and catalytic processes of converting waste plastics into fuels are promising techniques to eliminate the hazards which are harmful to the environment, and decrease the dependence on fossil fuels. Thermal degradation decomposes plastic into three fractions: gas, crude oil, and solid residue. Crude oil from non-catalytic pyrolysis is usually composed of higher boiling point hydrocarbons. The optimization of conversion parameters such as the choice of catalyst, reactor design, pyrolysis temperature, and plastic-to-catalyst ratio plays a very important role in the efficient generation of gasoline and diesel grade fuel. The catalyst helps to lower the energy required for conversion, and the catalyst choice is very necessary for efficient fuel production. The specific and selected catalyst helps to increase the yield of crude oil with lower hydrocarbon content. Co-pyrolysis of plastics with coal or shale oil improves crude oil quality by decreasing its viscosity.*

Keywords: Plastic, Pyrolysis, Carcinogenic, Biomass, Gasoline, Hydrocarbons, Industrial Plastics, Viscosity.

I. INTRODUCTION

Plastics are produced in large quantities because of huge use in agriculture, households, automobiles, packing materials, toys, electronics etc. Plastic waste classified into two categories: Industrial plastics are generally more homogeneous and contamination-free. Municipal plastics tend to be more heterogeneous and contain extraneous materials. Plastic disposal is a major concern in many countries, including the United States. After its initial use, over 60% of the total plastic solid waste (PSW) produced is discarded in landfills throughout the world. Less than 10% of plastic waste is recycled. The waste plastics ending up in ocean makes a huge plastic soup and garbage patch like the great Pacific garbage patch risking the health of aquatic animals. Aside from the challenge of plastic waste disposal, another global issue is the energy crisis. Transportation consumes one third of the world's energy. The main energy sources for transportation are fossil fuels, coal, oil, and natural gas, all of which are non-renewable sources of energy. Fossil fuels are also major sources of environmental pollution, greenhouse gases, and ocean acidification.

II. OBJECTIVE

Biodiesel is a more sustainable and environmentally friendly fuel that is made by using non-biodegradable substance i.e. plastic. Plastics have now become indispensable materials, and the demand is continually increasing due to their diverse and attractive applications in household and industries.

III. PROCEDURE

Heat the plastic waste in non-oxygen environment, it will melt after it has melted, it will start to boil and evaporate and put those vapours through a cooling pipe and when cooled the vapours will condense into a liquid and some of the vapours with shorter hydrocarbon lengths will remain as a gas. The exit of the cooling pipe is then going through a bubbler containing water to capture the last liquid forms of fuel and leave only gas that is then burned. If the cooling of the cooling tube is sufficient, there will be no fuel in the bubbler, but if not, the water will capture all the remaining fuel that will float above the water and can be poured off the water.

On the bottom of the cooling tube is a steel reservoir that collects all the liquid and it has a release valve on the bottom so that the liquid fuel can be poured out. The device works on electricity which has six nichrome coils which helps for

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heating and consumes nearly 6kW. The coils are turned on and off by three solid state relays, one for each phase, the relays are controlled by a digital thermostat with a temperature sensor just a bit below the lid, so that the vapour temperature can be monitored. You need to heat the plastic slowly to about 350 degrees and just wait till it does the magic. Our device has a capacity of 50 litters and can hold about 30 kg of shredded plastic.

The process takes about 4 hours, but it can be shortened considerably by tweaking the design a bit. As I said, this makes a liquid fuel that can be used as multifuel, that means it can be used on diesel engines and also on gasoline engines, but we still need to test it will work on gasoline. It works for diesel engines just fine, that has already been tested. There is a difference in what plastic you use, if you use polyethylene (plastic cans, plastic foil, and all kind of flexible non break plastics) you will get out liquid fuel that will solidify as it cools into paraffin, it is still good for diesel engines as long as you use a heated fuel tank, because it needs to be heated just about at 30 degrees Celsius to be liquid and transparent. If you don't want that, you can put the paraffin through the device for one more time and you will chop those hydrocarbons even smaller and half of the paraffin will turn to liquid fuel and other half will remain a paraffin, but much denser and will melt at higher temperatures, this is the stuff you can make candles out of and it does not smell at all when burned, maybe a bit like candles. But if you use polypropylene (computer monitor cases, printer cases, other plastics that break easily), you get out only liquid fuel, no paraffin at all. All you need is just filter the fuel out of solids and you good to go and put it in your gas tank. We have made the analysis and it is almost the perfect diesel fraction. It has no acids or alkaline in it, like fuel from tires does. The unit in the pictures can convert about 60 kg of plastic into 60 litres of fuel in one day. Other methods of heating the reactor can be employed, electricity is just easier to work with and control.

Some Japanese companies manufacture such devices, but their prices for this size unit is more than 100 000$, our home made device cost us 900$ max. We use aluminium oxide bricks to insulate the heat, they are light as foam and can be easily cut in any shape, but any kind of insulator can be used. The bricks make the highest costs for this device. It can also be made using liquid fuel burners to heat the reactor; this will enable to make the device self-sustainable by using about 10-15% of the produced fuel along with the produced gas. A small farm can use a device this size and make fuel for itself by converting plastic waste to fuel, farms have very much plastic waste and it is a big problem, at least in my country.

Our next goal is to make the same thing possible using biomass, every farm could then use old leafs, wet grass, saw dust and all kind of biomass and gasify it into tar like substance that can then be put through the pyrolysis device and turned into biodiesel. All diesel engines and vehicles can use biodiesel. Certain older vehicles may require replacement of fuel lines as biodiesel can cause these lines to swell or crack.

Is diesel and biodiesel the same thing? Biodiesel is the name of clean burning alternative fuel, produced from domestic, renewable resources. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. It can be used in compression-ignition engines with little or no modifications.

3.1 Advantages of the use of Biodiesel

- Renewable fuel, obtained from vegetable oils or animal fats.
- Low toxicity, in comparison with diesel fuel.
- Degrades more rapidly than diesel fuel, minimizing the environmental consequences of biofuel spills.
- Lower emissions of contaminants: carbon monoxide, particulate matter, polycyclic aromatic hydrocarbons, aldehydes.
- Lower health risk, due to reduced emissions of carcinogenic substances.
- No sulphur dioxide (SO_2) emissions.
- Higher flash point (100℃ minimum).

3.2 Disadvantages of Biodiesel

- Variation in quality of biodiesel.
- Not suitable for use in low temperatures.
- Food shortage
- Increased use of fertilizers
- Clogging in engine

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- Regional suitability
- Water shortage
- Monoculture
- Fuel distribution

3.3 Comparison between Diesel and Biodiesel

Diesel is a liquid fuel that is used in diesel engines. It is commonly derived from crude oil. Petroleum diesel is produced by distilling crude oil. Biodiesel is composed of long-chain alkyl esters. It is made by combining chemically reacting with an alcohol producing fatty acid esters. Process of creating diesel includes drilling for crude oil. The oil drilled from the ground is then sent to a refiner. At the refinery, heat is used to separate out different products at boiling points. The oil is then sent through a distillation, where it is applied with heat and pressure causing a chemical reaction. Biodiesel produces fewer emissions than standard diesel. It is has no sulphur content which means it cannot contribute to formation of acid rain, whereas standard diesel can be a cause for acid rain.

Biodiesel is safer to use compared to standard diesel, and has significantly higher flash point than standard diesel Biodiesel burns at much higher temperature compared to standard diesel thus the hances of biodiesel to accidentally combust are much lower compared to standard diesel. Biodiesel has less energy content compared to standard diesel. Biodiesel releases nitrogen oxide emissions which can contribute to the formation of smog, due to this reason there are researches going on which aim to find biodiesel formulations that do not increase nitrogen oxide emissions. Current solutions for this problem include blending with kerosene or Fischer-Tropsch diesel. Thus we can see that biodiesel has significantly better lubricating properties, which will help the engine move easily and increase diesel engines life.

IV. Conclusion

In this plastic waste is made into a fuel in the absence of oxygen and plastic as a non-degradable substance can be made into a useful resource which can be used as a fuel in the feature. It is possible to obtain diesel fuel from plastic waste and the pyrolysis oil could be used as an alternative fuel for diesel engines in the future which helps to recover energy from waste and reduce the environmental problems caused by this waste.

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