A Review of Tire Pyrolytic Oil Filtration Process Using Sand Based Filter

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Abstract- *Keeping in mind the rising quantity of scrap tire produced around the world and the predicted shortfall of fossil fuels, an alternative to fossil fuels is suggested. Tire pyrolytic oil is oil processed from tire by pyrolytic separation. This oil is filtered by using a sand based filter and the quality of the filtered oil is checked.*

Keywords- alternative fuel, bentonite clay, filtration, tire pyrolytic oil

I. INTRODUCTION

It has been estimated that the global production of tires is around 1200 million. This is a huge environmental problem as once these tires are scrapped they end up in a landfill. 75% of the tires volume is void thus these tires consume a lot of space in the landfill. This can be very expensive since landfills take up a lot of area which can be utilised in a better way. Also the tires form a breeding ground for mosquitoes which also is dangerous since these become a hub for diseases to people living close to these areas.

Tire Pyrolytic oil is oil formed by cooling the condensate from anaerobic heating and decomposition of vulcanized pneumatic tires which are used primarily for automobiles and other construction equipments. This raw pyrolytic oil is high in sulfur and carbon content. Also it has a pungent odor and a murky brown color. The raw oil finds application in construction works such as for the construction of roads and is also used as furnace oil. The raw oil has gross calorific value around 10400 cal/g. It is however not widely used as a fuel since it has a very high carbon content which may cause problems like coking in engines. The properties of the oil are similar to that of light diesel oil obtained after refining of petroleum. Apart from the oil, the process also yields char which finds application as activated carbon which can be used for filtration of water and also in steel manufacturing units. Steel wire which is used as reinforcement in the tire can also be retrieved from the process and is largely the same as the original steel.

Various methods for filtration of the oil have been tried. The pyrolytic oil needs filtration because it has properties similar to that of diesel fuel. It has been used as an alternative fuel by blending it with diesel oil with resulting performance that is similar to that of diesel fuel. Finding alternative to fossil fuels is important because it is estimated most of the crude oil reserves will be depleted in the next 70 years.

Filtration of pyrolytic oil has been carried out in small scale or in the laboratory before by using a centrifuge or by chemical reaction. The main objectives of the filtration are to reduce the odor, decolorize the oil, reduce the sulfur content of the oil.

This is brought about by using bentonite clay or fuller's earth. It is also used in the bleaching of crude oil to decolorize the oil and to reduce its odor. While this reduces the odor and changes the color, the sulfur content is reduced by acid treatment. The acid used is sulfuric acid and it also leads to the reduction of carbon content in the oil.

II. METHODOLOGY

The methodology of the system design is evaluated by following procedure.

- Literature survey and its study
- Developing geometry for the acid treatment tank
- Analysis of time required for acid and oil treatment
- Analysis of temperature variation of acid treatment tank
- Analysis of losses occurred during treatment
- Analysis of vacuum requirement for the system
- Analysis of settling time required for settling tank to settle down sludge
- Analysis of time and vacuum required for the vessels to pass oil
- Analysis of filtered oil.

III. EXPERIMENTAL SET UP

Fig.1: setup

Fig.2: Agitator vessel

The experiment was carried out at a tire pyrolysis plant in Pune. The setup for the experiment was a agitator vessel which was used for mixing of the oil and acid. The agitator vessel was fitted with a stirrer which stirred the oil after mixing it with acid for a period of 45 minutes. This acid treated oil was then transferred to the settling tank where the oil is kept for 16 hours. The sludge is removed from the agitator vessel before transferring the oil into the agitator vessel.

The oil is transferred to the filter vessels after the settling tank. There is a vacuum pump used here to increase the driving force of the oil through the sand filter. The sand is a mixture of bentonite clay and mineral sand. It works by gravity filtration. The oil passes through the pores in the sand bed and because of the contact with the sand it undergoes decolorization and deodorization.

Fig.3: Bentonite clay

Fig.4 : Mineral Sand

The oil is then transferred to the clean tank after the filtration process is completed.

IV. Results

The filtered oil was reddish in color as opposed to the murky brown color of the raw pyrolytic oil. It also had a much tolerable smell. The filtered oil was sampled for testing and the results are listed in following table.

Test	Unit	Result
Kinematic Viscosity	cSt	4.5
Dirt Content	g/l	0.188
Flash point	Celsius	52
Gross Calorific Value	Cal/gm	11140
Sulfur content	%	<0.1
Carbon residue	%	1.71
Moisture content	%	0.023
pH	-	2.76

V. CONCLUSIONS

The oil available after filtration was found to be of good quality. All of the objectives mentioned above were met sucessfully. The gross calorific value of the filtered oil was 11140 cal/gm. However, the process took a long time to complete. This can be improved upon by increasing the flow rate of the oil by reducing the number of filter vessels or by decreasing the amount of sand in the filter to reduce the contact time. Also the flow rate can be improved by increasing

the capacity of the vacuum pump. Or by reducing the leakage losses of vacuum in the system.

Reducing the contact time, however, could have the negative impact of reducing the quality of the oil produced.

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