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Pyrolysis of Waste Tyres to Fuel Oil

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Abstract: *Living way, the quality and quantity of life and progress of a country lies on its total capita energy usage. Renewable Energy giving that mainly follows on fossil fuel is decreasing day by day. Pyrolysis behaviour of a single waste tyre wasinvestigated. The influence of temperature(350°C-400°C) and without oxygen content in gas on combustion behaviour of tire sample product and solid samples product of pyrolysis process was studied. The primary objectives ofthis work was studied to illustrate the conversion of scrap tires toTPO(Tyre Pyrolysis Oil). Different Purification method like distillation, Catalytic reaction, adsorption, moisture removal, desulfurization, Vacuum distillation etc. methods were studied for TPO purification. Different parameters like density, viscosity, flash point,cloud point, proximate and ultimateanalysis of oil wasstudied At the end it was studied that it will be possible to use scrap tyre pyrolysis oil in fuel engines by comparing the property of TPO and purified fuel oil with diesel, in using waste tyre.*

Keyword: *Pyrolysis, purified oil*

I. Introduction

About lot of tires are being manufactured which is creating waste potential ratio high and creating lot of pollution.(P.T.Willams et al., 2013).Rising inhabitants and industrialization, the manufacturing of solid waste that is tire is rising daily. In initial growing countries, disposal is challenging task.The new developed technique presents a feasible solution of scrap tires disposal in form of energy manufacture and ecological safety, Pyrolysis is the recycle technique producing energy (C.Berrueco et al., 2005, F.J.Mastral et al., 2005).Moreover, different methods are also used for tire recycling for eg. retreading, incineration, grinding, liquefaction,gasification adsorption, etc. so it is necessary to find the another sources which will remove drawbacks and limitations (Williams P.T. et al.,1998).

A low down proportion of scrap tires are used with material improvement, reused for waste quality of rubber manufactured goods. The difficulty is that waste tire is thrown away in age band whose ratio is quite higher than the good quality tire used. As their elevated high energy value, scrap tire have been used as energy in rotary cement kiln. Though, this procedure can be adequate from an environmental point as it creates poisonous emission while burning. The great explosive of carbon content and heating value (33-35 MJ/kg) make the scrap tires an outstanding material for energy recovery. So for this Pyrolysis and combustion becomes important part as methods. Pyrolysis offers environmentally different method for decaying, including waste tires. In the Pyrolysis process, the organic volatile substance of tires is decaying to near to the position solid, liquids or gases which can be used as fuels or chemicals source.The non-volatile carbon black and the inorganic mechanism (40%) which is used as other application. Combustion of scrap tyres has become important in age band. For reducing emissions of the combustion process must be opted. The refining of TPO obtained fromthermal Pyrolysis of waste tyre in a reactor at a temperature range of 410°C to 700°C was carried out by two different methods a)simple distillation b)distillation with steam and iron catalyst to get the purified oil (Hariram.V et al., 2014,Mohamed et al., 2014)

II. Materials And Methods

Waste automotive tire were collected from a local market in Rajkot. The major composition of waste tire was found to be vulcanized rubber, metal cords and beadings, carbon black, sulphur, oxides of zinc and textile fabric etc. The metal beading in the tire was carefully removed and made into small square pieces with the help of cutting instruments. The waste rubber pieces were washed continuously in the flowing water for 1hr at 45 ^{0}C to remove the impurities and coating materials. This process was repeated for two more times to confirm the removal of impurities which could affect the Pyrolysis process. The stock is on the outside burned up in the reactor is in anaerobic form.

The pyrolysis reactor experimental design has cylindrical cavity of inner diameter 10cm, outer diameter 11 cm, and height 15cm which is fully insulated. The influence is applied to the reactor for outside heating. Temperature controller is used for controlling. The process is carried out at 400–600 ^{0}C.The heating rate is maintained at 5 K/min. The residence moment of the stock in the reactor is 150minutes.The yield of pyrolysis in the form of Vapour are sent to a water chilled condenser and the strong liquid is collected as oil(I.de Marco Rodriguez, M. F. Laresgoiti, M. A. Cabrero, A. Torres, M. J. Chom ´ on, and B. Caballero et al., 2001).

III. TPO Purification Method

The TPO purification method mainly includes

1. Removal of Moisture

Originally crude TPO is heated up to 150 °C in a cylindrical container for a particular time to remove the humidity, before subjecting it to any auxiliary chemical treatment.

2. Desulfurization-

The moisture-free simple TPO contains impurities,carbon particles, and sulfur particles. A known concentric hydrosulfuric acid (8%) is mixed with the crude TPO and mixed well. The combination is kept for about 42 hours. After 42 hours, the combination is found to be in two layers. The top layer is a thin combination and the bottom layer is thick mud. The top layer is taken for atmospheric distillation and the sludge is removed and liable of. In the desulfurization process, the efficiency of sulfur removal is 60.6%.

3. Distillation-

Distillation is a commonly used process for purifying liquid sand separating mixtures of liquids into their single components .Atmospheric distillation procedure is carried out to divide the lighter and heavier fraction of hydrocarbon oil. A known sample of chemically treated crude TPO is taken for vacuum distillation process. The sample is externally heated in a closed chamber by electric heater. The vapour leaving the chamber is condensed in a water condenser and the distilled tire pyrolysis oil (DTPO) is collected separately. No condensable volatile vapours are left to the environment. The distillation is carried out at 170–200 ^{0}C because the maximum amount of DTPO is obtained within this range .(M.N.Islam et. al, 2016,M.R.Nachin et. al, 2016).

Table1. From Literature survey Range of Physical Properties for Diesel, Pyrolytic oil,TPO

Sr. no	Physical Properties	Diesel	Pyrolytic oil	TPO
1)	Density (kg/m^3)	0.28-0.86	0.1-0.2	0.2-1
2)	Flash point(°C)	Above 55	48-52	Below 10.00
3)	Kinematic Viscosity (Cst)	2.00	15-18	0.11-0.99
4)	GCV (MJ/kg)	44.00-46.00	41.00-43.00	40-45
5)	% C	87	80-85	85-88
6)	% H	12.71	8.8-9	9-11
7)	% N_2	0.31	1-1.55	1-1.89
8)	% S	0.16	1.05-1.99	0-0.88

IV. Conclusion

We can say that from pyrolysis ,we can obtain fuel oil which is very useful in engines and is very productive as diesel is vanishing this days.From the literature survey we found that Pyrolysis process was one of the best methods to treat waste tire under solid waste management technique. De-moisturizing, de-sulphurisation, and distillation process were carried out for purification of TPO. The physio-chemical properties of treated TPO were found to be comparable with straight diesel with higher sulphur content. The blends of TPO and straight diesel also showed improvements in density, kinematic viscosity, flash & fire point and carbon residue with a marginal decrease in cetane index and calorific value.

References

[1]. Rai G D. Non-Conventional Energy Sources. 5th ed. India: khanna publisher; 2011.
[2]. Pakdel H, Roy C, Aubin H, Jean G, Coulombe S. Formation of dl-limonene in used tyre vacuum pyrolysis oils. Environmental Science and Technology 1991; 25: 1646-1649.
[3]. Mirmiran S, Pakdel H, Roy C. Characterization of used tyre vacuum pyrolysis oil. Nitrogenous compounds from the naphtha fraction. Journal of Analytical and Applied Pyrolysis 1992; 22: 205-215.
[4]. Roy C, Chaala A, Darmstadt H. The vacuum pyrolysis of used tyres en-uses for oil and carbon black products. Journal of Analytical and Applied Pyrolysis1999; 51: 201-221.
[5]. Roy C, Darmstadt H, Benallal B Amen-Chen C. Characterization of naphtha and carbon black obtained by vacuum pyrolysis of polyisoprene rubber. Fuel Processing Technology 1997;50: 87-103.
[6]. Lopez G, Olazar M, Aguado R, Elordi G, Amutio M, Artetxe M, Bilbao J. Vacuum pyrolysis of waste tyres by continuously feeding into a conical spouted bed reactor. Industrial and Engineering Chemistry Research 2010; 49: 8990-8997.
[7]. Zhang X, Wang T, Ma TL, Chang J. Vacuum pyrolysis of waste Tyres with basic additive. Waste Management 2008; 28: 23012310.
[8]. Roy C, Labrecque B, De Caumia B. Recycling of scrap tyres to oil and carbon black by vacuum pyrolysis resources. Conservation and Recycling 1990; 4: 203-213.
[9]. Chaala A, Roy C. Production of coke from scrap tyre vacuum pyrolysis oil. Fuel Processing Technology 1996; 46: 227-231.