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WASTE TYRE RECYCLING: A REVIEW

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Abstract : Origin of the study Energy crisis and environmental degradation area unit the most issues that humans is facing currently a days. this can be thanks to the growing population, fast industrial enterprise and disposal of numerous solid wastes, that area unit generated on an everyday basis. to resolve this energy crisis and environmental degradation, scientists area unit golf shot a lot of effort on the potentials of utilizing acceptable technologies to recover energy and helpful by-products from domestic and industrial solid wastes. so significant analysis has been done to recover energy from waste materials, together with materials that aren't bio-degradable. Such materials embody biomass, municipal solid wastes, industrial wastes, agricultural wastes and different low grade fuels also as high energy density materials like rubber and plastics. Rubber containing wastes like tyre and tube waste area unit inflicting a giant environmental drawback as a result of it's a man-made compound and conjointly not perishable. Rubber containing waste takes considerably for much longer time as compared to biomass materials just in case of picture degradation. there's a predominant increase in tyre and tube wastes thanks to fantastic increase in range of vehicles at intervals Republic of India. The applied math information of production of tyre and tube is celebrated from the Indian Rubber trade, at a look 2011. In India, the assembly of tyre increased from 66032 metric tonnes to 97137 metric tonnes from 2005-06 to 2009-10. equally the assembly of tube increased from 53421 metric tonnes to 81448 metric tonnes from the year 2005-06 to 2009- ten.According to this information the assembly of tyre is forecasted to extend and this means that at an equivalent time the annual disposal of waste tyre volume can increase at an equivalent rate as new tyre is factory-made**.**

Keywords: - Types of Additives used in tyre , types of tyres , rubbers used in production of tyres, Pyrolysis , its types , physical and chemical studies of by-product of tyre.

I.INTRODUCTION

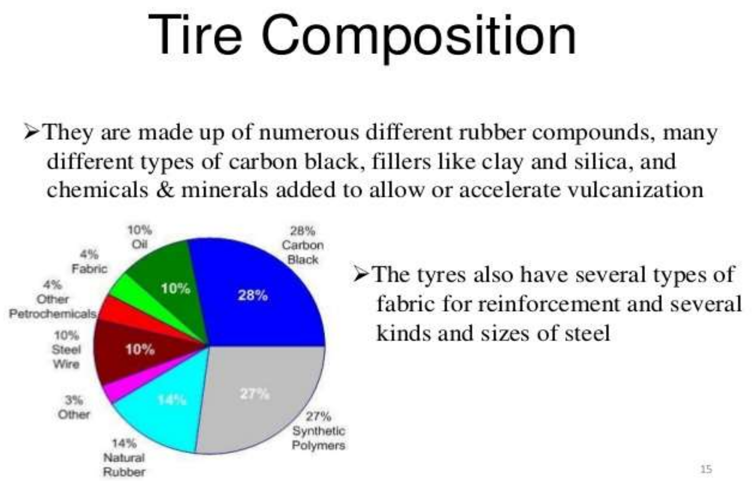
Origin of the study Energy crisis and environmental degradation ar the most issues that man is facing currently a days. this can be because of the growing population, fast industrialisation and disposal of various solid wastes, that ar generated on a daily basis. to resolve this energy crisis and environmental degradation, scientists ar golf stroke a lot of effort on the potentials of utilizing applicable technologies to recover energy and helpful by-products from domestic and industrial solid wastes. Rubber containing wastes like tyre and tube waste ar inflicting a giant environmental drawback as a result of it's a man-made chemical compound and conjointly not perishable. Rubber containing waste takes considerably for much longer time as compared to biomass materials just in case of ikon degradation[5]. there's a predominant increase in tyre and tube wastes because of extraordinary increase in range of vehicles at intervals Bharat. The applied math information of production of tyre and tube are often acknowledged from the Indian Rubber trade, at a look 2011. In India, the assembly of tyre inflated from 66032 metric tonnes to 97137 metric tonnes from 2005-06 to 2009-10. equally the assembly of tube inflated from 53421 metric tonnes to 81448 metric tonnes from the year 2005-06 to 2009- 10[6].According to this information the assembly of tyre is forecasted to extend and this means that at an equivalent time the annual disposal of waste tyre volume can increase at an equivalent rate as new tyre is manufactured[1] . a pair of These discarded wastes create a threat to the setting and human health if not handled properly. so timely action concerning usage of used tyres is critical to resolve the matter keeping in sight the increasing price of staple, resource constraints and environmental issues together with fireplace and health hazards related to the stockpiles of the used tyres. Therefore, transmutation is a motivating and difficult space of analysis. Besides that, transmutation of tyre waste has many blessings which will facilitate resolve the energy crisis. thus variety of studies are conducted to research the transmutation of waste tyres in each laboratory and industrial scale, underneath either inert or partial oxidizing atmosphere and perhaps optimized to provide high energy density oils, solid char and gases. additionally to it, the oil product are often hold on till needed or without delay transported to wherever it are often most expeditiously used [2].And it's wellknown that waste tyres possess high volatiles and low ash content, with a heating worth that's bigger than that of coal and biomass. thus waste tyre are often a supply of energy and valuable chemical product, and their thermal decomposition makes the recovery of helpful compounds attainable. typical strategies for tyre shredding and metal separation, permits seamless incorporation of this technology for drilling and waste tyre disposal. so in recent years there has been associate inflated interest in production of oil fuel from waste tyre by transmutation methodology. This innovative technology, due to its movability and measurability, unambiguously address the challenges visaged once changing tyres to low sulfur oil.

A. Research Objectives:

In this study, bicycle tyre and tube waste have been used as raw materials for pyrolysis process.

1. To obtain liquid fuel from bicycle tyre and tube waste by thermal pyrolysis.
2. To characterize the liquid fuel for their physical properties and chemical composition.

B. Tyre Composition



C. Different Types of rubber used in tyre production

Rubber could be a versatile product with varied usages. it's full-grown in varied countries worldwide and plays an important role within the Indian economy too. India is one in all the leading producers of rubber within the world. India is fourth largest producer of natural rubber next to Siam, Indonesia and Asian nation [1]. the expansion of the trade and importance of rubber goes hand-in-hand. it's a identified indisputable fact that seventy fifth of rubber created within the world is employed within the production of tyre [10].From the Fig a pair of.2 and Fig a pair of.3 it's been discovered that the assembly of tyre and tube has been increased year wise [1]. 3 major classes of rubber ar used for tyre and tube creating. they're particularly natural rubber, gum elastic and saved rubber. Natural Rubber: The statement of natural rubber could be a compound of isoprene (2-methyl-1, three butadiene). Natural rubber is created from the sap of rubber tree that grows primarily in South East Asian countries; there ar variety of alternative trees that additionally turn out rubber like the elastic, that could be a native of the Congo, and Parthenium argentatum, a desert scrub from United Mexican States and Arizona. Synthetic Rubber: Synthetic rubber is artificial rubber, made up of raw materials like hydrocarbon, styrene, isoprene, butadiene, butylene, cyanide, gas and propene. quite 1/2 the world's gum elastic is vinyl polymer-butadiene rubber (SBR) made up of styrene and hydrocarbon monomers that ar abundant in fossil oil 3 quarters of all the SBR created goes into tyres. the remainder goes into product like footwear, sponge and foamed product, tight materials, and adhesives. vinyl polymer hydrocarbon rubber resembles natural rubber in process characteristic additionally as finished product. It possesses high abrasion-resistance, high loadbearing capability and resilience. On the opposite hand, it gets without delay change, particularly in presence of traces of gas gift within the atmosphere. synthetic rubber that is employed in tyre tubing, is additionally an artificial rubber created by the polymerisation of isobutene with alittle quantity of isoprene.

D. Tyres producing companies:

1] JK Tyres
2] Apollo
3] Yokohama
4] Bridgestone
5] Birla Tyres
6] Michelin Tyres
7] MRF Tyre

II. DESCRIPTION

A. Most commonly used pyrolysis processing methods:

1. Thermal Pyrolysis
2. Catalytic Pyrolysis

B. WASTE TYRE PYROLYSIS PROCESS AND DESCRIPTION :

Pyrolysis Process

Pyrolysis is one of the unique methods of recycling the organic waste. It is a thermo-chemical process which involves heating organic waste material at higher temperatures in the oxygen free atmosphere to break them down to simpler organic compounds. Carbon, solid char, oil and gas are produced on the pyrolysis of organic solid wastes. Pyrolysis usually occurs at temperature between 400°Cand 800°C. In case of pyrolysis, lower temperature produces more oil products and higher temperature produces more gases. The derived oil from tyre pyrolysis may be used directly as fuels or added to petroleum refinery feed stocks, and also helpful for the refined chemicals. The derived gases are also useful as fuel and the solid char may be used either as activated carbon and carbon black. Pyrolysis basically involves the thermal decomposition of the tyre rubber at high temperatures (200-3000 C) in an inert atmosphere. The pyrolysis of solid tyre wastes has received increasing attention since the process conditions may be optimized to produce high energy density oils, char and gases. In addition, the oil products can be stored until required or readily transportation to where it can be most efficiently utilized. The tyre pyrolysis oils production pathway with their wide range of potential opportunities for heat, chemicals, fuels and electricity application. Thermal pyrolysis is the decomposition of the polymeric materials by heating in the absence of oxygen. The process is usually conducted at temperatures between 250-4000C and it results in the formation of a carbonized char and a volatile fraction that may be separated into condensable hydrocarbon oil and a non-condensable high calorific value gas. Solid motorcycle tyre waste was thermally pyrolysed in a fixed bed reactor under different operating conditions with different feed size of (2 cm3, 4 cm3,8 cm3 and12 cm3). The optimum oil (49%) was obtained at 2200 C with feed size of 4cm3. The derived tyrepyrolytic oil from thermal pyrolysis of waste tyre under static-bed batch reactor at a different range of 200-4000 C was characterized and it was found that the fuel property was similar to light petroleum fuel oil. The temperature has a major influence for increase in the aromatic content of the oils, with a consequent decrease in aliphatic content. The vacuum pyrolysis process for used tyres and got 45% of oil from which 27% was naphtha and showed that the mass spectrometry provides superior quantitative capabilities, while infrared spectroscopy is an excellent complementary technique for simultaneous qualitative analysis of pyrolytic oil. Kyari et al. considered pyrolysis analysis of seven different brands of used car tyres from several countries throughout the world and characterized the product oils obtained from individual and mixture of seven categories of tyrewastes [11]. They reported that there had been major variation in concentration of different compounds presented in the derived oils and gaseous products.During the pyrolysis of car tyre it was observed that there was no significant influence of temperature and characteristics of pyrolysis products over 500o C. The obtained oils are a complex mixture of C5 - C20 organic compounds, with a great proportion of aromatics with high gross calorific values of 42MJKg-1. The obtained pyrolysis gases composed of hydrocarbons of which C1 and C4 are predominant, together with some CO, CO_2 and H_2S and they have very high gross calorific values (68–84 MJ Kg-1).On the other hand authors have also demonstrated that at 500ºC, 600ºC and 700ºC and at longer reaction time do not decrease solid yields in tyre pyrolysis. Therefore, it can be concluded that tyre decomposition at 500ºC, 600ºC and 700ºC is complete and that ≈3–4% of char or carbonaceous material is produced. The effect on the degradation rate of a pyrolysis temperature of below 400ºC is more sensitive than that above this temperature. The total yield of gas products is 30- 53%, oil yield is28-42%, and char yield is 14-28%by weight. Further, the fuel oil, a part of the oil product, has a maximum level up to 15% by weight at a temperature of 350ºC. The recycling of rubber from old tyres by batch hydrogenation has been performed using reactors. Process variables such as temperature, reaction time, initial hydrogen pressure and nature of gas used have been studied and it was shown that, high temperature does not increase rubber conversion but decreases oils yield. A similar trend was found when long reaction times are used. Results are very similar to those obtained when high hydrogen pressures are used concerning to oils quantity but not to oils quality. Experiment were carried out by using TGA analyzer and different conditions for particle ignition were investigated, with initial temperature ranging from 500-700oC and initial concentrations of oxygen varying from 5 to 21 mol%. It was shown, that the combustion time depends on pyrolysis conditions. This fact can be due to different pore 18 structure development inside the particle. Many factors that affect the light oil fraction of oil produced during pyrolysis of waste tyres were investigated with GC-MS, FT-IR, and chromatographic column as separation means. The results showed that carrier gas flow rate, heating rate, and temperature influence the percent of light oil. Compared to N_2 and water vapour as carrier gas, CO_2 can better improve the fraction of light oil and reduce the fraction of heavy oil. Fast flow rate can give greater benefit to increase of the percentage of light oil. In contrast to this, fast heating rate is not favorable to improve the yield of light oil. The depth of pyrolysis was seriously related to the temperature. The content of PAH compounds in the pyrolytic oil always increased under the condition of less than 800o C as the temperature was raised. Pyrolysis of rubber appears to be a logical choice, all the more because, apart from minor fugitive sources and equipment leaks, this process products virtually no emissions. One of the problems with thermal pyrolysis is that of wide oil product distribution with poor economic value. Therefore, catalytic pyrolysis, an alternative technique to thermal pyrolysis, is under extensive exploration.

Catalytic Pyrolysis

The derived oils from tyre shift while not catalyst are discovered to be extremely aromatic, that area unit keen on be used as AN alternate oil fuel. Since the derived oils contain concentrations of valuable chemicals like benzol, toluene, xylenes, etc., in order that they may be extracted from the derived oils and used as chemical feed stocks within the industry. therefore catalysts area unit wont to manufacture a lot of single ring aromatic compounds throughout tyre shift. The waste tyre has been pyrolyzed by victimisation water softener USY catalyst and studied the influence of the shift temperature, chemical change temperature, catalyst/ tyre magnitude relation and heating rate on the yield of the product. The results showed that the influence of the presence of water softener USY catalyst was to scale back the yield of oil with a subsequent increase within the gas yield. The yields of oils bated for the most part because the chemical change temperature and catalyst/ tyre magnitude relation multiplied and therefore the yield of sunshine dissolver.

III. Conclusion

The oil obtained after pyrolysis of waste tyre appears dark black in colour, viscous in nature with strong acidic smell resembling petroleum fractions.

Appearance and properties

- Black in colour
- Strong "burned rubber" smell
- Density: 835 kg/m^3
- Ash content: 2%

Primary Products	Wt%	Secondary Products
Pyro gas	11	
Oil	51	
Char	38	Activated Carbon

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