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PYROLYSIS OF GROUNDNUT SHELL BIOMASS TO PRODUCE BIO-OIL

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ABSTRACT

The utilization of bio waste is important issue in all over the world. Pyrolysis is the important method to utilize the biomass and research carry out at all over the world. Pyrolysis converts the biomass into bio oil, char and gases by the absent of oxygen. In this method we can utilize the bio waste and also we can get fuel for the I.C engines. In this paper we have taken the groundnut shell biomass and extracting the oil from it and analyzed the various composition present in the oil, functional group present in the oil by FT-IR and GCMS study. And physical and chemical properties of oil is tested by ASTM.

Keywords: Pyrolysis, Bio-fuel, Bio Waste.

INTRODUCTION

All over the world, increasing the demand of fuel for I.C engines in day to day life, it need for alternative fuel energy sources such as, vegetable oil, orange oil, cashew nut oil, and tyre pyrolysis etc (Faith Demirbas.M, 2007). The bio waste has been converted into useful pyrolysis oil by using different techniques such as, hydrolysis, gasification, liquefaction, dry combustion, pyrolysis, anaerobic digestion, and bio photolysis (Ganapathy Sundaram.E, 2009). The pyrolysis is one of the important methods for production of oil from bio-mass waste and it has been divided into three categories they are fast, slow and vaccum pyrolysis. Pyrolysis is a thermo chemical process and it converts the bio-waste into liquid, gas and solid product (Dmitri A, 2011; Nirwan Syarif, 2012; Augustinova.J, 2013; Theodore Dickerson, 2013). The pyrolysis has certain benefits compared to the other methods like operating cost and pressure is low, simple to handle and higher efficiency. In this method can produce the bio oil from the biomass, the biomass is to heated at higher temperature in the closed combustion system at absence of oxygen to produced pyrolysis by product such as pyrogas, pyrolytic oil and char (Nurun Nabi.Md, 2011; Prakash. R, 2011).

Source of the groundnut shell

The source for the groundnut shell biomass was taken from the formers around our village. Figure1 shows the image of groundnut shell. The collected biomass was dried for 48-72hrs which lead to remove the dust and moisture content of the sample. After that the material was cut into smaller size such as 15-22mm. The elements of the carbon, hydrogen, oxygen, sulphur and volatiles are present in the sample, they were determined using ASTM given in table 1.

Table 1: Elemental composition of groundnut shell

S.NO	ELEMENT	Wt%
1	Carbon	42.05
2	Oxygen	48.00
3	Hydrogen	7.70
4	Nitrogen	0.35
5	Sulphur	0.10
6	Ash	1.80

Figure 1: Image of groundnut shell

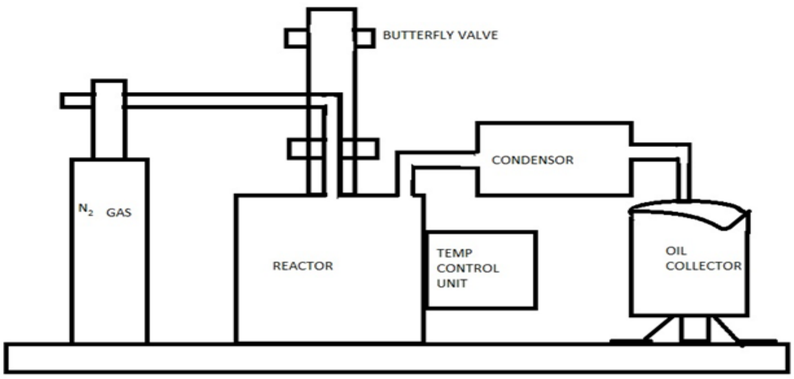

Fig 2 : pyrolysis setup

Experimental Setup and Procedure

Figure 2 & 3 shows the diagram and pictorial view of pyrolysis setup. The stainless steel was used to make of the reactor with a length of 300mm and inlet diameter is 190mm. The reactor was placed inside of the electric furnace with a capacity of 7.5kWhr. The nitrogen cylinder was directly connected to the reactor. The stainless steel pipe with a length of 100mm can be used to connect between the reactor and condenser. The condenser can be prepared using stainless steel with a length of 600mm and inlet (ID) and outlet (OD) diameters are 25mm and 50mm. After that the condenser was directly connected to the gas-oil separator. The height and diameter of the gas-oil separator is 340mm and 100mm. The material of the groundnut shell can be used as a production of pyrolysis oil using fast pyrolysis method. The sun dried groundnut shell had placed in the reactor. Then the reactor was placed in the electric furnace. The nitrogen gas was supplied to the reactor then the N2 gas reacts with the oxygen content of the reactor and to remove the oxygen and moisture content inside of the reactor. Next, the reactor was heated by using electric furnace at optimum condition 450-650°C. After that the liquid product of pyrolysis oil sent to the oil separator and it can be used to separate the pyrolysis oil and solid content. This pyrolysis oil can be used to the IC engine.

Fig 3: Pictorial View of Pyrolysis Apparatus

Result and discussions

Figure 4 shows the temperature versus pyrolysis oil. The temperature increases, the pyrolysis oil yield is also increased. The experiment starts at 140°C and to increases the temperature from 140 to 450°C. Finally obtained the 220ml of pyrolysis yield at 650°C. At higher temperature the liquid and char was increased and solid sample was decreased. After that decreases in liquid and increases in gas pyrolysis product at lower temperature. Figure 5 shows the pyrolysis yield of gas, oil and char versus temperature. The liquid pyrolysis yield was obtained at 650°C for 25% and another one product of gas was obtained at 45% of pyrolysis yield. Figure 6 shows the time variation versus temperature variation of the pyrolysis oil. Total reaction time is 4.5hrs. To reach the temperature at 650°C for 4.5hrs the experiment has been completed and obtained the 0.2kg of pyrolysis yield.

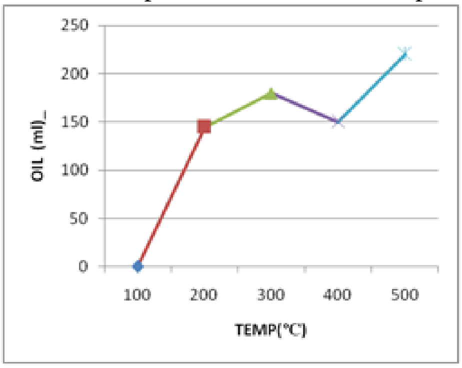

Fig 4: Temperature vs pyrolysis oil

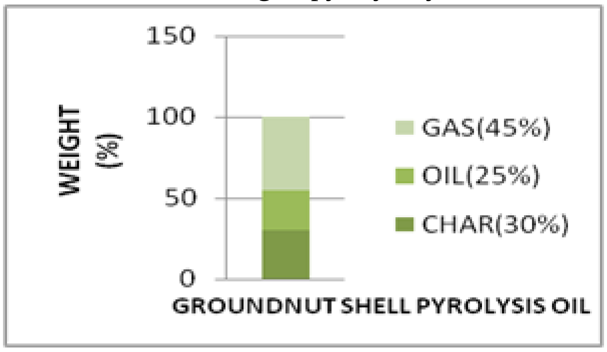

Fig 5: pyrolysis yield vs weight percentage.

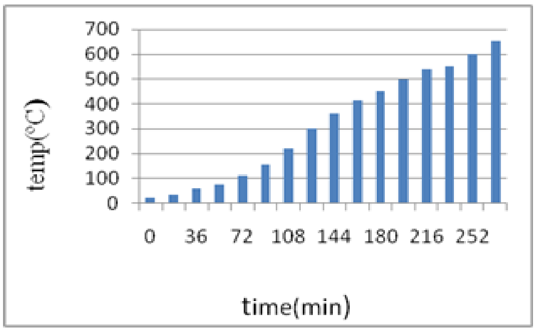

Fig 6: Time vs temperature of the pyrolysis oil

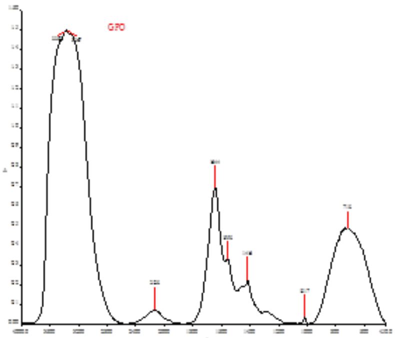

Fig 7: FT-IR spectrum of pyrolysis oil

The elemental composition of Groundnut shell pyrolysis oil is shown in table:1

Table 1: Elemental composition GPO

S.NO	ELEMENT	Wt%
1	Carbon	69.20
2	Oxygen	10.05
3	Hydrogen	11.75.
4	Nitrogen	2.2

FT-IR Spectroscopy

FT-IR spectroscopy can be used to determine the functional groups present in the pyrolysis oil. Figure 7 shows the FT-IR spectrum of pyrolysis oil. The peak at 3367-3389cm^{-1} corresponding to the O-H stretching vibrations and alcohols are present in the bio-oil. Aromatic and O-H functional groups are present in the sample at the 1416 and 718cm^{-1}. The absorption peak is at 1416cm^{-1} due to the C-H stretching and bending vibrations being presence of the pyrolysis oil. Alkynes groups are present in the oil at the 2128cm^{-1} and fluoro alkanes are present at the 1017cm^{-1}

GCMS study

Table: 2 Components of GPO

COMPONENTS	(%)
Carbonicacid, hydroxy, ethylester	0.35
2,4-hexaden-1-ol	10.99
3-Methylene cyclohexene	6.64
Imidazole, 2cyano-4methyl	15.29
1H imidazole-2-methanol	7.42
3-octyne 7methyl	7.83
1H-imidazole, 2,4,5trimethyl	12.39
Dicylopropyl ketoxine	15.19
3cyclohexane-carboxaldehyde,1-methyl,oxime	4.07
2-oxatricyclo decane	6.37
2-isopropy lidane-5methylhex-4enal	6.48
Cyclohexane,1,5,5trimethyl- 6-actylmethy	2.26
Pentadeconicacid,13-methyl,methylester	2.72
Heptadecanoic acid 9 methyl, methylester	1.94

CONCLUSION

For a sample of 1kg (100%), the volatile content is 70.7%, and char residue is 29.3%. By total volatile content, we may assure to get into condense of 25% only.

Oil yield was started from 150°C and the oil yield was ended at 650°C with the 220ml of groundnut shell pyrolysis oil. The gas chromatography results shows that the oil contains methanol and 4-methyl group contribute the major percentage in the oil. It can operate the Gasoline engines. Thus groundnut shell bio waste are effectively utilized by using pyrolysis method and we got the fuel for the I.C engines.

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