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Research Planning and Experimental Procedure for Production of Bio-Oil by using Renewable Sources

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ABSTRACT:

In present days the consumption of fossil fuels rapidly increasing with increase in population. To generate the power widely available renewable source is Bio oil. Bio oil is obtained by using biomass waste. The Bio mass waste is cheaper and easily available. The Bio mass wastes are like coconut shells, Rice husks, Soya beans etc. The extraction of Bio oil from coconut shells by pyrolysis in a Fixed bed reactor has been taken into consideration in this study. The maximum yield of Bio oil depends on various parameters like Temperature, Heating rate, Feed Particle size etc. From the literature survey we understood that the maximum yield of Bio oil was obtained at 575îC and feed size is maintained at 1.18 - 1.8mm. Post- experimentation of pyrolysis, the obtained oil sample was compared with the referred fuel properties, functional group and elemental analysis of the compounds present. Bio oil is widely used in production of cosmetics, Medicine, Fuel etc. The object is to increase the yield of bio oil in pyrolysis process.

Keywords: Pyrolysis, Coconut shell, Bio mass, Bio oil, Yield, Temperature.

INTRODUCTION

As the world's population is increasing rapidly the consumption of fossil fuels are increasing. These fossil fuels are limited and nonrenewable sources. Which takes several years for generation [1]. As the fossil fuels are reducing the demand for bio fuel is increasing. The bio oil made from Bio mass. And it is an alternative source to the fossil fuels. Bio mass is Biological waste living organisms. Bio mass as a source of energy saw renewed interest [2]. Bio mass can

Fig.01: Coconut shells

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Composition of Coconut shells:[8]

	On air dried material(%)	On Dry weight (at 105°C)
Moisture	8.78	-
Cold water soluble	0.19	0.2
Hot water soluble	3.25	3.57
Alcohol Soluble	2.29	2.51
Benzene Soluble	0.25	0.27 (Ether Soluble)
1% Alkali Soluble	17.15	18.8
Ash	0.56	0.61
Lignin	33.3	36.51
Cellulose	48.4	53.06
Total pentosans	26.7	29.27
Pentosans in Cellulose	-	20.54
Pentosans in Cellulose (On basis at Cellulose)	-	38.69

also be obtained from agriculture waste like coconut shells, Rice husks, Soya bean etc. In these resources the Coconut shell is very cheaper and easily available. Coconut shells used as raw material for pyrolysis process to generate bio oil [3].In this process activated carbon from different waste bio mass including coconut shell [4].

Relatively cheap,super compost is generated from the coconut shell obtained by breaking up with hammer.Coconut shell occupies 15% of a total weight of a coconut fruit which means an approximate 9 million tons of the coconut shells are discarded globally every year. Coconut shells contain mainly cellulose, hemicelluloses and moisture which are potentially source of carbon [5].

In general pyrolysis of organic substance produces gases and liquid products and leaves a solid residue richer in carbon content (char). Pyrolysis is performed at anaerobic conditions at elevated temperature of organic materials which is a thermochemical process. This change of physical and chemical phases is reversible. The word pyrolysis is coined from the Greek derivative element “pyro” fire and “lysis” separating. Pyrolysis is a type and is most commonly absorbed in organic material composed of high temperature [6].

BIO MASS:

MATERIALS AND METHODS:

Materials:

The coconut shells are collected from near by temples in uppal.

Preparation of raw material:

The collected coconut shells are cleaned and dried in the presence of sun for few days to remove the moisture content in it. Weigh the coconut shells before and after the drying. Note the amount of moisture content removed. Now the coconut shells are crushed into small

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Fig.02 Coconut shell powder

size by placing them in the jaw crusher. Before crushing the coconut shells make sure that the jaw crusher is clean. Initially the coconut shells are process through large jaw crusher where medium size of feed sample is obtained. And then it is passed into small jaw crusher where small size of the feed sample is obtained. These small size of sample is send into roll crusher to reduce the particle size smaller than the product sample sample of small jaw crusher. The average diameter of the particle the roll crusher is about 4-6mm. To get the maximum yield of bio oil the particle size should be 1.18-1.8mm. To get this size the product obtained from roll crusher is sent into ball mill. In ball mill the particle size is reduced from 4-6mm to 1-2mm. And it screened with standard sieves according to mesh size. Indian standard screens (4-52)separate to give fraction of less than 0.3mm, 0.3-0.35mm, 0.355-0.85mm, 0.85-1.7mm, 1.7-4mm. The elements carbon, hydrogen, nitrogen, oxygen and sulphur content on the sample was identified by the ASTM standards.

Components and Elemental analysis:

Components:

Volatiles	72.93%
Fixed carbon	19.48%
Ash	0.61%

Experimental analysis: [a]

Carbon	53.73%
Hydrogen	6.15%
Oxygen[b]	38.45%
Nitrogen	0.86%
Sulphur	0.02%
Calorific value (MJ/kg)	20.88
Moisture content (%)	6.98%

(a) Weight percentage on dry basis
(b) By difference

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Experimental apparatus:

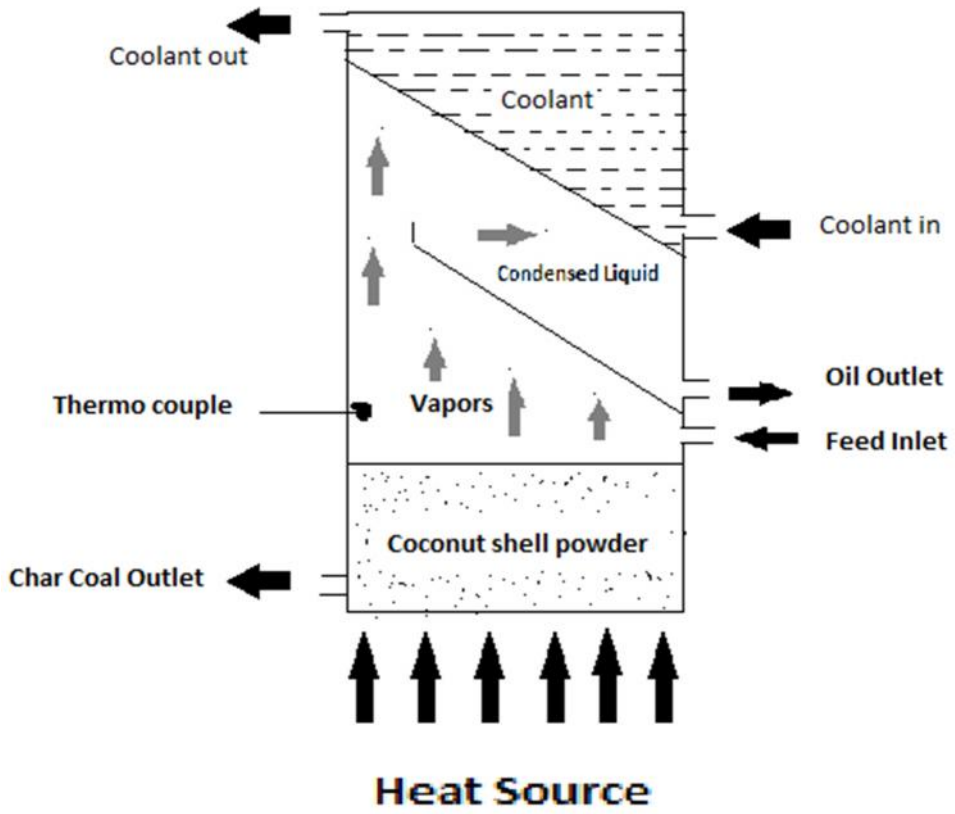

Fig.03:Pyrolysis Apparatus

The equipment consists of a cylindrical shell which is inclined close at the top of the cylinder. And a small opening at a side of the reactor to escape the vapors to condense. Above the inclined wall the cylinder is closed parallel to the inclined wall to condense the vapors. In this gap there is an outlet at the bottom of the gap to condensed oil out. Above the closed wall coolant is poured to condense the oil vapor which is coming from the fixed bed reactor. There is inlet and outlet to flow the coolant. To insert the feed into the reactor inlet arranged at the top of the reactor vessel and outlet is arranged at bottom of the reactor to discharge the residue (charcoal). A (Cr-Al) thermocouple is arranged inside the reactor to measure the temperature of the process. The reactor and condenser covered with an insulator to reduce the heat losses. The inclined wall which separates the reactor and condenser is also an insulator covered with stainless steel to prevent the vaporization or heating of condensed oil. A heater is arranged at the bottom of the reactor to heat the reactor (feed).

Experimental procedure:

Coconut shell powder is fed into the semi batch reactor. The feed size particle is having diameter 0.3mm, 0.3-0.355mm, 0.355-0.85mm, 0.85-1.7mm, 1.7-4mm. simultaneously switch on the heater and supply the coolant ,that is water to the condenser from bottom to top. Note the feed condition for different intervals of

temperature. Increase the temperature slowly to 575C and maintain at that temperature. Manually condense the vapors which is coming from the reactor using condenser. The condensed oil is collected at the outlet of the condenser . The final residue is charcoal it is unloaded at the bottom of reactor and the charcoal is sent to water treatment plant. The collected bio oil is sent to analysis. When the vaporization stops the oil formation will stop. Cool down the reactor to 30-25C slowly. The pyrolysis is carried out in the absence of oxygen. Then the reactor is prepared to another batch.

ANALYSIS OF OIL:

Physical characterization of liquid product:

The physical properties are density, specific gravity, viscosity, water contentand pH value of the bio oil are determined using the standard methods are there.

Viscosity:

According to ASDM D445, the viscosity of bio oil was tested usinga petroleum products kinematic viscosity tester. All the samples are analyzed for viscosity for 40C.

Water content:

According to ASTM E203, the water content of bio oil sample was tested using Karl-Fischer titration.

pH value;

According to the pH –potentiometer method, the pH value of bio oil sample was determined using a pH meter.

Physical characterization of liquid product:

GC-MS:

Chemical composition of bio oil was tested by GC-MS (auto system XL GC/TurboMass MS, perkinelemer) with a quadruple detector and a DB-IMS capillary column (30 m * 0.25 mm inner diameter * 0.25µm thickness). Helium (UHP) was used as carrier gas with a constant flow of 1.2mL/min. The intial temperature program was set at 40C and continued for 4 min, rising by 5C/min to 250C, which continued for 10.0min. The injector temperature was 250C. The volume of injected sample (10% of bio-oil in chloroform) was 1µL. Electron ionization (EI) was used in the MS and standard mass spectra with 70 eV ionization energy were recoreded with a scanned range from 0 to 1200 amu. The computer matching of mass spectra was performed using the NIST98 and WILEY7.0 library and the retention times of known species injected in the chromatographic column were used for identification of the peaks.

FT-IR:

The FT-IR analysis of bio-oil was carried out using Fourier infrared and Raman spectrometer type EQUINOX 55.

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