CHARACTERISTIC INVESTIGATION OF SOYBEAN SEEDS AND DEOILED CAKE UNDER PYROLYSIS TREATMENT

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Abstract: Bio-energy is now accepted as having the potential to provide the major part of the projected renewable energy provisions of the future. Pyrolysis is one of the methods which can be used to convert a solid fuel into liquid fuel. Thermal pyrolysis of de-oiled cake and soybean seeds were carried out in batch reactor made up of stainless steel at temperature range from 400°C to 600°C to produce the valuable yield. The effect of temperature on pyrolysis of the above raw materials is studied to know the optimum temperature for maximum liquid yield. The oil samples obtained at optimum condition is analyzed according to their fuel properties, elemental analysis, and compounds presents.

IndexTerms **– Pyrolysis, Biomass.**

I. INTRODUCTION

Bio-fuel has been introduced in many countries as fuels for transportation propose which is produced by transesterification of edible and non edible seed oils. In this process the oil produced by the cold pressing of different oil containing seeds is esterifies in presence of different catalyst to get bio diesel. During the process of cold pressing, after extraction of oil from seeds some amount of also remains in the de-oiled cake. So less amount of is extracted, which is again sent for transesterification purpose to produce bio fuel. But by the process of pyrolysis maximum liquid yield can be obtained from the seed directly. The yield and composition of pyrolysis products greatly depends on the reaction parameters: temperature, particle size of the fuel, heating rate and residence time (***Onay and Kockar, 2003).***
Fig. 1 shows the schematic diagram of the biomass pyrolysis experimental set up. The pyrolysis unit consists of pyrolysis reactor, electrically heated furnace, temperature controller, glass condenser and measuring cylinder. The temperature of the furnace was maintained by sensitive PID controller.

Here work has been carried out on de-oiled cake and soyabean to obtain fuel oil by the process of pyrolysis. The physical and chemical properties of pyrolytic oil show that, the oil has a positive affinity towards the use of oil as transportation purpose.

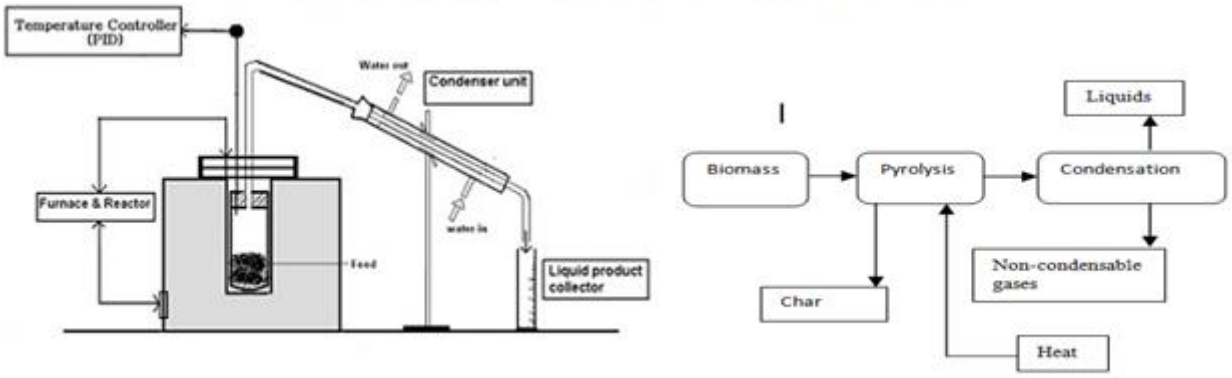

Fig:1: schematic diagram for setup and processes involved

II. MATERIALS AND METHODS.

Raw materials like mustard de-oiled cake and soybean seeds fig 2.1, are directly taken from the market. The proximate analysis determines the Moisture, volatile matter, Ash, fixed carbon content in the fuel. It is a quick and practical way of assessing the fuels quality and type. The moisture content of biomass has a marked effect on the conversion efficiency and heating value. Volatile matter evolves in the form of gas, light, hydrocarbon and tars. Volatile matter of the biomass is higher than the coal (around 75%). Higher volatile matter of the biomass makes it more readily de-volatilized than solid fuel. Liberating less fixed carbon hence makes them more useful for pyrolysis and gasification. Ash content and moisture content affect the heating value. The thermo gravimetric analysis (TGA) of raw materials was done using the DTG 60 instrument. The apparatus uses a horizontal differential system balance mechanism. 6-8 mg of samples was taken for each analysis. Samples were placed in a platinum container. TGA was carried out at heating rate of 15°C/min in presence of atmospheric air. The samples were heated up to final temperature of 800°C.

Fig: 2.1: De-oiled cake and soybean seeds

III. EXPERIMENTAL SETUP

The raw material is pyrolyzed in an externally heated stainless steel fixed bed reactor system. The main components of the system are fixed bed reactor and liquid condenser. The reactor is cylindrical shaped vessel made up of stainless steel having capacity of ½ liter. The pyrolysis experiments were performed in an apparatus designed with a batch reactor of height 17 cm, 5 cm ID and OD 5.5 cm. in diameter.

The reactor is heated externally by a heater at different temperatures (450, 500, 540, 570 and 600^{0}C) and this temperature is measured by means of a mercury thermometer. Pyrolysis vapor is condensed into liquid in the condenser and then is collected in the liquid collectors. The non-condensed gas is fed to the atmosphere.

IV. RESULT AND DISCUSSIONS

Fig 3.1 shows the product yield at a heating rate of 15^{o}C/min for slow pyrolysis of de-oiled cake. It was observed that the yield of liquid product increases with increase in temperature. But the weight % of the residue and non condensable gases decreases with the increase of the temperature.

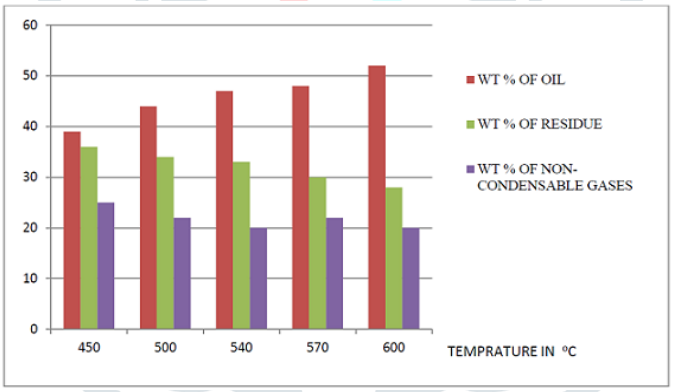

Fig: 3.1: Influence of temperature on the yield obtained from de-oiled cake at different temperatures when heated at the rate of 15^{0}C/Min.

As the temperature increases the char yield decreased because of the secondary reaction taking place at the third stage of pyrolysis, which means the char materials decomposes at higher temperature. During the pyrolysis of de-oild cake, the liquid yield increases from 43% to 53 % by weight observed from fig. 4.5as the temperature raised from 450-600^{o}C at the same time char yield decreases from 33 to 28 by weight %. After temperature 500^{o}C, when pyrolysis temperature increased to 600^{o}C the density of oil increased means the weight of oil was more with the same volume oil. It may be due to the formation of denser products at high temperature and lower residence time of feed materials in the reactor.

Thermal pyrolysis of soybean seeds were carried out in a semi batch reactor made up of stainless steel at temperature range from 450^{0}C to 600^{0}C and at a rate of 15^{0}C/min to produce bio-fuel and char.

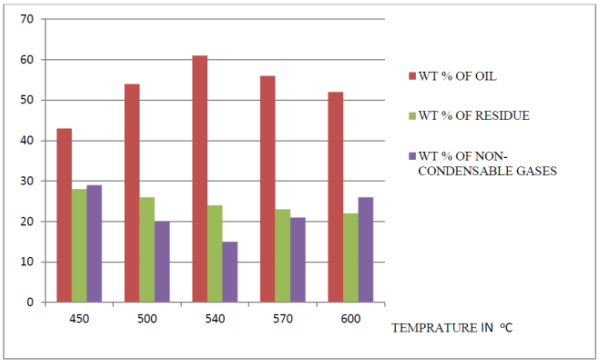

Fig.4.1: Influence of temperature on the yield obtained from soybean seeds at different temperatures when heated at the rate of 15^0C/Min.

The maximum yield of oil was 62% on wt. % basis for soybean seeds was obtained at a temperature of 540^0C. The effect of the temperature on the production of the char, oil and non-condensable gases from soybean seeds are shown in fig 4.1.

V. CONCLUSION

The biomass solid waste in the form of de-oiled cake is successfully converted into liquid, char and gas by fixed bed pyrolysis process. The maximum yield of oil derived from mustard de-oiled cake 52% at 600°C, The maximum yield of char derived from mustard de-oiled cake is 28% at 600°C, respectively. Reaction completion time for the pyrolysis of de-oiled cake is 26 min.

Pyrolysis of soybean seeds were carried out in a semi batch reactor made up of stainless steel at temperature range from 450^0C to 600^0C and at a rate of 15^0C/min to produce bio-fuel. The maximum yield of oil was 62% on wt. % basis for soybean seeds; it was obtained at a temperature of 540^0C. The fuel analysis of oil reveals that this pyrolytic oil can be used as fuel.The liquid as well as solid fuel obtained from this raw material is a low sulphur fuel which is environment friendly in nature that is discussed in the literature also.

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