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PRODUCTION OF BIO-OIL FROM BANANA PEDUNCLE BY THERMAL CRACKING PROCESS

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ABSTRACT

Depletion of the conventional fuel has been increases day by day, due the more utilization and lesser production. As the world has to think the alternative way for the energy resources. At this situation search for an alternative fuel research has been increased. Among various researches the waste material into useful energy (gas, oil)has became an important research and various techniques were involved. Thermo chemical method is one of the techniques of convert the waste into useful energy. In this work Bannan peduncle (BP), which is consider as an agricultural solid waste. Bannan peduncle (BP) is considered as the raw material for the pyrolysis process. Based on the Thermo gravimetric analysis pyorlysis experiment is carried out find its maximum oil yield temperature. The other products during the pyolysis are char and gas. The pytoltyic oil is analysed by using FTIR to find the various components present in it.

Keywords: Bannan, waste, Pyroltyic oil.

1. INTRODUCTION

Environmental concerns and possible future shortages have boosted research into alternatives for fossil-derived products. Agricultural waste is easily available worldwide and considered to be renewable. The demand of energy from fossil is growing at high rate due to the development of all aspects of the world and the utilization of the fossil fuel generating the environmental problems. There is need for identifying the sustainable energy options for energy production without polluting the environment. The renewable energy source can play a major role for sustainable development. Among the possible renewable energy options, agriculture and forest residues (generally called as biomass) can be used as a raw material to generate energy.

Among the various agricultural waste Bannan peduncle BP is consider as the raw material for the pyrolysis process [1]. Major cahew nut production is from cuddalore and villupuram districts of tamilnadu. Among the thermo chemical procsss pyrolysis is most important technique to produce the pyrolytic oil.

In this work batch type pyrolysis is designed to caary out the experimentation process. The main of the work (i) To conduct experiments in batch type pyrolysis according to the thermo gravimetric analysis. (ii) cahracterization of the rwa material BP. (iii) Analyses of pyrolytic oil by using FTIR.

2. MATERIAL AND METHODS

Banana peduncle (BP) was considers as raw material, and it's collected from panurti cuddalore district of Tamil nadu. In vegetable markets of both villupuram and cuddalore the empty banana is collected and the banana peduncle is chopped into various size and it is dried in sunlight for 2-3 days for the removal of moisture from it.

Fig. 1: Banana Peduncle

2.1Characterization of Raw Material:

Raw materials were characterized according to their ultimate (CHN) analysis (Make: Perkin Elmer, model: 240s). The result of ultimate analysis of the waste tyres is given in table 1.Thermogravimetric analysis (TGA) was performed with thermo gravimetric analyzer [2,3] (Make: Perkin Elmer, model; 4000) at the heating rate of 10°C/min with the initial sample weight of 11.5 mg respectively. Nitrogen was used as a carrier gas at the flow rate of 20ml/min. The TGA results were showed in the Figure 2.

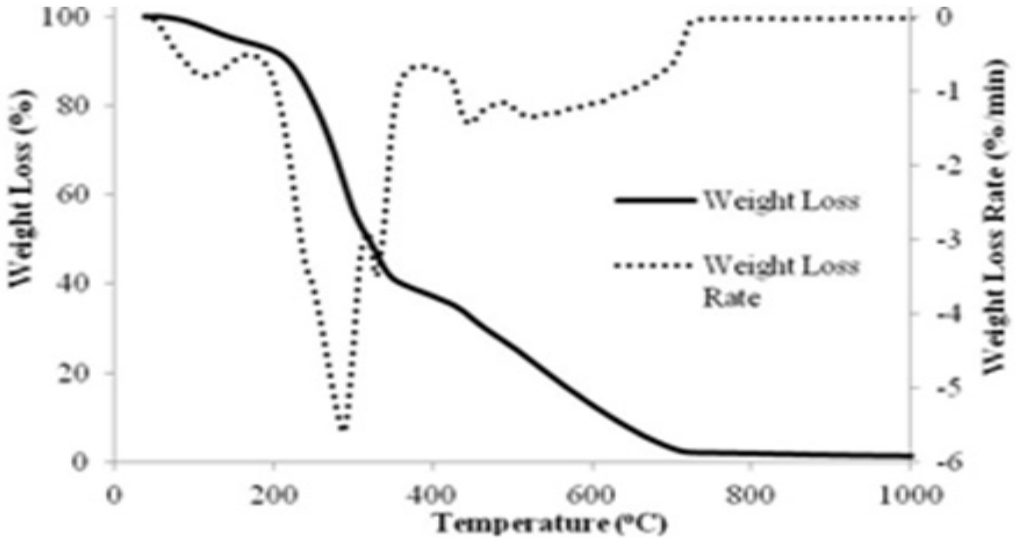

Fig. 2: TGA cure of BP

Table 1: CHN anlyses of BP

Sl. No.	Element	Wt%
1	Carbon	48.37
2	Hydrogen	5.90
3	Nitrogen	0.76
4	Sulphur	0.03
5	Oxygen[a]	44.94
[a] calculated by difference		

3. Pyrolysis of CHNS:

The pyrolysis process of BP was carried out in a semi-batch type pyrolysis apparatus shown in the Fig. 3. It consists of a stainless steel, cylindrical reactor core which can be placed in a silica brick shell. The reactor core can be taken out from the shell to feed the raw material and remove the residue [3]. A cover is provided to close the reactor and seal it from the surrounding atmosphere. Electrical windings are placed in the shell to heat the raw material. K-type thermocouple is mounted in the shell to indicate the reactor temperature. A stainless steel counter flow water cooled condenser is fitted at the top end of the reactor in order to condense the volatile matter produced during reaction time.

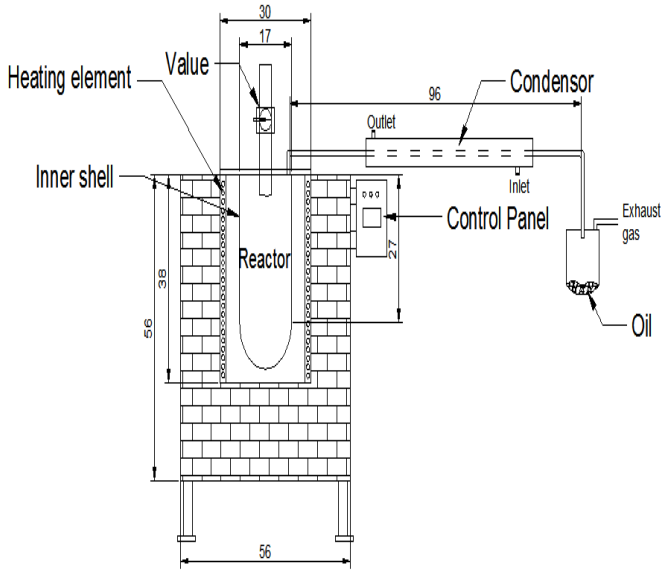

Fig. 3: Pyrolysis setup

4. RESULT AND DISCUSSION

4.1Thermogravimetric Anlyses:

Figure 2 shows the WL and WLR of Bannan peduncle as function of temperature under inert (N2) environment that distributed to main three regions drying, devolatilisation, and finally residues (char and ash). The first weight loss below 110°C, corresponds to the moisture loss o, at this temperature the moisture content was reduced by 3.76 % wt of the sample [4,5]. The second weight reduction correspond to increase of temperature to 730°C which is attributed to devolatilisation of xylene materials mainly hemicelluloses, cellulose and lignin. All the xylene was evolved at 730°C, and only the char remained. In this step, the yields of the xylene material were up to 94.07 % of the initial

weight of sample. Finally there was no extreme weigh loss this means residues (char) were left distorting to ash at 1000°C, where 2.17 %wt encountered.

The WLR curve has four peaks for weight loss rate steps. The first step accounts for moisture removal with peak at 110°C. The second major weight loss rate step represents the decomposition of hemicellulose and that occurred between 120 and 320°C, the temperature at which hemicellulose removal was at its maximum is 280°C as observed by the inflection point of the WLR curve. The third weight loss rate step happened between 320 and 375°C with peak at 330°C, this step is for cellulose decomposition [6-7]. At above 375°C, the lignin started to break and released with peak at 450°C. Beyond 730°C, the decomposition rate was almost negligible corresponding to the deformation of char components to ash.

4.2 Pyrolysis products:

The BP was subject to pyrolysis in batch type pyrolysis process with the initially weight of 1.5kg was carried out in the reactor.

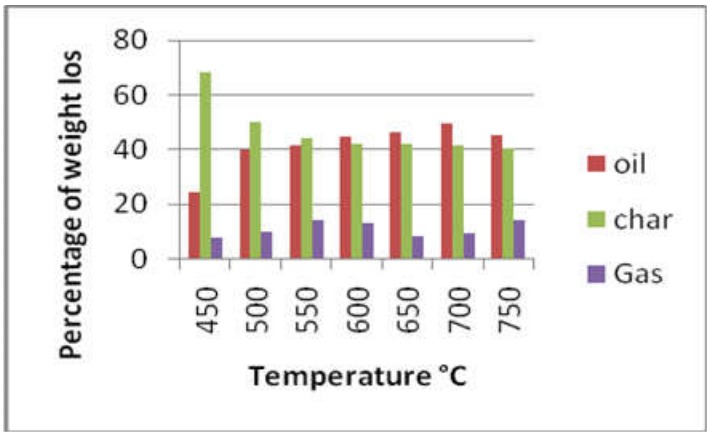

Fig. 4: Products of Pyrolysis yield.

From the figure 4, the maximum pyrolytic oil temperature is obtained from the above figure. it is noticed that the volatile matter evolved between 650-700°C.

4.3 Fourier Transform Infrared Spectroscopy

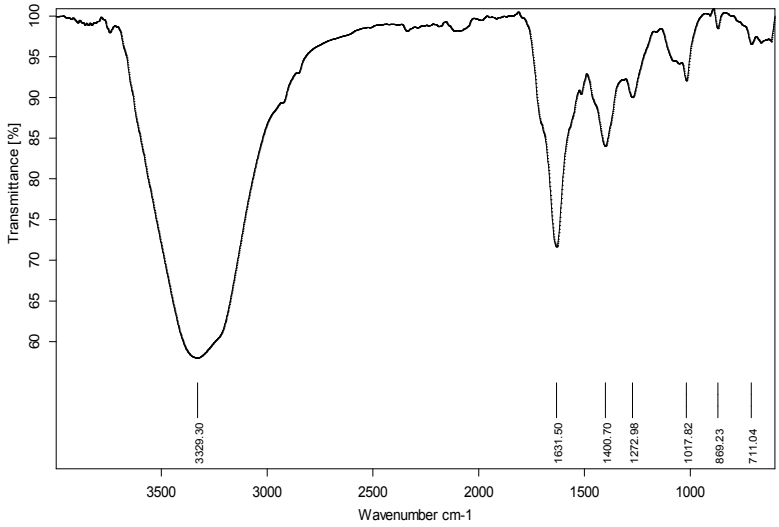

Table 2: Components present in pyrolytic oil

Peak value	Group name	Functions
3329.30	Alcohols	O-H stretch
1631.50	Ketones	C=H Bending
1400.70	Secondary Amines	N-H Bend
1272.98	Esters	C-O stretch
1017.62	Ethers	C-o stretch

5. CONCLUSION

The pyrolysis of Bannan peduncle BP were carried out in the batch type pyrolysis setup. From the experimentation process the maximum oil yield is obtained at the temperature of 600°C -750°C of BP. The major components present in the pyrolytic oil are Esters and Ketones by using FTIR analyses. The pH value of the pyrolytic oil is 3.65 since it is acidic in nature.

REFERENCE

1. L.Wilson, W. Yang, W. Blasiak, G. R. John, and C. F. Mhilu, "Thermal Characterization of Tropical Biomass Feedstocks," *Energy Conversion and Management,* vol. 52, pg 191–198, 2010.
2. P.Ndalila, G. R John and C. F. Mhilu, "Viability of Sugar Bagasse for Derived Fuel and Environmental Effects," 2nd Annual International Conference on Technology for National, Regional and Global Development and Integration, Eldoret – Kenya, May 16 - 18, 2012.
3. M. Müller-Hagedorn, and H. Bockhorn, (2007) Pyrolytic Behaviour of Different Biomasses (Angiosperms) (Maize Plants, Straws, and Wood) in Low Temperature Pyrolysis, *Journal of Analytical and Applied Pyrolysis*, 79, pp. 136-146.
4. S.B. Lee, and O. Fasina, TG-FTIR Analysis of Switchgrass Pyrolysis, *Journal of Analytical and Applied Pyrolysis*, 86, 2009, pp. 39-43
5. Sanger, S.H., Mohod, A.G., Khandetode, Y.P., Shrirame, H.Y. and Deshmukh, A.S. (2011) Study of Carbonization forBannan peduncle. *Research Journal of Chemical Sciences*, **1**, 43-55.
6. Rogers.J.G and Brammer J.G, "Estimation of the production cost of fast pyrolysis Bio-oil, Biomass and Bioenergy, Vol.36, 2012, PP.208-217.
7. sudagar.s, Balamurugan and Pugazhvadivu, "Studies on Pyrolysis of Waaste milk cover", IJEATE, Vol.4,