Department of Chemical Engineering

PRODUCTION OF BIOFUEL AND ACTIVATED CARBON FROM PYROLYSIS OF SEEDS OF WHEAT CROP WEEDS

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ABSTRACT

The study is focused to produce biofuel to minimize the dependency on fossil fuel. For this purpose a technique is established for the pyrolysis of seeds of wheat crop to produce biofuel & its residue is used to produce activated carbon. The seeds are pyrolysed in tubular furnace at temperature range of 500-800 ^{o}C in an inert environment. The liquid oil obtained has calorific value 35726 J/gm which is equivalent to calorific value of furnace oil used commercially. Further oil treatment is carried out by using hexane, methanol & catalyst and converted into biodiesel.

The residue produced during pyrolysis is converted into activated carbon by chemical activation process. The maximum value of iodine number obtained is 450 mg/gm at temperature of 700 ^{o}C & chemical ratio of 2.5.

Research Equipment Assembly

Raw Materials & Product Samples

INTRODUCTION

Biomass contributes approximately 14 % of the world annual energy consumption in comparison to 12 % from the coal and 15 % from gases. Biomass energy technologies produce energy with a lower level of greenhouse gas emission than fossil fuel sources. Biomass feedstock require less additional energy for growth, harvest, and can be grown under varies climate conditions.

There are growing interests of developing efficient biomass conversion technologies worldwide to provide the solutions for current energy crisis.

Biomass thermo chemical conversion process including combustion, gasification and liquefaction are employed for power generation and production of liquid biofuels, chemicals and charcoal which can be used as activated carbon.

Weeds are agricultural wastes which are unwanted and undesirable plants in wheat crop and utilize land and water resources. In cropland weeds compete with the beneficial and desirable vegetation reducing the yield and quality of main crop. Depending upon the degree of competition, weeds reduce the crop yields by 10 to 30 percent. The farmers are unaware about the utilization of seeds and tons of seeds are wasted into the land.

The present research is focused on exploitation by-product weeds for procuring biofuel to control the energy crises economically. In this work seeds were thermally cracked on different temperatures and volatile matter produced were condensed by using ice water. The produced oil was characterized by its calorific value. The char produced was further treated on different temperatures and times to convert into activated carbon.

METHOD & MATERIALS

MATERIALS

The raw materials used are seeds of weeds. Weeds are grown in wheat crop and during harvesting seeds of weeds are separated from the wheat grains. These waste seeds were collected from nearby land in raw form. Prior to use, samples were screened to remove the dust and any other materials. The seeds were ground with high speed cutting mill and then screened to give the fraction of 0.297 < Dp < 0.589 mm particle size. Furthermore, proximate analysis and calorific value determination was carried out on the prepared sample.

PYROLYSIS:

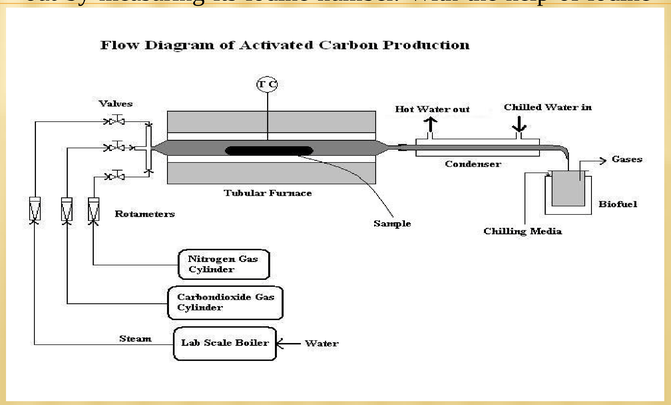
The Pyrolysis experiments were performed in fixed bed reactor in Nitrogen atmosphere. The 316 stainless steel tubular reactor (L = 610 mm, d= 25 mm) was used for Pyrolysis experiments and was heated electrically, with the temperature being controlled by thermocouple inside the bed. The reactor tube was connected with a condenser through small diameter pipe. The condenser was connected with a ice water system to condense the Pyrolysis products.

Pyrolysis reaction was carried by placing 50 g of sample (0.297 < Dp < 0.589 mm) in the reactor. The effect of temperature on the Pyrolysis yields was carried out by varying the temperature from 300^{o}C to 700^{o}C under the flow of Nitrogen gas at 20 L/hr. The Pyrolysis reaction was held at each temperature for 30 min, and then the resulting char was allowed to cool to room temperature. The biomass was thermally converted into liquid, char and gas. The vapors were condensed by ice water at 0^{o}C and resulting liquid is commonly referred to as bio liquid.

CHARACTERIZATION:

The bio oil obtained was characterized on the basis of calorific value. The calorific value was measured by using XRY-1B oxygen bomb calorimeter. The biomass derived Pyrolysis oils were fractionated using liquid column chromatography. 100 g of oil was dissolved in methyl alcohol to completely mix the oil and then filtered to separate any char material present in the oil. The mixture was further added into hexane and separated into two fractions as hexane soluble and hexane insoluble. The hexane was separated from hexane soluble oil fraction by evaporation under vacuum. The oil obtained was further tested by its calorific value.

The Characterization of activated carbon was carried out by measuring its iodine number. With the help of iodine



RESULTS

Table 01: Proximate Analysis of Weeds Seeds (as received)

Analysis	%age
Moisture	7.20
Volatile Matter	62
Ash	0.50
Fixed Carbon	30.30

Table 02: Comparison of Calorific Values

Fuel	Calorific Value (J/g)
Crude Biofuel (Seeds Extract)	35726
Crude Biofuel (Hexane Soluble)	42945
Diesel Oil	53153
Bio Diesel	50148
Furnace Oil	37666

Figure 01: Effect of Temperature on Yield

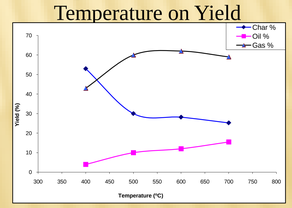


Figure 02: Effect of Chemical Ratio on Iodine Number

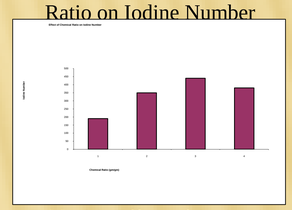
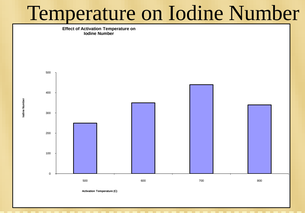


Table 04: Effect of Activation Temperature on Iodine Number



CONCLUSIONS

The biofuel produced has high calorific and approaches to the calorific value of available furnace oil. Further treatment of biofuel gives the product that has calorific value equal to calorific value of diesel oil. Very economical biofuel is produced and it can used instead of furnace oil and diesel oil. So it is a good alternative to fossil fuels and world wide energy crises can solved.

Activated carbon produced has high value of iodine number and surface area at minimum temperature, chemical ratio and activation time. So this produced activated carbon can be used effectively to treat wastewater.

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