PREPARATION OF BIO-CHAR FROM AGRICULTURAL RESIDUES BY PYROLYSIS

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ABSTRACT- Climatic change and global warming have world-wide adverse consequences. Bio-char production and its use in agriculture can play a key role in climatic change mitigation, carbon sequestration and soil fertility, and helps to improve the quality and management of waste materials coming from agricultural residue. In this study, pyrolysis of rice husk, rice straw alnd sugarcane bagasse was performed at the suitable temperature to recover bio-char. The experiments such as proximate analysis, XRF, XRD, gas pycnometer were carried out in order to investigate the effects of various parameters on utilization of bio-char. The results showed that the rice husk pyrolysis at the temperature range of 100-175℃ produces more yield and sufficient conversion of char when compared to other raw materials. The conclusion of the characteristic of physical and chemical properties of the raw material examines the prominent source of useful energy.

Key words: Rice husk, Rice straw, Sugarcane bagasse, Pyrolysis, XRD, XRF, Gas pycnometer.

1. INTRODUCTION

India is an agrarian country and generates a large quantity of agricultural wastes. In India, crop burning is a traditional way for farmers to decompose leftovers after they harvest crops such as wheat, rice and sugarcane. These may also produce GHG emissions from open field burning of agro-residues.

Various treatment processes are performed on agricultural residues such as composting, sanitary landfill, incineration, recycling.

Though the agricultural residues can be disposed off by the above mentioned disposal methods, they does not provide much advantageous than converting into bio-energy (bio-oil, bio-char, syngas). The conversion process is carried out by three methods. They are thermo-chemical conversion, biological conversion and mechanical method or physical conversion.

Among the various conversions, pyrolysis is advantageous when compared to other conversions. Pyrolysis involves thermal and chemical decomposition of materials at elevated temperature in limited or zero supply of oxygen. It involves a change of chemical composition and is irreversible.

It produces bio-char which is used in soil amendment, carbon sequestration and bio-oil which can be used as a supplement for fossil fuel.

2. MATERIALS AND METHODS

2.1 Experimental setup

The setup consists of round bottom flask (RBF) where the raw materials were kept, condenser to condense the vapor from RBF into bio-oil by circulating cooling water around them, thermometer to note the temperature at each stage, knob to provide heating rate. The RBF was covered with wool and Aluminium foil and paraffin papers

2.2 Sample preparation

The raw materials collected should be first dried under a light source for more than 24 hours in order to remove the moisture content present in them initially. As their sizes were very large, they were cut into small pieces which should be less than 5mm size. After these pretreatments of materials, they were kept ready for the further process.

2.3 Process

The pretreated feed materials (rice husk, rice straw, sugarcane bagasse) are weighed and loaded into the round bottomed flask. It is subjected to the process of pyrolysis at the suitable temperature range (around 100-400℃). The initial

temperature, condensation temperature, heating rate and residence time should be noted. After completion of the process, bio-oil and bio-char produced should be weighed. The bio-char is subjected to various characterization processes such as proximate analysis, XRF, XRD and gas pycnometer in order to define its physical parameters.

3. USES

Bio-char produced from the process of pyrolysis is used in various fields as follows.

- It is used in the Carbon sequestration. The burning and natural decomposition of biomass releases large amounts of carbon dioxide and methane to the Earth's atmosphere. Bio-char presents a stable way of carbon storage in the ground for centuries, potentially reducing or stalling the growth in atmospheric green house gas levels.
- The extremely porous nature of bio-char is found to be effective at retaining both water and water-soluble soil biologist indicates the extreme of bio-char as a habitat for many beneficialsoilmicro-organisms. It points out that when pre-charged with these beneficial organisms bio-char becomes an extremely effective soil amendment promoting good soil and, in-turn, plant health.
- Bio-char's unique chemical structure with a large surface area and tailored surface functional groups can be easily prepared by activation or fictionalization and shows great potential to be used as a versatile catalyst or catalyst support in many chemical processes. Bio-char can be easily separated from catalysts by oxidation to recover precious metals. Therefore, the utilization of bio-char as catalyst will not only enhance its utilization but also promote the development of a variety of catalysts.
- Economical substitute to the activated carbon to remove diverse organic contaminants such as agrochemicals, antibiotics, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, volatile organic compounds and aromatic dyes, and a series of inorganic

contaminants from aqueous, gaseous and/or solid phases.

4. CONCLUSION

The agricultural residues such as rice straw, rice husk and sugarcane bagasse are transformed into a useful product through the process of pyrolysis allowing a biomass reduction, is a promising answer to the need of valorizing this waste avoiding and polluting burden on the environment. After analyzing the experimental results, the bio-char obtained from the rice husk shows the best results in most parameters such as yield (42.66%), average density (1.5 kg/m^3) and contains maximum amount of SiO_2. The further studies of bio-char may provide the exact information about its porosity and absorption capacity in order to use it as absorbent and carbon sequestration.

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