PRODUCTION OF BIOCHAR AND DEVELOPMENT OF PREDICTIVE METHODS FOR DETERMINING PERFORMANCE IN VALUE-ADDED COMPOSITE MATERIALS

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Current pyrolysis technologies are used for the production of liquid bio-oil, solid biochar, and gases, at temperatures in the range of 400-600 °C in the presence of little or no oxygen. Typically, pyrolysis processes have been investigated with the aim of producing the oil and char for their potential value as sustainable sources of energy and chemicals. Biochar, or biocarbon, the carbonaceous residue remaining after the volatile components have exited the biomass material, has typically been used in low value applications such as soil amendment. However, for pyrolysis technology to become fully established, it remains necessary to extract as much value as possible from all product streams. Recently, biochar has been gaining interest for it's potential application as a filler material in polymer composites, as the porous and thermally stable nature of biochar could provide advantageous in material applications, and could allow for biochar to replace carbon black. Moreover, this application would present an effective carbon sequestration and storage technology. Peterson (2012) found that mixing biochar with carbon black as a filler increased the tensile strength and elongation of styrene-butadiene rubber. More recently, Das, Sarmah & Bhattacharyya (2015) found that wood-plastic biochar composites could alleviate problems found with the parent composite. One of the limiting factors in the development of pyrolysis is the reactor technology, as larger throughput equipment is either mechanically complicated, or the biochar is diluted by heat carrying inert solids. The Mechanically Fluidized Reactor (MFR) was developed as a means of continuously producing large quantities of pure biochar and high-quality bio-oil. The system currently available at ICFAR is capable of processing up to 100 kg/hr of raw biomass, using induction systems to provide precise and rapid temperature control. Biochar was investigated initially using a continuous smaller scale (2.9 L) mechanically mixed reactor. Feedstocks ranging from various woods to wastewater sludge were used to obtain biochar produced under various operating conditions. Of special interest are feedstocks that yield char containing contaminants that would make it unsuitable as a soil amendment or activated carbon. The biochar then went through standard characterization, as well as introduction into a clear epoxy resin mixed with white dye. Optical analysis methods were then used to determine the degree of dispersion and variation in colour intensity within the epoxy resin. From here, the biochar was sent to the Bioproducts Discovery and Development Centre (BDDC) at the University of Guelph. The biochar was introduced as a filler to various polymer-composite materials used for testing, from which the ideal biochar characteristics for reinforcement could be determined. Thus, the optimum conditions and feedstock could be determined for industrial scale biochar production using the MFR technology. This project aims to add value to biochar as an additive in industries based off of composites, and therefore recover the full value from biomass conversion. As an additive in green composites, biochar will help reduce the dependence on petroleum-based additives, while working to diminish waste and maintain carbon neutrality.

References:

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