ABSTRACT

RAW MATERIAL CHARACTERIZATION AND PRODUCTION OF ACTIVATED CARBON

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The production of activated carbon from local carbonaceous materials is one way of converting these materials to a higher value product. This dissertation describes the production of activated carbon from Caribbean pine (CP), mixed wood (MW), bagasse (B), coconut shells (CS) and coconut husks (CH), by carbonization at temperatures below 600°C followed by activation using air at 600°C and steam at 800°C.

Properties capable of numerical evaluation, both in the raw materials and the solid product of activation, have been studied to determine their effects on the activated carbons produced. The adsorptive properties of the carbons were evaluated and compared with two commercial carbons. The manufactured carbons developed comparable adsorptive properties for methylene blue and iodine adsorption.

The thermal decomposition of fine samples of the raw materials were studied using dynamic thermogravimetry. The decomposition followed an Arrhenius first order mechanism having activation energies, CP: 74352 J/mol, MW: 67277 J/mol, B: 64600 J/mol, CS: 62729 J/mol, and CH: 52786 J/mol. The raw materials displaying higher cellulose, volatile matter and oxygen contents, and higher hydrogen/carbon (H/C) ratios, exhibited higher resistance to thermal decomposition.

A new technique using thermogravimetric analysis to characterize raw material properties, and the development of surface in cellulosic materials is presented. It was found that materials displaying higher activation energies produced carbons with higher surface areas. Previously there was no means of quantitatively evaluating the net effect of raw material properties during the production of activated carbon. This work is the first known attempt at defining a parameter that describes the lumped effect of raw material properties on the development of adsorptive properties during activated carbon production.

A prefeasibility study for the manufacture of activated carbon from West Indian biomass has indicated the vast potential in this area of industrial activity. A plant for the production of 6.6M kilograms of activated carbon per annum was estimated to require a capital investment of US$11.9M with a rate of return on investment of 36% and an internal rate of return of 42%.