ABSTRACT

Fluidized Bed Combustion of Coconut Shells

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Fluidised bed combustion is a potentially attractive method for generating heat from solid fuels. In the context of the Caribbean situation, appropriate solid fuels are wood, industrial wastes e.g. bagasse, agricultural wastes, e.g. coconut shells and municipal wastes. An approach has been developed in this work to study the technical feasibility of the fluidised bed combustion of such materials. The approach involves three basic stages, raw material characterization, fluidised bed mixing studies and fluidised bed combustion studies and has been applied to fluidised bed combustion of coconut shells.

The raw material characterization showed that coconut shells demonstrate good potential as a fuel, with a low moisture content 10.5wt% and high calorific value > 20000 $kJkg^{-1}$. They have a high volatile matter content of 48.5wt% together with 35wt% fibre and 6wt% ash.

The mixing experiments showed that 10 to 14# sand gave efficient mixing in a short period of time.

Mixing improved slightly with increasing air velocity and was satisfactory at shell weight concentrations in the range 7½% to 12½%. Above 12½% there was a tendency for the shells to sink towards the bottom of the bed.

Using the 10 to 14# sand, the shells combusted well at bed temperatures in excess of 300°C, the maximum bed temperature of 800°C being imposed by the tendency of the sand particles to fuse. Three separate periods were clearly identified during combustion, a heating up period, a volatile combustion period and a char combustion period. Batch combustion experiments showed that the total burn-out time and the time in each of the three combustion periods reduced with increasing bed temperature, reducing shell size and increasing air flow rate. Increasing the bed depth reduced the heating up time, all other times being increased.

Measured heating up times showed reasonable agreement with theoretical prediction. Over the range of variables investigated the results seemed to indicate that volatile combustion was controlled by the pyrolysis reaction and char combustion by the combustion reaction.

Experiments under continuous operation demonstrated good potential for fluidised bed combustion as a means of heat release from coconut shells. It is recommended that the approach be adopted to study the potential of other regionally available solid fuels.