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Development of a Controller for Intermittently-fed Small Scale Biomass Boilers to Improve Overall Performance

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Biomass is rapidly becoming an alternative fuel for conventional fossil fuel fired boilers and furnaces in the manufacturing and service industry in Sri Lanka. In majority of these boilers, there is no proper way to control the combustion process to ensure higher performance. Existing costly solutions have not attracted particularly the small scale boiler owners. In this background, the aim of this research was to develop a low-cost control system to improve combustion efficiency of small scale intermittently-fed biomass combustors. A lab-scale biomass combustor was developed and a series of experiments were conducted by attaching a single-pass water-tube heat exchanger to the combustor. Microcontroller based controller was developed to control the forced draft fan speed by analyzing the combustion patterns observed during experiments. The heat output was measured using the heat gained by the flowing water. The gross heat output and its time variation under varying fan speeds were observed by maintaining the water flow through the heat exchanger at constant. Results showed that the overall heat energy produced and its time variation depends on the fan speed, and there is an optimal fan speed yielding the maximum gross rate of heat output for a given batch of biomass. The technology developed in this research can directly be incorporated to develop a low-cost controller applicable for medium and small scale intermittently-fed biomass boilers and combustors.

Keywords: batch feeding of biomass, biomass boiler, biomass combustion, boiler controller, combustion efficiency