

Potential Assessment of Charcoal Production Using Earth Pit Kilns and Pollution Smoke Treatment Efficiency During Carbonization

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Abstract

This research aims to evaluate the potential biomass charcoal production combined with the liquid condensation technique and the exhaust gas re-combustion technique to reduce the haze disaster in Chiang Mai and the upper northern region in Thailand. The agricultural biomass was made of neem, mango, and longan woods, ranging from 5-30cm in diameter and 30-100cm in length. The overall biomass load per batch ranged from 6,450-6,650kg after an average air-drying period of 7 days. To achieve emissions control, 0.7 m² of shell-and-tube heat exchanger was installed to condense the smoke into wood vinegar, and the rest of the gas was partially recirculated and re-combusted. The results indicated that the operating temperature of the charcoal kiln was in the range of 400 – 500°C with a yield of charcoal of 27.91 – 28.96%. Average values of the three types of charcoal were between 25.60 and 27.98 MJ/kg, which were within the Thai Community Product Standards (TCPS). Furthermore, the earth-pit kiln combustion smoke removal capability was 68.1% with the average thermal efficiency of 49.7–51.73% and the product cost of 7.39–7.78 THB/kg. The developed smoke elimination technology in the kiln is highly feasible for community promotion for producing income in the community and simultaneously solving the environmental problem.

Keywords: Wood charcoal, Earth-pit kiln, Carbonization, Haze disaster, Agricultural residues