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Performance of Pellets from Jatropha Hulls and Shells in a Prototype Small Scale Stove

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Abstract

Jatropha curcas L. fruits and its byproducts can be used for diverse applications. During processing of Jatropha fruits, hulls and shells come up as byproduct in significant quantities. Hulls and shells can be used as energy carriers in combustion facilities for producing energy from renewable resources.

In the present study pelleting experiments with hulls and shells of Jatropha and combustion tests with a prototype small scale pellet stove were carried out. The physico-mechanical and chemical properties of produced pellets were analysed for different pellet production quality. Emissions gasses were monitored and controlled by altering combustion properties such as air flow rate and fuel feeding rate. To improve pelleting properties different moisture contents (0, 5, 10 and 15 % w.b.) were induced during pellet production.

Pellets were optimised by finding the best mixture in terms of successful pelleting and effective combustion. Moisture content and pellet temperature during production were identified to have a strong influence on the physico-mechanical properties. Combustion experiments showed that pellets without additional water had significant higher burning temperatures than pellets produced with additional water.

The flame temperature was around 700°C, burning chamber temperature was between 600 and 700°C and the flue gas was around 200°C. The CO_2 emissions ranged from 3 to 5 Vol. % for all experiments. With increasing air mass flow, the CO_2 values were slightly increasing. The CO emissions were below $2\,g\,m^3$ for all experiments. Increasing the feeding rate from 5 to $10\,kg\,h^{-1}$ the CO value also increased, but for higher rates there was no further influence on CO emissions.

In general, increasing moisture content of pellet leads to decreasing thermal efficiency. The study shows that there is a good opportunity to substitute traditional biomass like wood by *J. curcas* hulls and shells pellet for cooking and heating.

Keywords: Combustion, emission control, *Jatropha curcas*, mechanical properties, pellet production

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