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Comparative study of thermal efficiency in five different fuel wood cook stoves for conserving biomass energy sources in Sri Lanka

C. P. Gunasena, D. K. J. Jayasanka and C. P. Rupasinghe*

Department of Agricultural Engineering, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka.
*chintha@ageng.ruh.ac.lk

Abstract

Minimum energy requirements for cooking and heating may be estimated as 6 - 10 GJ, or 0.5 - 1 m^3 of fuel wood per person per year. Inefficient use of biomass for anthropogenic activities causes reduction of biomass availability. Therefore, there is a scientific need to identify most efficient cook stoves to improve the efficiency of using bio mass for cooking for the sake of saving forest cover and for the solution of the green energy requirement.

The present research study formulated to evaluate the efficiency of existing cook stoves such as "Batapola Lipa" (BS), "Anagi Lipa" (AS), and traditional three stone cook stove (TS) with newly developed cook stoves such as traditional three stone cook stove with grater (TSG) and a prototype metal stove (PMS) developed by the Department of Agricultural Engineering, Faculty of Agriculture, University of Ruhuna. The standard boiling water laboratory test was done for studying the thermal efficiency. Cinnamon sticks were used as the source of biomass. Initial and boiling water temperatures, amount of water boiled and evaporated, amount of biomass utilized and unburned remaining biomass in weight basis after the boiling test, were measured and percent heat utilized and power output of stoves were calculated.

The results which were analyzed using ANOVA procedure with Duncan's Multiple Range Test, revealed that energy output of the BS, AS, TS, TSG and PMS, were observed as 15.1 kW, 5.8 kW, 3.9 kW, 4.7 kW and 14.3 kW respectively. Comparatively higher percent heat utilized value were observed in TSG, AS and BS than TS and PMS. The BS, TS, TSG, PMS consumed 190, 274, 172, 298 g, within 3.95, 22, 11.25, 6.52 minutes respectively. Lowest biomass consumption rate was observed in TSG. It revealed that 102 g of biomass and 10.75 minutes can be saved by TSG than TS for boiling one liter of water. Therefore the significant amount of fuel wood can be saved successfully by introducing a grater to the traditional three stone cook stove which may save natural forests resources in Sri Lanka.

Key words: Cook stoves, Biomass consumption, Percent Heat utilized