ABSTRACT

Most stoves based on the principle of micro gasification have improved thermal efficiencies with low emissions, however, knowledge on the effect of the stove operation at different air flow rates on thermal efficiency, fire power, emissions, specific fuel consumption and burning rate is scarce. The main objective of this research was to evaluate performance a micro gasifier cook stove. An experimental forced draft cook stove was therefore developed using the available materials based on the design equations and household energy requirements. Simulation of air flow was integrated to help in the selection of the fan. The water boiling test was used and carried out at volumetric air flow rates of 0.014 m3s-1, 0.020 m3s-1, 0.027 m3s-1 and 0.034 m3s-1 with three replications. Performance was based on carbon dioxide, carbon monoxide, particulate matter, temperature near the pot and time for boiling water recorded real time. The average thermal efficiency and boiling time were 33±4%, and 13.5±3 minutes, respectively. There was linear proportionality for variation of air flow rate with the fire power of the stove in both cold and hot phases. The resistance to airflow exerted by the fuel and by the char inside the reactor during gasification was an average of 0.125 cm of water which was the minimum resistance needed by the fan. Burning rate increased with increase in volumetric air flow rate in both cold & hot phases. Specific fuel consumption increased linearly up to 0.027 m3s-1 and then dropped drastically in cold Phase. Considering Carbon monoxide & particulate matter emissions, the optimum air flow rate was 0.021 m3s-1 that corresponded to an average thermal efficiency of 33.5% for cold phase high power. During hot phase, the optimum air flow rate was 0.029 m3s-1 which resulted to thermal efficiency of 34%. Therefore, the general performance of the stove represents tier 3 according to International Workshop Agreement. This knowledge is finally useful to the users of gasifier stoves and designers in minimizing emissions at optimum efficiency.

Keywords

Egerton University