Title	TEMPERATURE CONTROL SYSTEM DEVELOPMENT FOR BIOGAS PRODUCTION BY HYBRID SOLAR AND BIOGAS ENERGY
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ABSTRACT

Food waste has developed as an alternative for the production of renewable fuels such as biogas from AD. In relation to the biogas production rate, digester temperature setting is one of the very important factors for digester operation, especially in low temperature countries. In this study the effect of digester temperature on biogas and methane production efficiency in the AD of food waste was evaluated. The two-stage anaerobic digestion has a total reactor volume of 70 L. (acid reactor volume was 35 L. and methane reactor volume was 35 L.). There were incubated at mesophilic and thermophilic conditions for 25 days to determine a temperature profile for the AD process. The results of the laboratory-scale experiment, maximum biogas production occurred at 55°C (38.14 L. of biogas) for a period of 11 days when compared to the other temperatures. Second best was at 50°C (37.44 L. of biogas) for a period of 12 days, followed by 40°C (35.36 L. of biogas) for a period of 15 days respectively.

Heat required for the bioreactor was performed by a solar collector combined with biogas energy. Water contained within the jacket of the bioreactor was 35 liters and the bioreactor volume was 70 liters. Heating this volume of water to 35-60°C for the solar collector design. The solar collector consists of a galvanized steel flat plate of 4.98 m^2 dimensions. The absorber was insulated with a glass wool layer of 4 cm thickness at the bottom. All of these parts were arranged within a box of galvanized

steel base and glass top. The heat exchanger consists of a cylindrical storage tank of 35 L. The storage tank is wrapped with glass wool of 5 cm thickness. Cold water is supplied through the bottom of the flat plate collector and the hot water is retained in the storage tank of the heat exchanger. The outlet water from the bioreactor is fed back to the heat exchanger where it is reheated and then pumped back to the water jacket of the bioreactor. Heat of the bioreactor using solar energy can be approximated by first order dynamics and the night using biogas energy burn hot water. Two types of controllers were an on–off controller, and an analog PID controller. The on–off controller sensor was sensitive to small temperature variations.

Payback period of temperature control system for biogas production system was 5.88 year. Consideration total expenses cost per rate of system production and expense cost operating per rate of system production. The evaluation economic analysis of temperature control system for biogas production system was long time payback period because of the hot water system is very expensive. If the hot water system gets free, Payback period of biogas production system was 0.66 year.