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Exergy Analysis of Poultry Litter-to-Energy Production by the Advanced Combustion System

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Abstract : The need for generating energy from biomass in an efficient way as well as maximizing the yield of total energy from the thermal conversion process has been a major concern for researchers. A holistic approach which involves the combination of First law of thermodynamics (FLT) and the second law of thermodynamics (SLT) is required for conducting an effective assessment of an energy plant since FLT analysis alone fails to identify the quality of the dissipated energy and how much work potential is available. The overall purpose of this study is to investigate the exergy analysis of direct combustion of poultry waste being converted to energy with a handful of environmental assessment of the conversion processes in order to maximize thermal efficiency. The exergy analysis around the shell and tube heat exchanger (STHE) was investigated primarily by varying the operating parameters for different tube shapes and flow direction, and an exergy model was obtained from estimations of the higher heating value and standard entropy of poultry waste from the elemental compositions. The STHE was designed and fabricated by Lee Research Group at Morgan State University. The analysis conducted on theSTHE using the flue gas temperature entering and exiting show that only about one-third of the energy input to the STHE was available to do work with an overall efficiency of 13.8%, while a huge amount was lost to the surrounding. By recirculating the flue gas, the exergy efficiency of the combustion system can be maximized with a greater reduction in the amount of exergy loss.

Keywords : exergy analysis, shell and tube heat exchanger, thermodynamics, combustion system, thermal efficiency
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