E.ENG.33

ENERGY AND EXERGY EFFICIENCIES IN A TYPICAL MEDIUM SCALE SRI LANKAN TEA FACTORY

R. G. R. N. K. Ariyartne[1], B. D. N. Fernando[1], M. M. R. Pathmasiri[2], R. Shanthini[1]

[1]Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya
[2]Sri Lanka Sustainable Energy Authority

The Sri Lankan tea factory is a heavy consumer of both thermal and electrical energy. Thermal energy is mainly required in the drying stage of tea processing, and is provided by burning firewood. Electrical energy is mainly used for running motors and other machinery. Cost competitiveness, current energy crisis and environmental considerations have encouraged the search for energy conservation means suitable for the Sri Lankan tea industry. Energy depends on matter and energy flow only. But exergy depends on both matter or energy flow and the environment. So exergy analysis can identify locations of energy quality degradation in a process, and therefore, lead to improved operation.

The objective of this study is to identify the energy conservation potential in a typical medium-scale tea factory located in Rathnapura. The methodology used was to estimate the energy and exergy efficiencies of selected energy-intensive processes of the chosen tea factory, and to understand the energy conservation potential by comparing the efficiencies calculated. Drying, withering, rolling and sifting were the energy-intensive processes chosen. Devices considered for analysis in the drying process were two furnaces with firewood as the energy source, and two dryers. In the withering, rolling and sifting processes, motors and fans, operated by grid electricity, were considered for analysis.

Field data were collected from the daily log-books and by real-time temperature measurements at the factory. Electrical motors were found to have the highest energy and exergy efficiencies at 84%, but were limited by the motors working below rated power capacity owing to their age. Energy and exergy efficiencies of transportation were 27% and 23%, respectively. Such low values were mainly due to the low heat to work energy conservation of the diesel engines powering the vehicles used. Average energy and exergy efficiencies were about 63% and 35% for firewood furnaces, and 52% and 32% for dryers respectively.

The low exergy of the furnace-dryer system indicates potential for efficiency improvement in the system. Heating up the process air by burning firewood causes exergy degradation which could be reduced by preheating the process air by using the exhaust air streams of the furnace and/or dryer. Solar energy is another alternative for the purpose. Supply of hot air to the dryer could be optimized by annexing an air flow control system to the furnace.