

Techno-economic analysis of a hybrid solar dryer with a vacuum tube collector for Hibiscus Cannabinus L Fiber

ABSTRACT

Solar energy is one of several types of renewable energy and has numerous applications. Types of solar energy include photovoltaic, thermal, and thermophotovoltaic modes. Drying is an application of thermal solar energy which is used to remove water from a sample. The main reason this study was done was due to the lack of use of hybrid solar dryers for high load kenaf fibers. This dryer is capable of extracting water from the sample with a maximum load of up to 1400 kg. This study aims to evaluate certain open drying methods as compared with modern thermal drying methods. The dried samples were a type of natural fiber commonly known as kenaf (*Hibiscus Cannabinus L*). The test amounts were 175 kg and 1400 kg, respectively. The solar thermal drying uses several components, including an evacuated tube collector, water storage tank, heater, air intake, pump, and a drying chamber. The parameters to be measured included weight, water content, time, and electricity usage. Dryer performance was evaluated in terms of water extraction rate, exact water extraction rate, specific energy usage, dryer operational costs, and specific operational costs. The results of the evaluations indicate that drying with the maximum load of 1400 kg increased the extracted water, exact water extraction rate, and dryer operational costs by 97.27 kg/hour, 39.86 kg/kWh, and 3.72 Malaysian ringgit (approximately 0.90 USD), respectively. Specific energy consumption and specific operating costs fell by 0.10 kWh/kg and 0.05 RM/kg (0.012 USD/kg), respectively. Based on these findings, economic analysis was carried out to estimate the profitability and frequency of drying. The results indicate that a maximum load of 1400 kg is superior to the open drying method, with an annual yield and return of investment period of RM 64992 (15,723 USD) and 3.7 years, respectively