

PERFORMANCE EVALUATION OF AN INDUSTRIAL HEAT PUMP DRYER

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The performance of the industrial heat pump dryer was evaluated using hygroscopic materials. Heat pump dryers are commonly used as energy-efficient dryers for hygroscopic materials. Turmeric (*Curcuma longa* L.) and black pepper (*Piper nigrum* L.) are used as hygroscopic materials to evaluate the industrial heat pump dryer. In this study, turmeric and black pepper were dried in a batch-type heat pump dryer, and drying curves were obtained to assess dryer performance. The sample weights, condensed water at the evaporator, drying chamber temperature and relative humidity (RH), condenser and compressor inlet pressures, and electric current were recorded throughout the drying periods. The temperature and RH in the drying chamber while drying black pepper were $49.33 \pm 1.8^\circ\text{C}$ and $42.75 \pm 4.0\%$, respectively. Further, the temperature and RH for turmeric drying were $46.94 \pm 0.26^\circ\text{C}$ and $45.6 \pm 0.09\%$, respectively. The condenser inlet pressure during black pepper drying was 268.40 ± 7.0 kPa, while the compressor inlet pressure was 65.0 ± 3.49 kPa. The condenser inlet pressure was 253.96 ± 5.62 kPa and the compressor inlet pressure was 60.94 ± 1.05 kPa during turmeric drying. The mean drying rate constant for turmeric was determined to be 0.11 hr^{-1} . Further energy efficiency calculations were determined with moisture extraction rates of $0.60 \pm 0.17 \text{ kg hr}^{-1}$ and $0.50 \pm 0.12 \text{ kg hr}^{-1}$ and specific moisture extraction rates of $5.22 \times 10^{-7} \text{ kg J}^{-1}$ and $4.46 \times 10^{-7} \text{ kg J}^{-1}$ for turmeric and black pepper, respectively. These findings indicated that the industrial heat pump dryer used for the study is suitable for drying hygroscopic materials. However, further studies are needed to assess the quality of the dried hygroscopic materials.

Keywords: Black pepper, Moisture extraction rate, Specific moisture extraction rate, Turmeric