

MAXIMIZING THE WATER CONDENSATE IN THE EVAPORATOR OF HEAT PUMP DRYER

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Heat pump drying is widely used in the food industry to dry agricultural materials. However, a significant constraint in this mechanism is the lack of a simple method to control the drying air properties. Therefore, this study aimed to design and develop a mechanism to maximize the water condensation in an evaporator of a heat pump drying system. The drying conditions of the heat pump dryer were manipulated by the pulse with modulation (PWM) technique applied to the condenser blower. A microcontroller based temperature and relative humidity data acquisition system was developed to collect data at the drying chamber inlet, drying chamber outlet, and evaporator outlet. The condensate at the evaporator was measured at three duty cycles 60%, 80%, and 100% for one hour. The relationship of duty cycle with temperature and relative humidity at the drying chamber inlet and outlet, evaporator inlet and outlet, condensation at the evaporator were studied. The drying chamber inlet and outlet temperature were decreased with increasing duty cycle. However, the relative humidity at the drying chamber inlet and outlet was increased with the duty cycle. The evaporator outlet temperature and relative humidity were constant with time. The condensate at the evaporator was increased by increasing the duty cycle. After one hour, the temperature and relative humidity at the drying chamber inlet were 57°C, 55°C, and 53°C, and 31%, 26%, and 24%, for 60%, 80%, and 100% duty cycle, simultaneously. The respective water condensate at the evaporator was 80 ml, 170 ml, and 175 ml. The results indicated that changing the duty cycle may change the drying air properties in the heat pump drying system. The changes in the duty cycle may affect the airflow rates of the heat pump dryer. Therefore, the condensation was changed at different duty cycles. In conclusion, the results indicate that the PWM technique can effectively control the water condensation in the evaporator.

Keywords: Drying, Evaporator, Heat pump dryer, Pulse width modulation