DESIGN PARAMETERS FOR AN OPTIMUM BATCH-TYPE CLOSED-LOOP HEAT PUMP DRYING PROCESS

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Mathematical modeling and computer simulation is a powerful technique for better understanding of the physical process of drying. The optimum design parameters reduce the cost of production of heat pump dryers. In this study, a computer programme has been developed to calculate the design parameters for a batch type closed-loop heat pump dryer. The design parameters considered in this study were the capacity of heat pump components and refrigerant mass flow rate. The performance of the developed design parameters was measured by the Specific Moisture Extraction Rate (SMER), coefficient of performance, and moisture extraction rate. Accordingly, an algorithm for calculating the optimum design parameters was developed integrating heat and mass conservation principles, psychrometric equations, thermodynamic properties of refrigerant, and heat pump dryer model. The algorithm was implemented in PyCharm, an integrated development environment in Python language. A graphical user interface was developed using the Tk interface. The programme was compiled without errors, and there was no lag when executing the code. Batch-type closed-loop heat pump drying data for coffee (*Coffea arabica*), papaya (*Carica papaya*), chestnuts (*Castanea crenata*), and alfa-alfa (*Medicago sativa*) were obtained from the literature and fed to the programme. The SMER values resulted from the programme were 0.72, 0.36, 0.49, and 0.62 $kWhkg^{-1}$ and the corresponding SMER values were 0.71, 0.37, 0.52, and 0.64 $kWhkg^{-1}$, respectively. The error percentage for SMER values from literature and resulted from the programme were 1.32%, 2.95%, 6.12%, and 3.82%, respectively. These output SMER values were in the range of optimal for heat pump drying. The study concludes that the developed programme could accurately provide design parameters for optimizing the heat pump drying process.

Keywords: Algorithm, Computer aided software, Design calculation, Drying, Heat pump dryer