Abstract

A factorial design of experiments was carried out to obtain effective mass transfer coefficients in a packed bed dryer of mate leaves by varying mass velocities from 0·09 to 1·04 kg m^{-2} s^{-1} at the temperatures of 50 and 103 °C, respectively. The mass transfer coefficients were tuned on transient experimental moisture content profiles by using the semi-empirical model of Lewis to represent the transport of water from the leaves. An empirical equation in terms of coded independent variables varying from -1 to $+1$ was tuned on the calculated transport property. The parameters estimated in this regression model, which are related to the effects of the drying temperature and airflow rate, suggest a significant influence of both these factors on the mass transfer coefficient. The drying thermal efficiency, defined as the ratio of heat energy utilised in the process to that supplied to the dryer, was obtained in the range of operating conditions investigated in this study. The results indicate that a drying thermal efficiency of 50% is available at the typical drying temperatures in the mate industry (100 °C) if a value of mass velocity in the order of 0·1 kg m^{-2} s^{-1} is set. This means that an energy consumption of only 6·8 GJ is necessary for every tonne of dry mate produced. A comparison between these data and the experimental results of thermal efficiency measured at mate factories (11% or 31 GJ t^{-1} [dried mate]) draw attention to the huge energy savings achievable by adopting the optimum drying conditions suggested in this investigation.