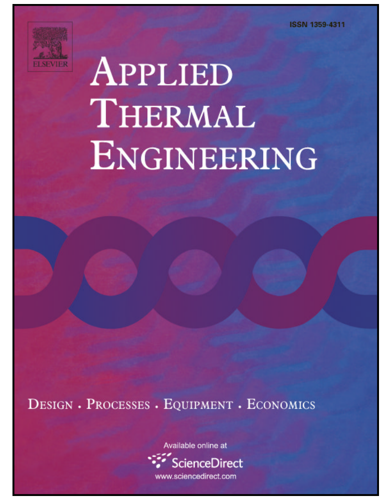

Research Paper

Thermal Performance of Indirect Forced Convection Solar Dryer and Kinetics Analysis of Mango

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PII: S1359-4311(17)35806-4
DOI: https://doi.org/10.1016/j.applthermaleng.2018.01.115
Reference: ATE 11769

To appear in: *Applied Thermal Engineering*

Received Date: 7 September 2017
Revised Date: 4 December 2017
Accepted Date: 29 January 2018

Please cite this article as: W. Wang, M. Li, R.H.E. Hassanien, Y. Wang, L. Yang, Thermal Performance of Indirect Forced Convection Solar Dryer and Kinetics Analysis of Mango, *Applied Thermal Engineering* (2018), doi: https://doi.org/10.1016/j.applthermaleng.2018.01.115

Thermal Performance of Indirect Forced Convection Solar Dryer and Kinetics Analysis of Mango

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Abstract: In this paper, an indirect forced convection solar dryer (IFCSD) with auxiliary heating device has been presented for drying mango. The dryer consists of an evacuated tube solar air collector, three phase inverter fan, auxiliary heating device, drying chamber, and automatic control system. Moreover, the influence of different drying air temperatures on the dryer performance, the drying characteristic and the drying kinetics of mango slices in this dryer have been investigated. The experimental results showed that the temperatures at four different locations of the drying chamber were varied within a narrow band. Meanwhile, the average thermal efficiency of IFCSD was ranged from 30.9% to 33.8%, the specific moisture extraction rate (SMER) was 1.67 (kg $_{water}$/kW·h) at a drying temperature of 52°C. In addition, the theoretical results revealed that the Page's model was the most appropriate model for describing the drying kinetics of mango slices in IFCSD. Furthermore, the effective moisture diffusivity (D_{eff}) values of mango slices were obtained from the Fick's diffusion equation at the range of 6.41×10^{-11} to 1.18×10^{-10} m^2/s, over a temperature range of 40-52°C. Meanwhile, the D_{eff} values increased with the increasing of drying air temperatures, due to the increase of heating energy could increase the activity of water molecules of mango slices. In conclusion, this study provides the basics of the theoretical and experimental data to support the follow-up research.

Keywords: Solar drying; mango; thermal performance; mathematical modeling; drying kinetics;

1. Introduction

Solar energy technology has been used widely due to the large capacity, renewable and clean source of energy. Solar drying is generally considered to be the most promising alternative to traditional methods because the drying of agricultural products is usually carried out at low temperature. Compared with traditional direct solar drying or open-air drying, indirect solar drying has the following advantages: shorter drying period; best quality products; lower loss of raw materials; larger scale of production [1]. Therefore, many solar dryer have been developed to dry agricultural products in recent years [2-5].

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