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Energy and Exergy Analyses of Thin-Layer Drying of Pineapple Slices

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Abstract : Energy and exergy analyses of thin-layer drying of pineapple slices (Ananas comosus L.) were conducted in a laboratory tunnel dryer. Drying experiments were carried out at three temperatures (100, 115 and 130 °C) and an air velocity of 1.45 m/s. The effects of drying variables on energy utilisation, energy utilisation ratio, exergy loss and exergy efficiency were studied. The enthalpy difference of the gas increased as the inlet gas temperature increase. It is observed that at the 75 minutes of the drying process the outlet gas enthalpy achieves a maximum value that is very close to the inlet value and remains constant until the end of the drying process. This behaviour is due to the reduction of the total enthalpy within the system, or in other words, the reduction of the effective heat transfer from the hot gas flow to the vegetable being dried. Further, the outlet entropy exhibits a significant increase that is not only due to the temperature variation, but also to the increase of water vapour phase contained in the hot gas flow. The maximum value of the exergy efficiency curve corresponds to the maximum value observed within the drying rate curves. This maximum value represents the stage when the available energy is efficiently used in the removal of the moisture within the solid. As the drying rate decreases, the available energy is started to be less employed. The exergetic efficiency was directly dependent on the evaporation flux and since the convective drying is less efficient that other types of dryer, it is likely that the exergetic efficiency has relatively low values.

Keywords : efficiency, energy, exergy, thin-layer drying
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