Thermodynamic and environmental analyses for paddy drying in a semi-industrial dryer

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Abstract

In the present work, the first and second laws of thermodynamics were used to perform energy and exergy analyses for deep bed drying of paddy in a convective dryer. Also, the equivalent specific CO_2 emission was assessed. Drying experiments were carried out at drying air temperatures of 40, 50 and 60 °C, and air flow rates of 0.008, 0.012 and 0.017 $m^3\ s^{-1}$. Energy utilization, energy utilization ratio and energy efficiency were obtained to be in the range of 0.061–0.1412 kJ s^{-1}, 22.41–46.81% and 4.37–8.56%, respectively. Exergy loss decreased continually with drying time and the average values ranged from 0.019 to 0.081 kJ s^{-1}. Exergy efficiency varied in the range of 32.44–66.91%. Energy and exergy efficiency was improved at low temperature–low flow rate and high temperature–high flow rate, respectively. The results of environmental analysis declared that specific CO_2 emission ranged from 3.83 to 8.42 kg CO_2 kg^{-1}_{water} where high temperature–low flow rate drying air reduced the footprint.