

Energetic and Exergetic Evaluation of Box-Type Solar Cookers Using Different Insulation Materials

Authors : A. K. Areamu, J. C. Igbeka

Abstract : The performance of box-type solar cookers has been reported by several researchers but little attention was paid to the effect of the type of insulation material on the energy and exergy efficiency of these cookers. This research aimed at evaluating the energy and exergy efficiencies of the box-type cookers containing different insulation materials. Energy and exergy efficiencies of five box-type solar cookers insulated with maize cob, air (control), maize husk, coconut coir and polyurethane foam respectively were obtained over a period of three years. The cookers were evaluated using water heating test procedures in determining the energy and exergy analysis. The results were subjected to statistical analysis using ANOVA. The result shows that the average energy input for the five solar cookers were: 245.5, 252.2, 248.7, 241.5 and 245.5J respectively while their respective average energy losses were: 201.2, 212.7, 208.4, 189.1 and 199.8J. The average exergy input for five cookers were: 228.2, 234.4, 231.1, 224.4 and 228.2J respectively while their respective average exergy losses were: 223.4, 230.6, 226.9, 218.9 and 223.0J. The energy and exergy efficiency was highest in the cooker with coconut coir (37.35 and 3.90% respectively) in the first year but was lowest for air (11 and 1.07% respectively) in the third year. Statistical analysis showed significant difference between the energy and exergy efficiencies over the years. These results reiterate the importance of a good insulating material for a box-type solar cooker.

Keywords : efficiency, energy, exergy, heating insulation

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