

Thermal Performance of Four Types of Water Heating Flat Plate Solar Collectors for Providing Process Heat for Milk Pasteurization

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Abstract

Thermal performance tests were carried out on four water heating flat plate solar collectors with the aim to select a suitable one to be used to provide process heat for milk pasteurization. The collectors included three commercial solar collectors purchased from local shops in Nairobi, Kenya and one prototype collector designed and fabricated by the author. The three commercial solar collectors had effective areas of 1.67, 1.87 and 1.83 m² while the self-made collector had an effective area of 1.60 m². Thermal performance of the collectors was determined in terms of the Hottel-Whillier-Bliss equation, with $FR(\tau\alpha)_e$ and $FRUL$ indicating how energy is absorbed and lost from the collector, respectively. The $FR(\tau\alpha)_e$ values were 0.76, 0.75, 0.73, and 0.82, respectively, for the commercial collectors and the self-made collector. The $FRUL$ values were 8.33, 12.01, 9.80 and 13.77 $W.m^{-2}.C^{-1}$, respectively. The instantaneous efficiencies for the four solar collectors ranged from 12 to 87%. The solar collector with the lowest $FRUL$ value had a special (black chrome) selective absorber surface and was also the most cost effective collector for delivering temperatures of about 80°C. This collector is the most suitable for medium temperature applications such as provision of hot water for milk pasteurization.