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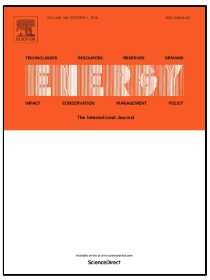

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Performance of solar air collector in the climatic condition of North Eastern India

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Abstract

The performance of the solar air collector is experimentally investigated at the climate of North Eastern India. Various governing parameters considered for the present investigation are collector tilt angles (30^0, 45^0, and 60°), single and double glazing, mass flow rate (0.0039 to 0.0118 kg/s) and two different absorber plates (plain and corrugated). Results reveal that double glazing absorber plate always gives better performance both energy and exergy point of view, because of reduction of top loses. Increase in mass flow rate of air enhances the energy efficiency. An overall increment of the efficiency with the increase of mass flow rate and number of glazing is as high as 10.35-17.42%. Use of corrugated plate enhances the energy efficiency by 14%, because of improved turbulence effect and increment of the heat transfer area. The maximum enhancement of exergy efficiency for double glazing collector is 6.867% for mass flow rate 0.0118 kg/s compared to single glazing collector. Corrugated absorber plate show 30Pa higher pressure drop than plain absorber plate. Thermo-hydraulic efficiency is found to deviate by almost 6.35% from the corresponding thermal efficiency. Mass flow rate of air in the range of 0.0078 to 0.0094 kg/s is found to yield qualitative heat transfer.

Keywords: *Solar air collector; energy analysis; pressure drop; thermo-hydraulic efficiency; exergy analysis.*

1. Introduction

Effective conversion and efficient utilization of renewable energy have gained a tremendous momentum during the last decade to substitute the culminating conventional energy. Solar energy being clean renewable energy, and abundant in nature, have the highest potential to meet the ever increasing energy demands. Solar air collectors are widely used to generate useful thermal energy from the incoming solar radiation, due to its simple construction and design, easy maintenance and low cost. Despite the advantages of non-freezing behaviour of air and the higher working pressure range, the lower thermal capacity of air coupled with the lower heat transfer coefficient limits its applications [1,2]. Continuous efforts are being made by the researchers to optimise the various design parameters of solar air collectors like profile of absorber plate, aspect ratio of the collector, number of glazing, and air velocity [3]. The present work is also an effort in the