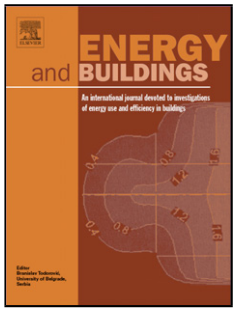

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Performance of a Liquid Desiccant Air-Conditioner Driven by Evacuated-Tube, Flat-Plate, or Hybrid Solar Thermal Arrays

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Abstract

Study was undertaken to determine the effects of location and solar thermal collector design on the performance of a liquid desiccant air conditioner (LDAC). A 95 m^2 evacuated-tube collector (ETC) solar thermal array, coupled to a LDAC located in Kingston, Canada, was monitored to obtain data to verify a simulation of the system. A TRNSYS model was modified to account for variations in LDAC effectiveness with different conditions. The model was used to investigate options for the collector array design including the use of flat-plate collectors (FPC), ETCs and hybrid arrays consisting of both FPC and ETCs. Simulations were conducted for three cities including: Toronto, Canada; Tunis, Tunisia; and Calcutta, India. To achieve comparable solar fractions to ETC arrays it was found that FPC arrays required approximately 15 m^2 more area than the ETC arrays in Toronto and Tunis, and 30 m^2 more in Calcutta. Tunis showed the best results for a hybrid system. A ratio of 30% FPCs and 70% ETCs achieved the same solar fraction (i.e., 0.56) as the array consisting of only ETCs. The reduction in the use of ETCs could lead to significant cost savings and flexibility in the design of LDAC systems.

Keywords*: solar thermal; collector performance; liquid desiccant; TRNSYS; HVAC; air-conditioning;*

1.0 Introduction

Solar energy has global interest as a powerful renewable energy source. The solar thermal collector is an effective method of capturing solar energy and converting it into heat. Many different types of solar thermal collectors exist and it is important to choose the best collector for each application in order to optimize the system's operation. Among the available types of stationary solar collectors, evacuated-tube collectors (ETCs) typically exhibit lower thermal losses and higher efficiency at high temperatures when compared to flat-plate collectors (FPCs). As such, they are often specified for solar thermal air-conditioning applications that usually require temperatures in excess of 80°C. Many variations of ETCs configuration exist, however, in the current work, the ETCs studied consisted of wickless heat-pipe absorbers enclosed in an evacuated cylindrical glass tubes as described by Kalogirou [1]. A previous study, performed on thermosiphon systems with FPCs and ETCs, confirmed that the