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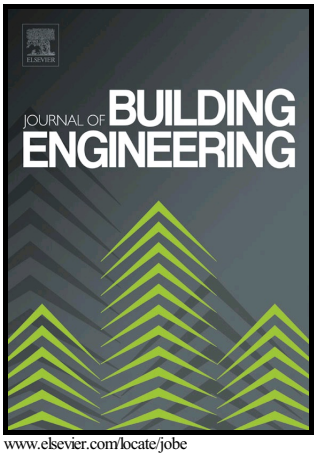

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Presentation of two new two-stage desiccant cooling cycles based on heat recovery and evaluation of performance based on energy and exergy analysis.

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Abstract

In recent years the importance of the issue of energy saving in air conditioning industry, has been taken into more consideration. Using natural refrigerants and setting up a system which is driven by low grade thermal energy sources such as solar energy are the reasons why desiccant cooling systems are alternatives to conventional vapor compression cooling systems. Due to the increase in capacity of dehumidification and decrease in required regeneration temperature in two-stage desiccant cooling systems, they are more efficient than one-stage systems. In addition, heat recovery in a two-stage cycle leads to a reduction in energy consumption. In this paper two new two-stage desiccant cooling cycles which work based on heat recovery are presented. The studied cycles according to their process air are classified into fresh air and returned air cycles. In order to assess the performance of presenting cycles and compare them with the conventional one-stage cycles, energy and exergy analysis are performed. In exergy analysis, some equations are redefined. Furthermore, the amount of fuel exergy, product exergy, summation of exergy destruction and exergy loss and exergy efficiency for each component and the overall system are calculated in all cycles which are studied in this paper. For the regeneration temperature equal to 80 ˚C, using the presented two-stage fresh air cycle, decrease temperature and enthalpy of the supplied air 13.06 % and 13.76 % respectively. Moreover increases the coefficient of performance and exergy efficiency 37.66 % and 1.12 % respectively compared to conventional one-stage fresh air cycle. In addition using the presented two-stage returned air cycle leads to 12.56 % and 12.77 % reduction in temperature and enthalpy of the supplied air and it increases coefficient of performance and exergy efficiency 6.87 % and 0.49 % respectively compared to the conventional one-stage returned air cycle.

Keywords:

exergy, desiccant wheel, evaporative cooling, two stage cycle, heat recovery

1- Introduction

Nowadays, because of improves in the standards of human life, the air conditioning is getting more important. A significant proportion of energy consumption in today's world is related to the building sector. Air conditioning systems are considered as a major consumer of energy in buildings, especially in hot and humid regions. Due to the crisis of energy and the environment, air conditioning industry today is faced with a big challenge. Conventional and