FINDING OPTIMUM OPERATING CONDITION OF THE REGENERATOR IN A SOLAR AIR-CONDITIONING SYSTEM

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Developing energy systems using solar energy has emerged into the center of many research activities for the sake of energy conservation and environmental protection. In the area of air-conditioning engineering, the use of solar energy has also received a particular attention from researchers and practitioners. This study investigates the design and operation of a solar air-conditioning system, which mainly consists of four components: a regenerator, a total heat exchanger, a storage tank, and a sensible heat exchanger. The system examined in this study uses liquid desiccant for the dehumidification purpose as shown in Fig.1. A regenerator is closely related to the dehumidification process, and its performance is one of the most important features for such a system.

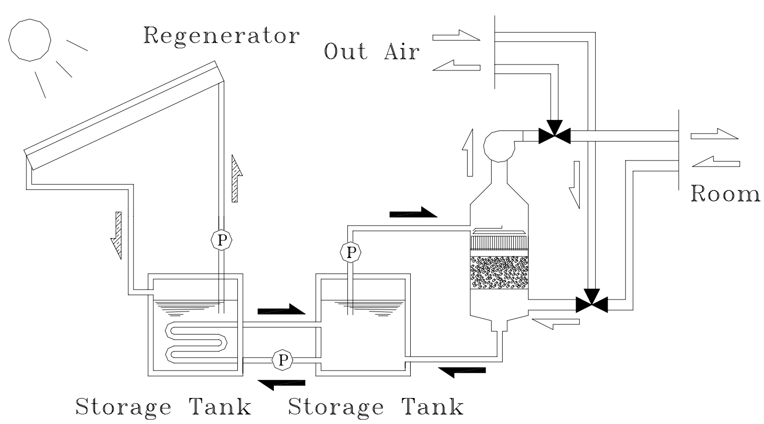

Fig. 1. All year-round Air conditioning System using solar collector Proposed

Absorption potential of desiccant solution significantly decreases after absorbing moisture from humid air, and it requires a significant amount of energy for the regenerator to recover absorption potential. In an effort to develop an energy-efficient regenerator, the regeneration process of the system under study uses hot air heated by solar radiation to recover absorption potential by evaporating moisture in desiccant solution. Based on the results from previous studies, it is known that the regeneration performance is affected by the following factors: temperature, concentration, and circulation of desiccant solution, flow rate and temperature of incoming air, etc. The main objective of this study is to find the optimum operating condition of the regenerator so that the regeneration rate is to be maximized. It will then be essential to grasp the relationship between the regeneration rate and affecting factors. Unfortunately, however, the exact functional relationship is not known for the system. As an alternative, this study utilizes a well-established statistical tool, so-called response surface methodology (RSM), to approximate the functional relationship.

The performance of an engineering system is generally affected by many factors, and the design or operational optimization of the system should be based on the relationship between system performance and affecting factors. For the most of the cases, however, the exact functional relationship is not known or too complicated. Combining experimental designs with optimization techniques, RSM is devised to explore the optimum condition of the system by approximating the functional relationship. An optimization model can be established on the basis of experimental results, and the optimum solutions may accordingly be obtained by solving the optimization model. This study demonstrates that the functional relationship between regeneration rate and affecting factors can be approximated via RSM as shown in Fig.2.

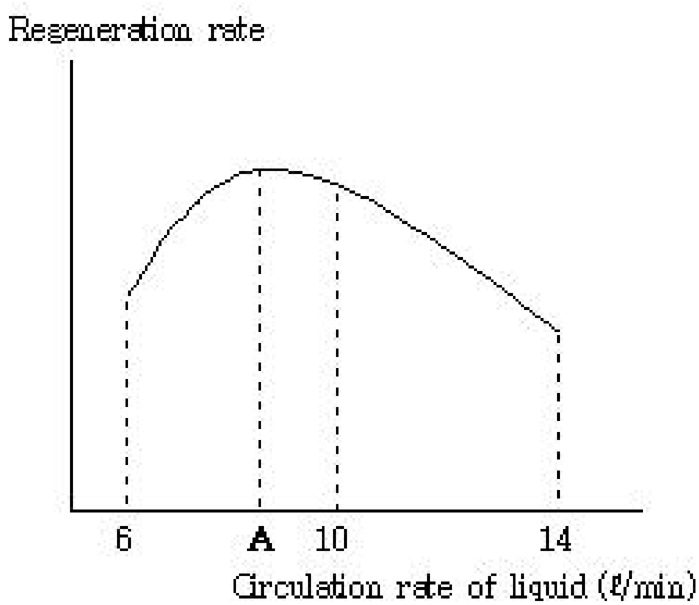

Fig. 2. Functional relationship between regeneration rate and circulation rate of liquid

Further, an optimization model is also constructed to find the optimum operating condition of the regenerator, where the regeneration rate is maximized. The analysis method and results from this study may provide practical guidelines when developing such a system.

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