Optimum Operational Conditions of a Rotary Regenerator Using Genetic Algorithm

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Abstract

The optimum operational conditions of an air-to-air rotary regenerator (also called air preheater or heat wheel) for air conditioning applications which was designed and manufactured in Energy Systems Improvement Laboratory (ESIL) has been investigated in this paper. The performance of such a rotary regenerator was modeled and the numerical values of modeling output were verified with the experimental data obtained from the equipment testing. In the next step, the optimum operational conditions of the rotary regenerator were obtained using genetic algorithm optimization technique subject to a list of constraints. The objective function in the optimization technique was the thermal effectiveness, while the design parameters (decision variables) were volumetric flow rates of cold and hot air streams, matrix rotational speed, and the exchanger frontal area (heat transfer surface area). The apparatus was tested under the optimized operating conditions and the results were compared with the results obtained numerically applying Genetic Algorithm optimization. The experimental value for the effectiveness showed an acceptable closeness (2.07%) with the corresponding value obtained from the system modeling and optimization. The economic analysis of energy savings by the designed and manufactured regenerator showed a pay back period about three years.

Key words: Rotary Regenerator, Thermal modeling, Genetic Algorithm, Optimization technique, Experimental output

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