

A Swiss-Roll Recuperator for the Microturbine Engine

蔡博章, 汪源磊

Mechanical Engineering

Engineering

bjtsai@chu.edu.tw

Abstract

The design and analysis of a Swiss-Roll recuperator are investigated using a theoretical approach, numerical simulation and an experimental approach. The novel Swiss-Roll recuperator is a primary surface-type heat exchanger for micro gas turbine engines. The preliminary design of the Swiss-Roll recuperator, which is based on theoretical analysis, provides the required channel width, number of turns and number of transfer units (NTUs) for a given effectiveness. Friction causing a pressure loss is also predicted. For a given recuperator design, model simulation was performed to provide insights and improve model performance. Comparison of numerical results and theoretical predictions for efficiency of heat recovery shows a 10% error; however, pressure drop predictions were consistent. Test results show that the engine with a recuperator has a thermal efficiency of 27%. Fuel consumption rate is 600 ml/min. Conversely, a microturbine without a recuperator has a thermal efficiency of 12%, and fuel consumption rate is 800 ml/min. This experimental result indicates the engine with a recuperator use at least 1.5 times less fuel than an engine without a recuperator. This experimental result is consistent with predictions from analytical and numerical solutions. An engine with a recuperator saves energy, is economical and produces low amounts of emissions.

Keyword : Recuperator

Thermal efficiency

Pressure loss

Heat exchanger