University of Technology, Sydney

Master Thesis

Performance analysis of a new single effect hot water absorption chiller system

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Certificate of Authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged.In addition, I certify that all information sources and literature used are indicated in the thesis.

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"Well the basic thesis is that there's a god in heaven who is all powerful who wants to help people. And that - he will answer prayer, and does miraculous things in people's lives. And so I've documented some of these wonderful things."

Saket Sinha

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Abstract

Conventional air conditioning significantly contributes to primary electricity consumption. The rise in living standards and working conditions combined with the increasing usage of renewable energy has led to a great expansion of modern air conditioning systems. Among existing chiller systems, absorption machines are promising as they use less electrical power and electric utilities. Another advantage of absorption units is that the working fluids are not harmful to the environment. Thus, there is a high demand for small capacity absorption machines for residential and small office applications. However, high investment cost, additional equipment requirement and few manufacturers are the main reasons for these machines not being economically competitive with conventional compression machines. There is a lack of best practice guides, test procedures and adequate standards for their evaluation. Therefore, it is important to conduct research, starting from design and validation work, into modelling and energy optimisation in energy-efficient air conditioning systems.

This thesis aims to develop simple and accurate steady-state models of small capacity absorption machines based on experimental data obtained from a solar, single-effect, hot-water absorption machine, installed at UTS. These models are further used in a simulation tool for energy optimisation of this absorption machine. The thesis encompasses components of testing, modelling and energy optimisation of small capacity absorption machines. The first task is obtaining highly reliable data from our installation. This part involves several steps: test planning, data modelling, uncertainty estimation and analysis of results.

The second research task focuses on the development of small capacity absorption chiller models from the obtained dataset. The study involves two different modelling methods, namely adapted characteristic equation and multivariable polynomial regression. It is possible to use external water circuits as input parameters to develop highly accurate empirical models. The study describes statistical tests that assist in selecting the most appropriate models.

The last research task focuses on energy optimisation of the chiller plant. Here, water-cooled chilled water plants are considered. The chiller plant optimisation problem is formulated by developing multi-variable regression models using equipment performance data. The water-cooled chiller plant optimisation involves the optimal combination of equipment and operating levels for minimum electrical power consumption.

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Dedicated to my Parents