Int j simul model 9 (2010) 2, 86-97
ISSN 1726-4529 Original scientific paper

MATHEMATICAL MODEL OF A VAPOUR ABSORPTION REFRIGERATION UNIT

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Abstract
By means of carefully devised assumptions, a simple linear model is presented for an absorption refrigeration unit employing either water-lithium bromide or ammonia-water refrigerant-absorbent pairs. Absorption systems are an alternative to vapour compression systems by being thermally activated. Such heat energy may come from the sun or even from hot exhaust gases from a particular engineering process. A thorough investigation of the optimal operating temperatures is necessary to ensure effective operation of the system. By means of this simulation, the system response to varying absorber, generator and condenser temperatures was analyzed.
(Received in October 2009, accepted in March 2010. This paper was with the authors 1 month for 1 revision.)

Key Words: Refrigeration, Absorption Systems, Water-Lithium Bromide, Ammonia-Water

1. INTRODUCTION

Vapour compression refrigeration units require a high grade energy input in the form of work by means of an electrically driven compressor. This leads to higher power demands from power stations which in turn lead to more CO_2 emissions.

Absorption systems use a low grade form of energy in order to provide a cooling effect. This means that the source of input energy need not necessarily come from electric power but rather from any other heat source which is at a sufficiently high temperature. Apart from being advantageous from this perspective of energy use, such systems also provide other advantages over vapour compression refrigeration units employing compressors. For example, their silent operation is unmatched when compared to the latter systems.

As absorption units become more popular not only in industry but also on a domestic level, their simulation becomes more important. This enables better understanding of the complex thermodynamic behaviour which such systems exhibit. Various mathematical models have been created in the past [1-2]. Much of the focus of these studies was put on systems using water-lithium Bromide ($LiBr$-H_2O) refrigerant-absorbent pair. Analysis of these systems has also been extended to multi effect units.

Nowadays, the investigation of ammonia-water (H_2O-NH_3) systems is becoming more important especially with the introduction of efficient Generator-Absorber Heat Exchange (GAX) absorption units. Although the latter systems are in principle the same, they require additional devices which in themselves require thermodynamic modelling.

In this work, a simulation of single-effect absorption was performed. The working fluids which can be modelled are $LiBr$-H_2O and H_2O-NH_3. The developed mathematical model, being linear, can be easily extended to model double or multi-effect systems. This however will be done in future work. By means of certain user inputs, the model calculates output parameters which are of fundamental importance for the analysis of these systems. Relationships between input and output parameters may be plotted automatically for better visualization of the system behaviour. A secondary aim of the simulation was to be able to aid

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