

Fast, stable computation of thermodynamic properties of ammonia-water mixtures



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ABSTRACT

Software implementations of thermodynamic property routines for ammonia-water mixtures are developed for refrigeration and air-conditioning applications. Saturation correlations are employed to identify single-phase state points, yielding up to a 5-fold reduction in property evaluation time. A run-time database of previously evaluated state points is implemented to improve initial guesses for iterative property evaluation, reducing property evaluation time by 45% in a representative study. The property routines are implemented in a standalone program and as a compiled routine for use in MATLAB[®] and Simulink[®]. Both implementations perform property evaluations significantly faster than existing software packages. Program performance is measured on a 2.2 GHz machine, and average individual state point evaluation times were found to range from 50 to 930 µs, depending on the provided input properties. Additionally, a segmented, transient, ammonia-water absorber model is developed in Simulink[®] to assess the use of the property routines for practical engineering calculations. The proposed computational techniques can be applied to accelerate property evaluations for other mixtures. © 2016 Elsevier Ltd and International Institute of Refrigeration. All rights reserved.

Etude numérique rapide, stable des propriétés thermodynamiques de mélanges ammoniac-eau

Mots clés : Absorption ; Ammoniac-eau ; Propriétés thermodynamiques ; Mélanges zéotropiques

1. Introduction

1.1. Background

The ammonia-water fluid pair is employed in a broad range of energy systems including absorption refrigeration, heat pumping, and even power generation through the Kalina cycle (Heppenstall, 1998). As these ammonia-water technologies are refined, and specialized two-phase heat and mass exchangers are developed, the demands on thermophysical property formulations, and the software implementations thereof, are greatly increased. The major objectives in the development and implementation of property formulations are outlined below.

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