

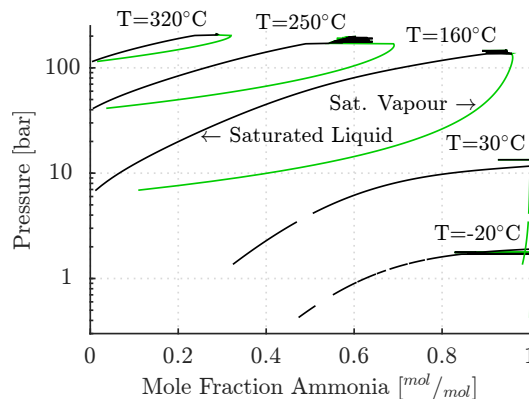
# Fundamental EoS Implementation for {Water+Ammonia} in Modelica

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The implementation of a library for the calculation of thermodynamic properties for the mixture {water + ammonia} based on a fundamental equation of state (EoS) for the Helmholtz free energy is developed and presented. The model uses the formulation of Tillner-Roth and Friend (1998) in order to provide the best available single state thermodynamic data. The calculation of the vapour-liquid equilibrium (VLE) with the aid of the fundamental equation of state is examined. However due to difficulties found under certain pressure and temperature conditions (see Figure 1), another method for calculating the VLE had to be used. The problems found included unreliable results and difficulties setting the initial values. Saturation temperature polynomials by Johnson et al. (2001) have been found to be faster and more reliable and have been implemented instead. It's possible to calculate thermophysical properties in single and two-phase region at pressures from the melting point up to 40 MPa.

In this paper the problems found to solve a VLE set of equations using an EoS of Helmholtz energy for two phase mixtures with Modelica are identified and discussed. An alternative and simpler solution for the VLE is presented and implemented in a fully working media library for the for the mixture {water + ammonia}.



**Figure 1.** VLE Solution for different temperatures

## References

- David Urnes Johnson, William E. Lear, and S. A. Sherif. *Curve Fitting of Ammonia-Water Mixture Properties: An Improvement of Patek and Klomfar's Ammonia-Water Correlations*. PhD thesis, University of Florida, 2001.
- Reiner Tillner-Roth and Daniel G. Friend. A helmholtz free energy formulation of the thermodynamic properties of the mixture {water + ammonia}. *Journal of Physical and Chemical Reference Data*, 27(1):63–96, 1998. ISSN 0047-2689.