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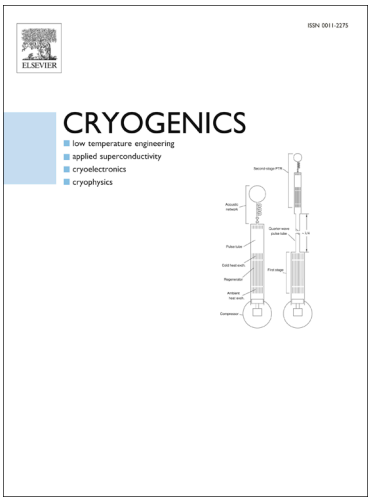

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Prediction of Vapour-Liquid and Vapour-Liquid-Liquid equilibria of nitrogen-hydrocarbon mixtures used in J-T refrigerators

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Abstract

Nitrogen-hydrocarbon mixtures are widely used as refrigerants in J-T refrigerators operating with mixtures, as well as in natural gas liquefiers. The Peng-Robinson equation of state has traditionally been used to simulate the above cryogenic process. Multi parameter Helmholtz energy equations are now preferred for determining the properties of natural gas. They have, however, been used only to predict vapour-liquid equilibria, and not vapour-liquid-liquid equilibria that can occur in mixtures used in cryogenic mixed refrigerant processes. In this paper the vapour-liquid equilibrium of binary mixtures of nitrogen-methane, nitrogen-ethane, nitrogen-propane, nitrogen-isobutane and three component mixtures of nitrogen-methane-ethane and nitrogen-methane-propane have been studied with the Peng-Robinson and the Helmholtz energy equations of state of NIST REFPROP and compared with experimental data available in the literature.

Keywords: J-T Refrigerators, Mixtures, V-L and V-L-L equilibria

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