

Recursive Equation Method for the Determination of Density and Heat Capacity: Comparison Between Isentropic and Isothermal Integration Paths

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Among the different ways to obtain the thermodynamic properties of a fluid in the liquid phase, there is the possibility to numerically solve a system of two differential equations where the unknowns are the density and the specific heat capacity, expressed as functions of temperature and pressure. By means of general methods, like Predictor-Corrector or Runge-Kutta, this system can be solved integrating along isotherm paths, once the initial conditions are known along an isobar and the speed of sound values are measured over the p-T region of interest. In this work a new perturbative method, called Recursive Equation Method (REM), based on the analytic recursive determination of the coefficients describing density and specific heat capacity, is presented. The main advantage of REM resides in the possibility to get also the value of the uncertainty associated to the solutions, obtained by means of standard methods of error analysis. Another improvement introduced by this method is the possibility to solve the system of equations following arbitrary integration paths. In particular, a comparison between the results of density and heat capacity, obtained integrating along isentropic curves and those calculated along isothermal paths is presented, both for water and for acetone.