

# Speed of Sound, Density, and Related Thermodynamic Excess Properties of Binary Mixtures of 2-Pyrrolidone and N-Methyl-2-pyrrolidone with Acetonitrile and Chloroform

Varfolomeev M., Rakipov I., Solomonov B., Marczak W.  
*Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia*

---

## Abstract

© 2016 American Chemical Society. Densities and speeds of sound were measured for binary mixtures of 2-pyrrolidone or N-methyl-2-pyrrolidone with acetonitrile or chloroform at temperatures of (293.15 to 323.15) K and at atmospheric pressure, with uncertainties of 0.5 kg·m<sup>-3</sup> and 0.5 m·s<sup>-1</sup>, respectively. From the measured speeds and densities, isentropic compressibilities and molar excesses of volume, isentropic compression, and thermal expansion were calculated. All of the excesses are negative, which is due to the geometries of the molecules and changes in the hydrogen bonding upon mixing. In the simplest case of the N-methyl-2-pyrrolidone + acetonitrile system, the negative excesses result only from the different sizes of the molecules because the components are incapable of forming either self- or cross-associates. For the other systems, the net effects of the formation and/or dissociation of the hydrogen bonds lead to bigger negative excesses of molar volume and thermal expansion. The negative excesses of compression are probably caused mainly by filling of the gaps between the big lactam molecules with the smaller acetonitrile or chloroform molecules, while the formation of the hydrogen-bonded cross-associates plays a minor role.

<http://dx.doi.org/10.1021/acs.jced.5b00474>

---