

# Calorimetric investigation of hydrogen bonding of formamide and its methyl derivatives in organic solvents and water

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## Abstract

Formamide and its derivatives have a large number of practical applications; also they are structural fragments of many biomolecules. Hydrogen bonds strongly affect their physicochemical properties. In the present work a calorimetric study of formamide and its methyl derivatives was carried out. Enthalpies of solution at infinite dilution of formamide, N-methylformamide, and N, N-dimethylformamide in organic solvents at 298.15 K were measured. The relationships between the obtained enthalpies of solvation and the structure of the studied compounds were observed. Hydrogen-bond enthalpies of amides with chlorinated alkanes, ethers, ketones, esters, nitriles, amines, alcohols, and water were determined. The strength of hydrogen bonds of formamide, N-methylformamide, and N, N-dimethylformamide with proton donor solvents is practically equal. Enthalpies of hydrogen bonds of formamide with the proton acceptor solvents are two times larger in magnitude than the enthalpies of N-methylformamide. The process of hydrogen bonding of amides in aliphatic alcohols and water is complicated. The obtained enthalpies of hydrogen bonding in aliphatic alcohols vary considerably from the amide structure due to the competition between solute-solvent and solvent-solvent hydrogen bonds. Fourier transform infrared spectroscopic measurements were carried out to explain the calorimetric data. Hydration enthalpies of methyl derivatives of formamides contain a contribution of the hydrophobic effect. New thermochemical data on the hydrogen bonding of formamides may be useful for predicting the properties of biomacromolecules. © 2012 Springer Science+Business Media New York.

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## Keywords

Amide, Enthalpy of solution, FTIR-spectroscopy, Hydrogen bond, Organic solvents, Water