An Investigation of the Ultrasound and Hypersound Propagation Velocity and the Absorption Coefficient in Several van der Waals and Associated Liquids

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By studying the fine structure of the Rayleigh scattering line in liquids, one can obtain valuable information about the hypersound wave propagation velocity and the absorption coefficient in liquids. The comparison of the hypersound velocity with that of the ultrasound allows us to evaluate the sound velocity dispersion value and to make grounded conclusions concerning liquid acoustic properties. With this purpose, we studied the Rayleigh's line fine structure in several van der Waals' liquids: isomers of bromotoluene, fluorine-toluene, fluorine-chlorine-benzene, and para-difluorene-benzene, and in liquids associated by hydrogen bonds: toluidine, cresol, chlorine-aniline, bromphenol, and anisidine in wide range of temperatures. For the van der Waals' liquids, a weak positive dispersion of sound velocities was observed. In the case of the associated liquids, such dispersion was noticeable. Reasons for the sound velocity dispersion may be the viscosity, head conduction, and relaxational processes connected with sound energy absorption. The hypersound velocity in aromatic amines, isomers of toluydine, chlorine-aniline, and anisidine is much larger than for other associated by hydrogen bond disubstituted benzenes. Despite the studied compounds having similar structures, their viscosities strongly differ.

With the temperature increase, the hypersound velocity decreases according to a linear law for only the van der Walls' liquids. For the associated liquids, such dependence is nonlinear. The analysis of the results obtained by us shows that for van der Waals' liquids the process of vibrational acoustic relaxation predominates, whereas the results of our studies and literature data show that for associated liquids the process of structural acoustic relaxation is typical.

The wide application of ultrasound waves in medical diagnostics is well-known. It has been established that the ultrasound propagation velocity in different cells and living organism parts is different. Such results, in the case of hypersound waves, are obviously not enough. The solution to this question defines problems for further investigations.