HYPERACOUSTIC PARAMETERS OF A SERIES OF ALCOHOLS AT DIFFERENT STATE PARAMETERS

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ABSTRACT

A great contribution to the study of the liquid state can be made by elucidating the nature of the structural changes in liquid molecules at various parameters of the state. Optical methods will enable us to obtain more complete information about the nature of structural changes in a liquid molecule. The aim of this work is to study the manifestation of changes in the structure and intermolecular interaction in the spectra of Mandelstam-Brillouin scattering of light and in hyperacoustic parameters at various parameters of state in a number of alcohols. The experimental results showed that with increasing temperature, the speed of hypersound in normal alcohols decreases nonlinearly, and at high temperatures the ends of the curves depending on T at 450 K approaches each other. If you build a graph of the dependence on pressure (P), you will notice that at high pressures, these curves for alcohols also approach each other. We associate this tendency in the case of an increase in temperature with destruction, and with an increase in pressure, apparently with an increase in the probability of the formation of H - bonds.

KEYWORDS: *Hypersound, Scattering, Liquid, Alcohols, Temperature, Pressure, Spectrum, Intermolecular Interaction,*

INTRODUCTION

The development of the molecular theory of the liquid state of matter contributes to the solution of applied problems in many branches of science and technology. However, the molecular theory of the liquid state of matter lags far behind in its development from a similar theory of gases and solids.

A great contribution to the study of the liquid state can be made by elucidating the nature of structural changes in liquid molecules at various parameters of the state.

Optical methods will enable us to obtain more complete information about the nature of structural changes in molecules. One of these methods is based on the study of the spectra of Mandelstam-Brillouin light scattering.

The aim of this work is to study the manifestation of changes in the structure and intermolecular interaction in the spectra of Mandelstam-Brillouin scattering of light and on hyperacoustic parameters for various parameters of state.

Normal alcohols have been the subject of acoustic research many times. However, the study has mainly focused on ultrasonic parameters. Hyperacoustic parameters with variation of state parameters have not been adequately studied. In work / 1 / the acoustic properties of a number of alcohols were investigated in the temperature range of 180-293 K. redistribution of intermolecular hydrogen bonds.

To solve this problem, a spectral apparatus was used, assembled on the basis of a Fabry-Pierrot interferometer with a dispersion region of 0.625 cm ^{2}.

The hypersound speed is determined from the shift of the Mandelstam-Brillouin scattering spectrum with the formula:

$$\vartheta_{гз} = \frac{\Delta\nu \cdot c \cdot \lambda}{2 \cdot n \cdot sin\frac{\theta}{2}} \qquad (1)$$

Where, is the displacement of the Mandelstam-Brillouin components (cm $^{-1}$), s is the speed of light, is the wavelength of the laser radiation, is the index of liquid retraction, is the scattering

angle

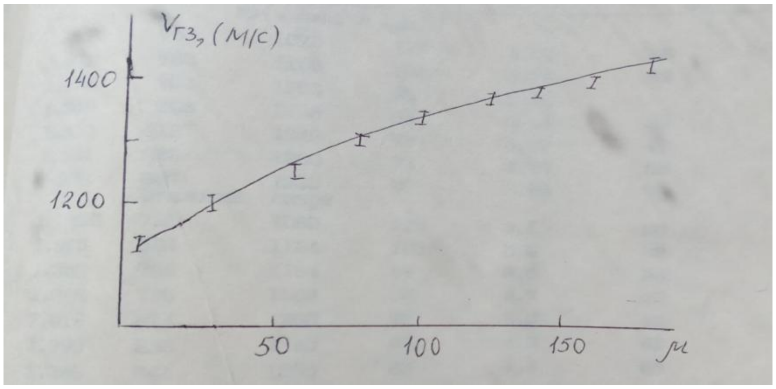
In order to study the relationship between sequential changes in structure and hyperacoustic parameters, as well as the effect of complexation through hydrogen bonding, ten normal alcohols were studied at various temperatures and pressures.

An increase in the molecular weight of alcohol in a homologous series corresponds to an increase in the speed of hypersound, and this dependence is nonlinear. Using the methods of mathematical statistics, an empirical equation was found that expresses the dependence of the speed of hypersound on the molecular weight of alcohols.

$$\vartheta_{гз} = \sum_{i=1}^{n} \vartheta_i \prod_{i \neq j} \frac{\mu - \mu_i}{\mu_1 - \mu_j} \qquad (2)$$

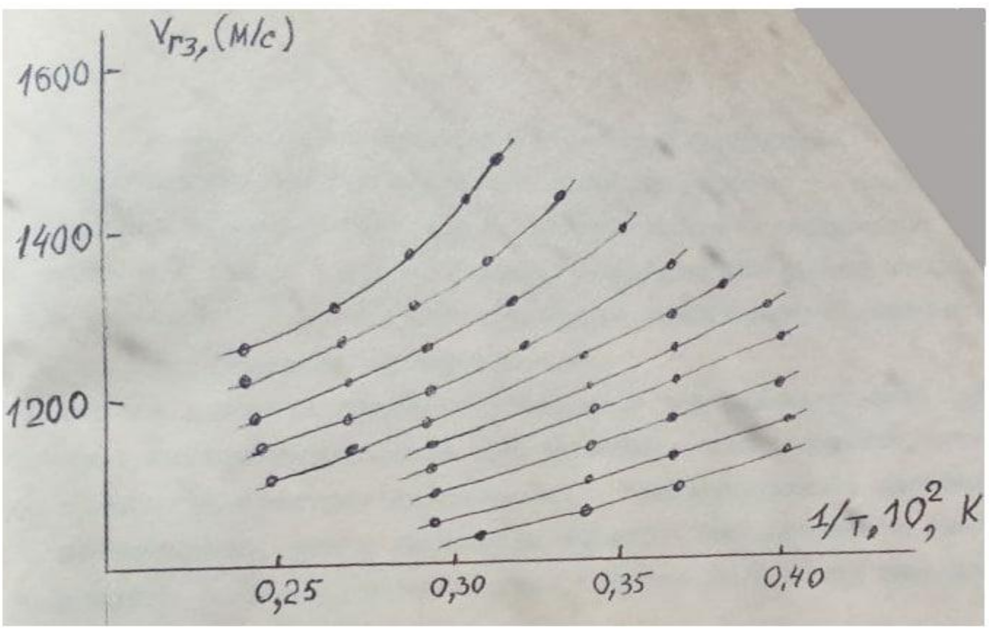
Where and - molecular weight alcohols with known hypersonic velocities, - hypersonic velocity otnosyashi molecular massi and , - at hypersonic velocity vychislyamayaMadelshtamma Brillouin spectra, sootvetstvuyushaya molecular weight .

The results of measurements of the speed of propagation of hypersound at various molar masses ( ) are shown in Fig. 1.



Rice. 1 Dependences of the speed of hypersound on the molecular weight for alcohols

With increasing temperature, the speed of hypersound decreases (Fig. 2). Such a decrease in all alcohols is qualitatively the same, and the tendency is such that the higher the temperature, the closer the hypersound velocity in these alcohols. The variance for the first members of the homologous series is small, however, for the higher members there is a tendency to increase.



Rice. 2. Dependences of the speed of propagation of hypersound on temperature for a number of alcohols $C_nH_{2n+1}OH$.

As we know, aliphatic alcohols are typical representatives of associated liquids with intermolecular hydrogen bonds. An increase in pressure leads to an increase in the number of H-bonds. This is consistent with Le Chatelier's principle / 2 /, according to which H bonds reduce the volume occupied by molecules, therefore, their formation is facilitated by those processes that lead to a decrease in the volume per molecule / 3 /.

An increase in temperature, on the contrary, leads to the destruction of associates. The experimental results showed that with increasing temperature the speed of hypersound in normal alcohols decreases nonlinearly, and at high temperatures the ends of the curves of the dependence on T at 450 K approach each other. If you build a graph of the dependence on pressure (P), you will notice that at high pressures, these curves for alcohols also approach each other. It can be concluded that at high temperatures and pressures, the quantitative difference in the speed of hypersound in normal alcohols tends to decrease. We associate such a tendency in the case of an increase in temperature with destruction, and with an increase in pressure, apparently, with an increase in the probability of the formation of H - bonds.

LITERATURE

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