A Study of the Enthalpy, Entropy, and Free Energy Changes of Relaxation Processes in Some Organic Liquids of the Aromatic Row

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According to the absolute rates of chemical reactions, the orientational relaxation process can be considered to proceed with a certain rate, at which the molecules of the liquid rotate in passing from one to another equilibrium position. One such equilibrium position corresponds to orientation of molecules towards the field, and the other to the reverse direction. Therefore, by experimentally measuring the molecular orientational relaxation times, one can determine the thermodynamic parameters of the relaxation process – the changes of molar activation enthalpy DH, entropy DS, and free energy DF. Therefore we studied the rotational mobility of molecules (characterized by an orientational relaxation time) of several di-substituted derivatives of benzene – isomers of fluorinetoluene, fluorienechlorine benzene, cresol, toluiodine, anisidine and bromphenol, as well their thermodynamic parameters, DH, DS and DF.

The orientational relaxation times have been determined from the anisotropical light scattering line width for liquids. As the excited light source, we used the radiation of a He-Ne laser with wavelength 632.8 nm. As the recording device, we used a scanning Fabry-Perot interferometer and a diffractional spectrophotometer, DFS-12.

Our results show that for all the compounds studied, DF > DH, and DS has a negative value (DS<0). For associated liquids (isomers of cresol, toluiodine and anisidine), DS wasnoticeably less than for the non-associated liquid. The negative value of DS indicates that the activated state is more ordered than the normal state. It is known that the main part of living organisms consists of liquid, and our results may be useful in the perspective of medico-biological diagnostics, since, according to M.V. Volkenshtein, for growing organisms the ordering is increased, but the entropy is decreased (DS < 0).