The results of our studies have shown that the complexation process in the Cu^{2+}-PEG and Cu^{2+}-PVP systems is characterized by negative Gibbs' energies, which indicates a spontaneous occurrence of the PMC formation process in these systems (Table 2).

The process of binding ions by the functional groups of the polymer leads to a limitation of ion mobility, is entropically unfavorable, and contributes to a decrease in entropy. However, in the systems under study, the entropy values are positive. This phenomenon can be explained by a number of reasons: first, this is due to the dehydration of ions and functional groups acting as ligands. In this case, the released water molecules acquire translational mobility, resulting in an increase in entropy [24]; secondly, it is a chelating effect during complexation, when one ion binds to several functional groups.

For low molecular weight systems, it has been shown that the formation of chelate complexes is accompanied by an increase in entropy. As an explanation of this effect, it is indicated in the literature that the occupation of several coordination centers of the complexing ion by the functional groups, belonging to one ligand molecule is entropy advantageous, since dehydration releases more water molecules than when the ligand molecules are bound [1].

The reaction of complexation of the copper ions with PVP is accompanied by an exo effect, as evidenced by the negative value of the enthalpy. As the temperature rises, the stability of this complex decreases.

In contrast to the system, based on Cu^{2+}-PVP, the complexation of the copper ions with PEG is accompanied by large positive enthalpy values, which indicate that the interaction of Cu^{2+} with the functional groups of the polymer is energetically unfavorable. The positive value of the enthalpy for this system indicates cooperative structural changes in the solution, accompanied by a gain in entropy.

Table 2 – Thermodynamic characteristics of the complexation process of the Cu^{2+} ions with PEG and PVP.

Complex	T, K	lgβ[0 a]	-$\Delta_r G^{0}$ [b], kJ/mol	±$\Delta_r H^{0}$ [c] kJ/mol	±$\Delta_r S^{0}$ [d] J/mol·K
PEG-Cu^{2+}	298	5.98±0.06	34.11±0.42	117.3±0.11	501.05±0.15
	318	6.10±0.07	35.98±0.41		
	343	7.25±0.09	44.13±0.45		
PVP–Cu^{2+}	298	14.50±0.19	82.72±0.09	175.7±0.30	218.62±0.94
	308	14.40±0.18	84.91±0.11	487.5±0.80	1307.13±0.57
	318	11.50±0.25	71.83±0.08	244.9±0.90	544.26±0.30

Note. [a]$β^0$ is the thermodynamic stability constant of the complexes. [b]$\Delta_r G^0$ is the change in the Gibbs' energy of the reaction. [c] $\Delta_r H^0$ is change in the enthalpy of reaction (thermal effect). [d] $\Delta_r S^0$ is the change in the entropy of the reaction.

IR spectroscopy is one of the simplest methods for determining the functional groups of a polymer ligand, which are involved in the formation of a coordination bond with a complexing metal. The IR spectra of PEG and Cu^{2+}-