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SOME PHYSICOCHEMICAL OPTIONS OF CHELATE COMPLEX OF BIURET WITH CADMIUM

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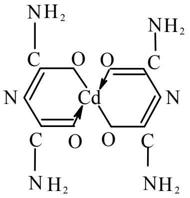
The electrical conductivity of chelate complex of biuret with cadmium was investigated. The degree and dissociation constant of aqueous solution of chelate complex were defined by using the numerical values of equivalent electrical conductance. In accordance with the temperature dependence of lg K from $1/T$ the heat effect and entropy factor of dissociation of chelate complex were defined.

Keywords: chelate complex, biuret, electrical conductance, dissociation constant.

Introduction. The derivatives of biuret, which are obtained by the condensation of urea with itself as well as with the derivatives of amines, are interesting both theoretically and practically [1–3]. Chelate complexes of applied destination, on the base of biuret and ions of metals have been synthesized by us [2]. In order to describe the properties and characteristics of that complexes it is necessary to investigate them with applying traditional and modern physicochemical techniques.

Taking into account the above given information, our aim was to study the electrical conductivity of the aqueous solution of chelate complex of Cd^{2+} with biuret at the different temperatures and some of its important physicochemical options. According to the work [2], the structure of chelate complex of biuret with Cd^{2+} can be presented in the following form:



Scheme.

Results of specific electrical conductivity of the above complex at different temperatures are given in Tab. 1.

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Table 1

The dependence of specific conductance of the aqueous solution of chelate complex from concentration (in temperature rate 293.15–325.15 K)

№	C, M	æ, $Om^{-1} \cdot cm^{-1}$					
		293.15	303.15	308.15	315.15	318.15	325.15
1	$1.0 \cdot 10^{-2}$	$1.4 \cdot 10^{-5}$	$4.0 \cdot 10^{-5}$	$7.80 \cdot 10^{-5}$	$1.30 \cdot 10^{-4}$	$2.80 \cdot 10^{-4}$	$3{,}90 \cdot 10^{-4}$
2	$2.5 \cdot 10^{-3}$	$4.6 \cdot 10^{-6}$	$1.3 \cdot 10^{-5}$	$2.50 \cdot 10^{-5}$	$0.42 \cdot 10^{-4}$	$0.68 \cdot 10^{-4}$	$1.24 \cdot 10^{-4}$
3	$1.0 \cdot 10^{-3}$	$2.8 \cdot 10^{-6}$	$0.3 \cdot 10^{-5}$	$1.45 \cdot 10^{-5}$	$0.24 \cdot 10^{-4}$	$0.40 \cdot 10^{-4}$	$0.70 \cdot 10^{-4}$
4	$5.0 \cdot 10^{-4}$	$2.0 \cdot 10^{-6}$	$5.5 \cdot 10^{-6}$	$1.00 \cdot 10^{-5}$	$1.70 \cdot 10^{-5}$	$2.80 \cdot 10^{-5}$	$5.20 \cdot 10^{-5}$
5	$2.5 \cdot 10^{-4}$	$1.4 \cdot 10^{-6}$	$3.7 \cdot 10^{-6}$	$7.10 \cdot 10^{-6}$	$1.10 \cdot 10^{-5}$	$1.90 \cdot 10^{-5}$	$3.50 \cdot 10^{-5}$
6	$1.0 \cdot 10^{-4}$	$0.9 \cdot 10^{-6}$	$2.1 \cdot 10^{-6}$	$4.20 \cdot 10^{-6}$	$7.00 \cdot 10^{-6}$	$1.10 \cdot 10^{-5}$	$2.00 \cdot 10^{-5}$
7	$5.0 \cdot 10^{-5}$	$0.6 \cdot 10^{-6}$	$1.4 \cdot 10^{-6}$	$2.60 \cdot 10^{-6}$	$4.40 \cdot 10^{-6}$	$7.00 \cdot 10^{-6}$	$1.30 \cdot 10^{-5}$
8	$2.5 \cdot 10^{-5}$	$0.4 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$	$1.90 \cdot 10^{-6}$	$3.00 \cdot 10^{-6}$	$5.00 \cdot 10^{-6}$	$7.50 \cdot 10^{-6}$

On the base of findings in Tab. 1, the equivalent electrical conductivities (λ_v), degrees (α) and constants of dissociation (K) of chelate complex are defined at different temperatures. The results are given in Tab 2.

As it is shown in Tab.1, there is a strict dependence between above listed physicochemical values and temperature, which has given us an opportunity to define both heat effect and entropy factor of dissociation of chelate complex. According to [4], the relation between α and λ_v is expressed by the equation $\alpha = \lambda_v / \lambda_\infty$, here λ_∞ is the equivalent electrical conductance at infinite dilution of electrolyte. Using the numerical value of α for the given concentration of electrolyte, the value of K is defined:

$$K = \left(\lambda_v / \lambda_\infty\right)^2 C,$$

where C is the concentration of electrolyte. The relation between K and energy of Gibbs (ΔG) is defined in accordance with [4].

$$K = e^{-\Delta G / RT},$$

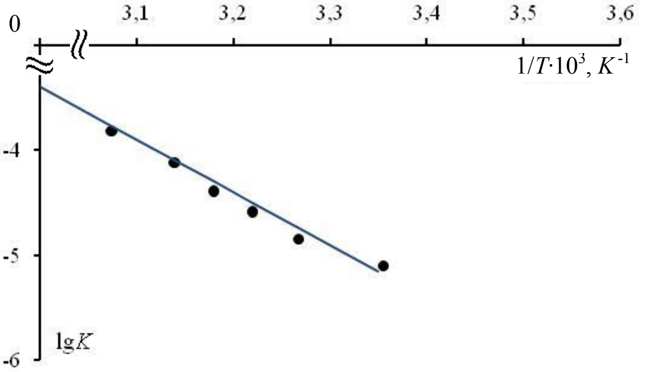
as $\Delta G = \Delta H - T\Delta S$, $K = e^{-(\Delta H - T\Delta S)/RT}$, where ΔH, ΔS are heat effect and entropy factor respectively.

Table 2

Dependence of equivalent electrical conductance (λ_v), degree α and constant of dissociation (K) from temperature and concentration of chelate complex

C, M $\times 10^{-5}$	Numerical values of options λ_v, α and K																	
	293.15			303.15			308.15			313.15			318.15			323.15		
	λ_v	α, $\times 10^{-2}$	K, $\times 10^{-6}$	λ_v	α, $\times 10^{-2}$	K, $\times 10^{-6}$	λ_v	α, $\times 10^{-2}$	K, $\times 10^{-6}$	λ_v	α, $\times 10^{-2}$	K, $\times 10^{-6}$	λ_v	α, $\times 10^{-2}$	K, $\times 10^{-6}$	λ_v	α, $\times 10^{-2}$	K, $\times 10^{-6}$
1000	1.44	1.8	3.2	4.0	3.7	13.7	7.8	5.2	27.0	13.0	6.7	45	21.7	8.7	75	39.4	12.0	140
250	1.84	2.3	1.3	5.2	4.8	6.0	10.0	6.7	11.1	16.9	8.7	19	27.5	11.0	19	49.8	15.0	50
100	2.80	3.5	1.2	7.7	7.0	5.0	14.5	9.8	9.0	24.1	12.0	15	40.0	16.0	26	70.7	21.1	44
50	4.00	5.0	1.3	11.0	10.0	5.0	21.1	14.0	10.0	35.1	18.0	16	57.5	23.0	26	104.4	31.0	48
25	5.80	7.2	1.3	15.0	14.0	5.9	28.5	19.0	9.0	46.8	24.0	14	77.5	31.0	24	141.5	42.0	44
10	9.00	11.0	1.2	21.0	20.0	4.0	42.0	28.0	8.0	70.2	36.0	13	115.0	46.0	21	209.0	62.0	38
5	11.20	14.0	1.0	28.4	26.0	3.3	52.0	35.0	6.0	87.7	45.0	10	145.0	58.0	16	262.8	78.0	20
2.5	16.00	14.0	1.0	44.0	40.0	4.0	76.5	51.0	6.0	122.8	63.0	10	202.5	81.0	16	309.0	90.0	20

Using Tab. 2 data and building up the dependence of $\lg K$ from $1/T$, the heat effect and entropy factor of dissociation of the chelate complex with Cd^{2+} can be defined (see Figure).



The dependence of $\lg K$ from $1/T$ (C=0.01M).

As it is shown above $\Delta H = 10.0 \pm 0.3$ *kkal/mol*, $\Delta S = 4.0 \pm 0.2$ *kkal/K·mol.*

Conclusion. The chelate complex of biuret was synthesized and identified in accordance with [2]. The electric conductivity of aqueous solution of biuret chelate complex with cadmium was defined according to the method described in [4].

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