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POTENTIOMETRIC AND THERMODYNAMIC STUDY OF Co(II) COMPLEXES OF THIOGLYCOLIC ACID IN 40% ETHANOL MEDIUM

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ABSTRACT

Cobalt complexes of Thioglycolic acid have been investigated by potentiometric technique in 40% V/V ethanol. It was found that cobalt forms colourless 1:2 complex. The stability constant of the complexes formed have been determined by applying Calvin and Melchior's extension of Bjerrum's method at three different temperature. The values of log K_1, log K_2 at 25º, C, 30ºC and 35º C have been found to be 7.81, 6.16, at 298 K, 7.83, 6.36 at 303 K, and 8.04, 6.65 at 308 K, in 40% ethanol medium respectively.

Keywords: *Cobalt complexes, Thioglycolic Acid, Potentiometric Technique, Bjerrum's Method, Ethanol.*

Introduction

The values of overall changes in ΔG, ΔH and ΔS, at three different temperature accompanying the reaction have also been evaluated at 303 K and the values of ΔG_1, ΔG_2, ΔH, ΔS_1, ΔS_2, are found to be -42.82 KJ mol-1 -26.830 KJ mol^{-1} and - 0.16129 J/K + 135.6259 J/K, + 78.6133 J/K in 40% ethanol medium.

There is no reference in the literature regarding the complexing tendency of thioglycolic acid with cobalt ion in 40% aqueous- ethanol medium. Hence the present investigation has been initiated. The composition and stability constant of the complexes have been studied by potentiometric method. The value of thermodynamic parameters ΔG, ΔH, and ΔS have also been calculated.

Methodology

Materials

Thioglycolie acid S.D. fine A.R. (B.D.H.) reagents $Co(NO_3)_2$ etc. were used and their solutions were prepared in doubly distilled air free water. Freshly prepared solutions of the reagents were always used to avoid the effect of ageing.

Equipment's

A Systronics - 335 digital pH meter was used for measurements. A saturated calomel electrode and a wide range glass electrode were used for pH measurements and calibrated by using several buffer solutions of pH 4.0, 7.0 and 9.2. Thus the reading gave immediately concentration and not activities of [H].

Procedure

Potentiometric Studies

The experimental procedure is similar to that described earlier. A series of potentiometric titration of thioglycolic acid with standard NaOH in the absence and presence of Co^{+2} at various ligands to metal ratios viz, 1:1, 2:1, 3:1 etc. were performed. Titrations were also carried out at different temperatures in 40% ethanol. For calculating the values of ΔG, ΔH, and ΔS accompanying the reaction, all the pH titration were performed in 40% V/V ethanol. in 0.1M KNO_3. The results of various titration have been recorded.

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The values of $\overline{n}$ and free ligand concentration [A], calculated from the titrations of ligand in the absence and presence of cobalt ion at ratios 5:1 with standard NaOH have also been tabulated together with the other results, obtained.

The experimental observation and the results obtained have been tabulated on the following pages.

DETERMINATION OF STOICHIOMETRY POTENTIOMETRIC TITRATION OF TGA IN PRESENCE OF Co^{2+} AT RATIOS (1) 1:0 (2) 1:1 (3) 2:1 (4) 3:1 IN 40% V/V ETHANOL MEDIUM WITH 0.1 M NaOH

- **M NaOH V/S 1×10^{-3} M TGA +0.1 M KNO_3 (1:0)**

Table 1

S. No.	Mole of NaOH per Mole of Ligand	pH
1	0.00	3.60
2	0.20	3.72
3	0.40	4.00
4	0.60	4.18
5	0.80	4.52
6	0.90	4.72
7	0.95	5.50
8	1.00	6.14
9	1.05	7.26
10	1.10	8.54
11	1.20	9.25
12	1.40	10.50
13	1.60	10.88
14	1.80	11.25
15	2.00	11.52
16	2.50	12.00
17	2.80	12.25
18	3.00	12.52

- **M NaOH V/S 1x10^{-3} M TGA +0.1 M KNO_3 + 1x10^{-3}M (Co^{2+}) (1:1)**

Table 2

S. No.	Mole of NaOH per Mole of Ligand	pH
1	0.00	3.15
2	0.20	3.40
3	0.40	3.60
4	0.60	3.95
5	0.80	4.10
6	1.00	4.30
7	1.20	4.52
8	1.40	4.6/
9	1.60	5.00
10	1.80	5.15
11	2.00	5.45
12	2.20	5.80
13	2.40	6.00
14	2.60	6.25
15	2.80	6.50
16	2.90	7.00
17	2.95	7.25
18	3.00	7.60
19	3.10	7.90
20	3.20	8.00
21	3.40	8.50

- **0.1 M NaOH V/S 1x10^{-3} M TGA +0.1 M KNO_3 + 5x10^{-4} M (Co^{2+}) (2:1)**

Table 3

S. No.	Mole of NaOH per Mole of Ligand	pH
1	0.00	3.26
2	0.20	3.75
3	0.40	3.99
4	0.60	4.00
5	0.80	4.24
6	1.00	4.92
7	1.20	5.01
8	1.40	5.25
9	1.50	5.90
10	1.60	6.20
11	1.80	6.42
12	2.00	7.02
13	2.10	7.75
14	2.20	8.05
15	2.40	9.50
16	2.60	10.1
17	2.80	10.30
18	3.00	10.40

- **M NaOH V/S 1x10^{-3} M TGA +0.1 M KNO_3 + 3.33x10^{-4} M (Co^{2+}) (3:1)**

Table 4

S. No.	Mole of NaOH per Mole of Ligand	pH
1	0.00	3.52
2	0.20	3.85
3	0.40	4.01
4	0.60	4.45
5	0.80	4.90
6	1.00	5.02
7	1.20	5.30
8	1.40	5.74
9	1.50	6.10
10	1.60	6.99
11	1.65	7.75
12	1.70	8.89
13	1.80	9.30
14	2.00	10.10
15	2.20	10.30
16	2.40	10.62

DETERMINATION OF STABILITY CONSTANT POTENTIOMETRIC TITRATION OF TGA IN THE PRESENCE OF Co^{2+} AT RATIOS (1) 1:0 (2) 5:1 WITH 0.2 M NaOH IN 40% ETHANOL

Temperature – 25ºC

- **0.2 M NaOH V/S 01. M KNO_3 + 2x10^{-3} M TGA + 4x10^{-3} M $HClO_4$ (1:0)**
- **0.2 M NaOH V/S 01. M KNO_3 + 2x10^{-3} M TGA + 4x10^{-3} M $HClO_4$ + 4x10^{-4} M (Co^{2+}) (5:0)**

Table 5

S. No.	Mole of NaOH per Mole of Ligand	pH	
		Curve 1 (1:0)	Curve 2 (5:1)
1	0.00	3.15	3.15
2	0.20	3.26	3.26

3	0.40	3.54	3.54
4	1.00	3.60	3.60
5	1.40	4.00	4.00
6	1.80	4.15	4.15
7	2.00	4.82	4.82
8	2.40	4.62	4.62
9	2.60	5.01	4.70
10	2.60	5.01	4.70
11	2.80	5.22	4.85
12	2.90	5.65	5.10
13	3.00	7.32	5.21
14	3.10	8.08	5.30
15	3.20	8.35	5.45
16	3.30	8.56	5.90
17	3.40	8.70	8.18
18	3.60	9.00	8.76
19	3.80	9.20	9.06
20	4.00	9.92	9.28

Temperature – 30ºC

- **0.2 M NaOH V/S 01. M KNO_3 + 4x10^{-3} M $HClO_4$ + 2x10^{-3} M TGA (1:0)**
- **0.2 M NaOH V/S 01. M KNO_3 + 4x10^{-3} M $HClO_4$ + 2x10^{-3} M TGA + 4x10^{-4} M (Co^{2+}) (5:1)**

Table 6

S. No.	Mole of NaOH per mole of ligand	pH	
		Curve 1 (1:0)	Curve 2 (5:1)
1	0.30	3.16	3.16
2	0.20	3.30	3.28
3	0.40	3.40	3.40
4	0.60	3.42	3.42
5	0.80	3.50	3.50
6	1.00	3.86	3.84
7	1.20	3.90	3.90
8	1.40	4.01	4.03
9	1.60	4.06	4.05
10	1.80	4.12	4.10
11	2.00	4.18	4.16
12	2.20	4.25	4.20
13	2.40	4.30	4.28
14	2.60	4.80	4.30
15	2.80	4.99	4.78
16	2.90	5.55	5.02
17	3.00	7.60	5.35
18	3.10	7.99	5.40
19	3.20	8.22	5.75
20	3.30	8.50	6.80
21	3.40	8.76	7.20
22	3.60	9.02	8.15
23	3.80	9.16	8.90
24	4.00	9.24	9.15

Temperature – 35ºC

- **0.2 M NaOH V/S 01. M KNO_3 + $4x10^{-3}$ M $HClO_4$ + $2x10^{-3}$ M TGA (1:0)**
- **0.2 M NaOH V/S 01. M KNO_3 + $4x10^{-3}$ M $HClO_4$ + $2x10^{-3}$ M TGA + $4x10^{-4}$ M (Co^{2+}) (5:1)**

Table 7

S. No.	Mole of NaOH per Mole of Ligand	pH	
		Curve 1 (1:0)	Curve 2 (5:1)
1	0.00	3.10	3.10
2	0.20	3.22	3.22
3	0.40	3.30	3.30
4	0.60	3.42	3.42
5	0.80	3.48	3.48
6	1.00	3.50	3.50
7	1.20	3.62	3.62
8	1.40	3.72	3.72
9	1.60	3.80	3.75
10	1.80	4.00	3.82
11	2.00	4.10	4.75
12	2.20	4.20	4.25
13	2.40	4.38	4.38
14	2.60	4.72	4.50
15	2.80	5.10	4.65
16	2.90	5.26	5.01
17	3.00	5.86	5.12
18	3.10	6.20	5.25
19	3.20	7.00	5.45
20	3.30	7.80	5.60
21	3.40	8.86	6.00
22	3.50	9.00	7.65
23	3.60	9.25	8.26
24	3.80	9.80	9.00
25	4.00	10.10	9.75

DETERMINATION OF DISSOCIATION COSTANT pKa_1 OF TGA IN 40 ETHANOL FROM FIRST UFFER REGION

Temperature – 25ºC

Table 8

S. No.	Mole of NaOH per mole of ligand	Stoichiometric Concentration			$\frac{[HA]}{[A]}$	$\frac{\log[HA]}{[A]}$	$pKa_1 = pH + \log[HA]/[A]$
		pH	[HA]	[A]			
1	0.20	4.25	0.0016	0.0004	4.00	0.6021	4.8521
2	0.40	4.45	0.0012	0.0008	1.50	0.1761	4.6261
3	0.60	4.93	0.0008	0.0012	0.67	-0.1739	4.7561
4	0.80	5.58	0.0004	0.0016	0.25	-0.6021	4.9779

$pKa_1 = 4.8030$

$Ka_1 = 1.573x10^{-5}$

Temperature – 30ºC

Table 9

S. No.	Mole of NaOH per mole of ligand	Stoichiometric Concentration			$\frac{[HA]}{[A]}$	$\frac{\log[HA]}{[A]}$	$pKa_1 = pH + \log[HA]/[A]$
		pH	[HA]	[A]			
1	0.20	4.22	0.0016	0.0004	4.00	0.6021	4.8321
2	0.40	4.39	0.0012	0.0008	1.50	0.1761	4.5661
3	0.60	4.86	0.0008	0.0012	0.67	-0.1739	4.6861
4	0.80	5.50	0.0004	0.0016	0.25	-0.6021	4.8979

$pKa_1 = 4.7455$
$Ka_1 = 1.796x10^{-5}$

Temperature – 35ºC

Table 10

S. No.	Mole of NaOH per mole of ligand	Stoichiometric Concentration			$\frac{[HA]}{[A]}$	$\frac{\log[HA]}{[A]}$	$pKa_1 = pH + \log[HA]/[A]$
		pH	[HA]	[A]			
1	0.20	4.17	0.0016	0.0004	4.00	0.6021	4.7721
2	0.40	4.34	0.0012	0.0008	1.50	0.1761	4.5161
3	0.60	4.81	0.0008	0.0012	0.67	-0.1739	4.6361
4	0.80	5.44	0.0004	0.0016	0.25	-0.6021	4.8379

$pKa_1 = 4.69055$

$Ka_1 = 2.039 \times 10^{-5}$

DETERMINATION OF pKa_2 FROM SECOND UFFER REGION IN 40% ETHANOL

Temperature – 25ºC

Table 11

S. No.	Mole of NaOH per mole of ligand	Stoichiometric Concentration			$\frac{[HA]}{[A]}$	$\frac{\log[HA]}{[A]}$	$pKa_1 = pH + \log[HA]/[A]$
		pH	[HA]	[A]			
1	0.20	10.16	0.0016	0.0004	4.00	0.6021	10.7621
2	0.40	10.62	0.0012	0.0008	1.50	0.1761	10.7961
3	0.60	10.96	0.0008	0.0012	0.67	-0.1739	10.7861
4	0.80	11.36	0.0004	0.0016	0.25	-0.6021	10.7579

$pKa_2 = 10.77555$

$Ka_2 = 1.676 \times 10^{-10}$

Temperature – 30ºC

Table 12

S. No.	Mole of NaOH per mole of ligand	Stoichiometric Concentration			$\frac{[HA]}{[A]}$	$\frac{\log[HA]}{[A]}$	$pKa_1 = pH + \log[HA]/[A]$
		pH	[HA]	[A]			
1	0.20	10.14	0.0016	0.0004	4.00	0.6021	10.7421
2	0.40	10.52	0.0012	0.0008	1.50	0.1761	10.6961
3	0.60	10.89	0.0008	0.0012	0.67	-0.1739	10.7161
4	0.80	11.30	0.0004	0.0016	0.25	-0.6021	10.6979

$pKa_2 = 10.71305$

$Ka_2 = 1.936 \times 10^{-11}$

Temperature – 35ºC

Table 13

S. No.	Mole of NaOH per mole of ligand	Stoichiometric Concentration			$\frac{[HA]}{[A]}$	$\frac{\log[HA]}{[A]}$	$pKa_1 = pH + \log[HA]/[A]$
		pH	[HA]	[A]			
1	0.20	10.12	0.0016	0.0004	4.00	0.6021	10.7221
2	0.40	10.42	0.0012	0.0008	1.50	0.1761	10.5961
3	0.60	10.83	0.0008	0.0012	0.67	-0.1739	10.6561
4	0.80	11.24	0.0004	0.0016	0.25	-0.6021	10.6279

$pKa_2 = 10.65055$

$Ka_2 = 2.235 \times 10^{-11}$

Summary of Dissociation Costant of TGA in Aqueous Ethanol Different Temperature

Temperature – 25ºC

Table 14

S. No.	Temperature	Dissociation Constants of TGA	
		Ka_1	Ka_2
1	25º C	1.573×10^{-5}	1.676×10^{-11}
2	30º C	1.796×10^{-5}	1.936×10^{-11}
3	35º C	2.039×10^{-5}	2.235×10^{-11}

VALUE OF $\bar{n}$ AND –log[A] AT DIFFERENT pH VALUE CORRESPONDING TO (FIG-I-(B)-2) IN 40% ETHANOL

Temperature – 25ºC

Table 15

S. No.	pH	Concentration of Ligand Bound x 10^{-3}	$\bar{n}$	–log[A]
1	4.8	0.10	0.250	8.01
2	5.0	0.20	0.500	7.82
3	5.4	0.30	0.750	7.34
4	5.5	0.35	0.875	7.20
5	5.7	0.40	1.000	6.95
6	5.8	0.45	1.125	6.87
7	6.0	0.50	1.250	6.67
8	6.2	0.55	1.375	6.40
9	6.4	0.60	1.500	6.25
10	6.5	0.70	1.750	6.20
11	6.8	0.75	1.875	5.84
12	7.2	0.80	2.000	5.46
13	7.5	0.90	2.250	5.09
14	8.0	0.95	2.375	4.62

VALUE OF $\bar{n}$ AND –log[A] AT DIFFERENT pH VALUE CORRESPONDING TO (FIG-I-(B)-3) IN 40% ETHANOL

Temperature – 30ºC

Table 16

S. No.	pH	Concentration of Ligand Bound x 10^{-3}	$\bar{n}$	–log[A]
1	4.8	0.20	0.500	8.08
2	5.0	0.25	0.625	7.75
3	5.2	0.30	0.750	7.40
4	5.4	0.35	0.875	7.26
5	5.5	0.40	1.000	7.10
6	5.6	0.45	1.125	7.05
7	5.7	0.50	1.250	6.90
8	6.0	0.55	1.375	6.56
9	6.2	0.60	1.500	6.30
10	6.5	0.70	1.750	6.07
11	6.7	0.75	1.875	5.93
12	7.0	0.80	2.000	5.60
13	7.2	0.90	2.250	5.34

VALUE OF $\bar{n}$ AND –log[A] AT DIFFERENT pH VALUE CORRESPONDING TO (FIG-I-(b)-4) IN 40% ETHANOL

Temperature – 35ºC

Table 17

S. No.	pH	Concentration of Ligand Bound x 10^{-3}	$\bar{n}$	–log[A]
1	4.40	0.10	0.250	8.57
2	4.50	0.15	0.375	8.41
3	4.60	0.20	0.500	8.24
4	4.70	0.25	0.625	8.12
5	5.90	0.30	0.750	7.60
6	5.20	0.35	0.875	7.38
7	5.40	0.40	1.000	7.10
8	5.50	0.45	1.125	7.05
9	5.70	0.50	1.250	6.80
10	5.80	0.55	1.375	6.65
11	6.00	0.60	1.500	6.48
12	6.20	0.70	1.750	6.32
13	6.70	0.75	1.875	5.82
14	7.00	0.80	2.000	5.54

SUMMARY OF log K_1, log K_2, K_1, K_2 & $[A]_{\bar{n}-1/2}$ $[A]_{\bar{n}-3/2}$ IN 40% ETHANOL DFFERENT TEMPERATURE

Table 18

S. No.	Temp.	log K_1	log K_2	K_1	K_2	$[A]_{\bar{n}-1/2}$	$[A]_{\bar{n}-3/2}$
1	25ºC	7.82	6.20	$8.215x10^{7}$	$1.998x10^{6}$	$1.145x10^{-8}$	$0.462x10^{-6}$
2	30ºC	8.08	6.30	$1.214x10^{8}$	$2.041x10^{6}$	$0.680x10^{-6}$	$0.308x10^{-6}$
3	35ºC	8.24	6.48	$2.218x10^{8}$	$2.818x10^{6}$	$0.402x10^{-6}$	$2.15x10^{-7}$

DETERMINATION OF STABILITY CONSTANT BY LEAST SQUARE METHOD IN 40% ETHANOL AT DIFFERENT TEMPERATURE

Temperature – 25ºC

Table 19

S. No.	pH	$\bar{n}$	[A]	$Y = \frac{\bar{n}}{(\bar{n}-1)[A]}$	$X = \frac{(2-\bar{n})[A]}{(\bar{n}-1)}$	X2x10^{-16}	XY
1	4.8	0.250	$0.593x10^{-8}$	$-0.5722x108^{8}$	$-1.38x10^{-8}$	1.855	0.7776
2	5.0	0.500	$1.174x10^{-8}$	$-0.8705x10^{8}$	$-3.492x10^{-8}$	12.22	2.999
3	5.4	0.750	$0.425x10^{-7}$	$-7.281x10^{7}$	$-2.095x10^{-7}$	431.95	14.99
4	5.5	0.875	$0.574x10^{-7}$	$-12.95x10^{7}$	$-4.945x10^{-7}$	2421.35	63.05
5	5.8	1.125	$1.198x10^{-7}$	$7.579x10^{7}$	$8.338x10^{-7}$	6937.23	62.98
6	6.0	1.250	$1.946x10^{-7}$	$2.587x10^{7}$	$5.828x10^{-7}$	3389.434	14.99
7	6.2	1.375	$0.322x10^{-6}$	$11.92x10^{6}$	$0.5266x10^{-6}$	2669.116	6.106
8	6.4	1.500	$0.504x10^{-6}$	$6.155x10^{6}$	$0.495x10^{-6}$	2383.203	2.999
9	6.5	1.750	$0.568x10^{-6}$	$4.151x10^{6}$	$0.1932x10^{-6}$	370.156	0.7772
10	6.8	1.875	$1.132x10^{-6}$	$1.920x10^{6}$	$0.1522x10^{-6}$	258.332	0.3059

Σxy	=	148.97	a	=	4.1167×10^{7}
Σx	=	18.74×10^{-7}	b	=	1.4498×10^{14}
Σy	=	-26.82×10^{-7}	log K_1	=	7.25
Σx^2	=	$15866.799 \times 10^{-16}$	log K_2	=	6.18
n	=	10	log β	=	13.43

Determination of Stability Constant by Least Square Method in 40% Ethanol at Different Temperature

Temperature – 30ºC

Table 20

S. No.	pH	$\bar{n}$	[A]	$Y = \frac{\bar{n}}{(\bar{n}-1)[A]}$	$X = \frac{(2-\bar{n})[A]}{(\bar{n}-1)}$	$X^2 x10^{-16}$	XY
1	4.8	0.500	$0.747x10^{-8}$	$-1.388x10^{8}$	$-2.36x10^{-8}$	5.534	3.1574
2	5.0	0.625	$1.52x10^{-8}$	$-1.152x10^{8}$	$-5.436x10^{-8}$	29.462	6.1091
3	5.2	0.750	$0.288x10^{-7}$	$-10.863x10^{7}$	$-1.59x10^{-7}$	193.326	15.1050
4	5.4	0.875	$0.501x10^{-7}$	$-14.08x10^{7}$	$-4.495x10^{-7}$	2016.12	63.010
5	5.6	1.125	$0.872x10^{-7}$	$10.93x10^{7}$	$3.792x10^{-7}$	3350.39	63.032
6	5.7	1.250	$1.156x10^{-7}$	$4.82x10^{7}$	$3.125x10^{-7}$	992.252	14.995
7	6.0	1.375	$2.226x10^{-7}$	$1.678x10^{7}$	$3.686x10^{-7}$	1343.16	0.1015
8	6.2	1.500	$0.439x10^{-6}$	$8.622x10^{6}$	$0.3452x10^{-6}$	1211.88	2.9993
9	6.5	1.750	$0.684x10^{-6}$	$3.524x10^{6}$	$0.2236x10^{-6}$	489.35	0.7798
10	6.7	1.875	$1.136x10^{-6}$	$2.121x10^{6}$	$0.1456x10^{-6}$	213.12	0.3076

Σxy	=	169.92	a	=	5.1167×10^{7}
Σx	=	20.24×10^{-7}	b	=	1.4498×10^{14}
Σy	=	-26.82×10^{-7}	log K_1	=	7.50
Σx^2	=	$18866.799 \times 10^{-16}$	log K_2	=	6.46
n	=	10	log β	=	13.96

Determination of Stability Constant by Least Square Method in 40% Ethanol at Different Temperature

Temperature – 35ºC

Table 21

S. No.	pH	$\bar{n}$	[A]	$Y = \frac{\bar{n}}{(\bar{n}-1)[A]}$	$X = \frac{(2-\bar{n})[A]}{(\bar{n}-1)}$	$X^2 x10^{-16}$	XY
1	4.4	0.250	$0.212x10^{-8}$	$-1.598x10^{8}$	$-0.4881x10^{-8}$	0.2477	0.7897
2	4.5	0.375	$0.312x10^{-8}$	$-1.972x10^{8}$	$-0.796x10^{-8}$	0.6628	1.5959
3	4.6	0.500	$0.484x10^{-8}$	$-2.272x10^{8}$	$-1.331x10^{-8}$	1.735	2.9199
4	4.7	0.625	$0.656x10^{-8}$	$-2.665x10^{8}$	$-2.311x10^{-8}$	5.327	6.213
5	5.0	0.750	$1.156x10^{-8}$	$-1.686x10^{8}$	$-9.052x10^{-8}$	79.421	14.105
6	5.2	0.875	$3.60x10^{-7}$	$-2.121x10^{7}$	$-29.689x10^{-7}$	88140.2	62.983
7	5.5	1.125	$0.806x10^{-7}$	$11.915x10^{7}$	$5.280x10^{-7}$	2771.35	62.991
8	5.7	1.250	$1.210x10^{-7}$	$4.32x10^{7}$	$3.735x10^{-7}$	1400.11	15.25
9	5.8	1.375	$1.514x10^{-7}$	$2.332x10^{7}$	$2.636x10^{-7}$	684.69	6.15
10	6.0	1.500	$2.54x10^{-7}$	$1.120x10^{7}$	$2.57x10^{-7}$	635.32	2.105
11	6.2	1.750	$0.316x10^{-6}$	$6.118x10^{6}$	$0.163x10^{-6}$	162.55	0.7783
12	6.7	1.875	$1.223x10^{-6}$	$1.795x10^{6}$	$0.1754x10^{-6}$	293.79	0.3062

Σxy	=	175.534	a	=	6.567×10^{7}
Σx	=	13.1014×10^{-7}	b	=	2.6578×10^{14}
Σy	=	-3.1861×10^{-7}	log K_1	=	7.78
Σx^2	=	9842.36×10^{-16}	log K_2	=	7.01
n	=	12	log β	=	14.79

Summary of Stability Constant Calculated by Least Square Method in 40% Ethanol Medium at Different Temperature

Table 22

S. No.	Temp.	log K_1	log K_2	Log β
1	25º C	7.25	6.18	13.43
2	30º C	7.50	6.46	13.96
3	35º C	7.78	7.01	14.79

SUMMARY OF STABILITY CONSTANT CALCULATED BY SCHRODER'S CONVERGENCE FORMULAS METHOD IN 40% ETHANOL MEDIUM AT DIFFERENT TEMPERATURE

Table 23

S. No.	Temp.	log K_1	log K_2	Log β
1	25º C	7.70	6.12	13.82
2	30º C	8.92	6.32	14.24
3	35º C	8.10	6.46	14.56

SUMMARY OF STABILITY CONSTANT CALCULATED BY SCHRODER'S CONVERGENCE FORMULAS METHOD IN 40% ETHANOL MEDIUM AT DIFFERENT TEMPERATURE

Table 24

S. No.	Method	25º C			30º C			35º C		
		log K_1	log K_2	log β	log K_1	log K_2	log β	log K_1	log K_2	log β
1	Extension of Bjerrum's	7.81	6.16	13.75	7.83	6.36	14.19	8.04	6.65	14.69
2	Least Square	7.25	6.18	13.43	7.50	6.46	13.96	7.78	7.01	14.79
3	Schroder's Convergence formula	7.70	6.12	13.82	7.92	6.32	14.24	8.10	6.46	14.56
	Mean Value	7.85	6.36	14.21	8.01	6.50	14.51	8.20	6.78	14.88

VALUE OF 1/T AND LOG β IN 40% ETHANOL

Table 25

S. No.	Temperature K	1/T□10^{-3}	log □
1.	298	3.356	13.75
2.	303	3.300	14.19
3.	308	3.247	14.61

Summary

Cobalt Complexes of thioglycolic acid have been investigated by potentiometric techniques in aqueous 0.1 M KNO_3. It was found that Co^{2+} ion form colourless 1:2 complexes. The stability constant of complexes formed have been determined by applying Calvin and Melchior's extension of Bjerrum's method at three different temperature and were further refined by alternative method (least square treatment : Convrgence formula of succesive approximation). The value of log K_1 and log K_2 computed by alternative method at 25°C, 30°C, and 35°C have been found to be 7.81 & 6.16 (25°C), 7.83 & 6.36 (30°C) 8.04 & 6.65 (35°C) in 40% Ethanol Medium.

The value of overall changes in ΔG_1, ΔG_2, ΔH, ΔS_1, ΔS_2 accompanying the reaction have also been evaluated at 30° and found to be -42.82, $KJmol^{-1}$, -26.830, $KJmol^{-1}$, -0.161 KJ, +135.62, J/K, +78.6133 J/K in aqueous ethanol medium.

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