

THE KINETIC STUDY OF CO-SOLVENT ETHYL ALCOHOL ON BENZYL FORMATE ESTER

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Abstract :- The acid catalysed hydrolysis of Benzyl formate has been carried out in water Et-OH media varying concentration of Et-OH from 30% to 80% at temperatures ranging from 293K to 313K at interval of 5K. It was found that acid catalysed hydrolysis of Benzyl formate ester follows A_{AC}^2 mechanism.

Key Words :- Specific rate constant, Activation Parameters, Aromatic formate, solvolysis, Solvent-Solute interaction, Dipolar.

Introduction :- The acid Catalysed hydrolysis of Benzyl Formate has been Carried out in aquo-EtOH media prepared by 30% to 80% of Et-OH by volume in the reaction media at temperatures ranging from 293K to 313K. The acid catalysed hydrolysis of Benzyl formate was found to obey Arrhenius law during the range of temperatures. In order to highlight the above noted idea, it was thought essential to investigate about how the mechanism, activation parameters have been affected in Water-Ethanol media.

Methods and Materials :- Purified ethyl alcohol of BDH grade and Benzyl formate of USSR make was used. Glass apparatuses were also of corning brand. 0.4ml of the benzyl formate ester was withdrawn with help of a syringe pipette and added quickly to the acidic solution of water-solvent mixture by constant shaking. The solvent water composition and the ester concentration were kept constant. The ionic strength of the medium was maintained constant at $\mu = 0.9$ by adding potassium chloride. The specific rate constant values for different $[H^+]$ have been given in table-I. From Table-I it is obvious that concentration of HCL increases where as the concentration of KCL decreases.

Influence of ionic strength and Dielectric constant data:-

Influence of ionic strength with different concentration of KCL solution varying from 0.1 to 0.6M were studied as usual on the acid catalysed hydrolysis of Benzyl formate at temperature 303K. 30% of ethyl alcohol composition and concentration of acid and ester were always kept constant for every set of the experiment. The

specific rate constant values at different ionic strength have been given in table-III

The dielectric constant values for all solvent water composition have been obtained from the interpolation of the curves plotted on the basis of data as reported by Felix franks¹ and Akerlof².

Calculation of Iso-dielectric Activation Energy E_D .

The experimental or Iso-composition activation energy involves a combined dependence of the rate constant on the temperature and the bulk dielectric constant of the medium. In order to study the effect of temperatures on the rates, the effect of bulk dielectric on it should be eliminated. This was done by evaluating the Iso-dielectric activation energy (E_D) from the corresponding rate constant values (K_D) in Iso – dielectric solutions. The logK and D values for both the water solvent media have been recorded in table-IV.

Research Objective :- The acidic hydrolysis of Benzyl formate ester is fruitful from food technological as well as medicinal points of views. Sarkar and Rakshit³ concluded that A_{AC}^2 mechanism in aqua Et-OH system. When alcohol is added to water then it is found that water Et-OH mixture dense form of water is changed to its bulky form which is observed by Packer and Tomllinson.⁴

Thermodynamic Activation Parameter of The Reaction :-

It is obvious that out of the three thermodynamic activation parameters namely ΔH^* , ΔS^* and ΔG^* are found to increase simultaneously.

By the use of thermodynamic equation,

$$\Delta G^* = \Delta H^* - T\Delta S^*$$

It is clear that ΔG^* values with increase in ΔH^* and ΔS^* values of the reaction is only possible when the extent of enhancement in ΔH^* values is greater than that in ΔS^* values.

It is concluded that acid catalysed hydrolysis of Benzyl formate in water Et-OH media is enthalpy dominating and entropy controlled. Similar observation have also been reported by Sinha and Singh⁵ and recently by Sinha and Singh⁶ Tauheed and Singh⁷ and Singh et.al.⁸

Table-I

Effect of $[H^+]$ on the acid catalysed hydrolysis of Benzyl methanoate in water-EtOH media at constant ionic strength $\mu = 0.90$ at 303K

[HCL]	[KCL]	μ	$K \times 10^2$ in min^{-1} EtOH = 30% (v/v)
0.10	0.80	0.90	47.89
0.15	0.75	0.90	68.08
0.20	0.70	0.90	96.38
0.25	0.65	0.90	121.62
0.30	0.60	0.90	144.61
0.40	0.50	0.90	192.80
0.50	0.40	0.90	244.41
0.60	0.30	0.90	308.96
0.70	0.20	0.90	375.84
0.80	0.10	0.90	416.97

Table-II

Specific rate constant values for acid catalysed hydrolysis of Benzyl formate in water – EtOH media.

$K \times 10^2$ in min^{-1}

Temp in K	% of Ethyl alcohol in water – EtOH media					
	30%	40%	50%	60%	70%	80%
293K	71.32	57.16	44.18	35.16	25.65	18.64
298K	150.73	110.94	89.37	74.20	57.82	44.34
303K	244.12	211.93	182.47	157.43	128.85	103.80
308K	436.72	390.93	354.73	315.06	272.96	231.26
313k	790.86	718.79	684.07	631.68	576.77	510.63

Table-III

Influence of ionic strength on the rate constant of acid hydrolysis of Benzyl formate in EtOH at 303K.

[HCL] = 0.1M

KCL	μ	$K \times 10^2$ in $(\text{dm})^3 \text{mol}^{-1} \text{min}^{-1}$
0.1	0.1	47.89
0.2	0.2	47.92
0.3	0.3	48.10
0.4	0.4	48.40
0.5	0.5	47.85
0.6	0.6	48.21

Table-IV

Variation of logK values with dielectric constant values of water- EtOH media.

% of ethyl alcohol	293K		298K		303K		308K		313K	
	D	2+logK	D	2+logK	D	2+logK	D	2+logK	D	2+logK
30%	62.63	1.853	61.17	2.178	59.67	2.388	58.23	2.640	56.73	2.898
40%	56.49	1.757	55.16	2.045	53.78	2.326	52.44	2.592	51.08	2.857
50%	50.38	1.645	4.12	1.951	47.85	2.261	46.56	2.550	45.30	2.835
60%	44.57	1.546	43.51	1.870	42.36	2.197	41.19	2.498	40.02	2.800
70%	39.14	1.406	38.06	1.762	37.00	2.110	35.94	2.436	34.88	2.761
80%	33.89	1.270	32.84	1.647	31.83	2.016	30.79	2.364	29.83	2.708

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