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Study on Effect of $Cuso_4$ and $Mnso_4$ on the Reaction Rate of Substituted Alcohols by N-Bromophthalimide in Aqueous Acetic Acid Medium

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Abstract: *The effect of catalysts on the reaction rate of substituted benzyl alcohols by N-bromophthalimide was carried out at 308 K. The reactions follow first-order kinetics each in [NBP] and [substitute benzyl alcohols]. The reaction is acid catalyzed. Oxidation-reduction is very sensitive to metal catalysts. The effect of catalyst ions as Cu++ and Mn++ (catalyst) on the rate of reaction was reported*

Keywords: *Involvement, consistent, composition, deterioration, discard.*

1. Introduction

Chemical kinetics is the branch of physical chemistry which explains itself with the study of velocity of chemical reaction and with the elucidation of the mechanism by which they proceed. Thermodynamic parameters consider how far a reaction will proceed. The study completely discards the formation of complexes and rules out the involvement of cations catalytic in oxidation process. We employ a variety of metal catalysts containing Cu(I) [1,2], Ni(II) [3,4], Co(II) [5,6], Pd(II) [7, 8] and manganese oxide [9-11] recently developed and have been used for many decades. However, most of the metal catalysts are expensive and may lead to the environmental pollution with the overgrowing economic concerns. The development of catalytic process for oxidation of alcohols is now an increasingly subject of importance.

2. Experimental

All the chemical employed in the investigation were of analytical grade. The solution of N-bromophthalimide was obtained by (99% purity) whose M.P. was found to be 418 K. The solution was prepared by dissolving its weighed quantity in 100% acetic acid and is kept in either amber coloured black paper wrapped around to save it from the action of diffused day of light which alters appreciably its concentration to avoid occurrence of photochemical deterioration. Other solutions required for the study as $CuSO_4$, $MnSO_4$, CH_3COOH, KI, $K_2Cr_2O_7$ acrylonitrile etc. are prepared and standardized as laid down methods prescribed in analytical chemistry

3. Result and Discussion

The effect of catalysts were studied by adding varying concentrations of Cu^{++} and Mn^{++} to the reaction mixtures, keeping the concentrations of substrate, oxidant, and composition of acetic acid-water and temperature constant. The results of the effect of Cu^{++} and Mn^{++} ions on the rate of reaction of para-methyl benzyl alcohol, para-chloro benzyl alcohol and para-nitrobenzyl alcohols by N-bromophthalimide was recorded in **Tables-1 and 2.** The plot of k_1 vs. [$CuSO_4$] and [$MnSO_4$] have been given in **Figs. 1 and 2** respectively

Table1. *Dependence of rate on the concentration of metal ions catalyst $CuSO_4$*

10^3 [NBP] (mol dm^{-3}) =2.50 (1, 2, 3);

10^2 [substrate] (mol dm^{-3}) = 4.00 (1) 2.50 (2, 3);

10^2 [H^+] (mol dm^{-3}) = 1.0 (1, 2, 3);

HOAc– H_2O %, (V/v) = 20 (1, 2, 3);

Temp. K = 308 (1, 2, 3).

S. No.	**[$CuSO_4$ $5H_2O$] $\times 10^3$ (mol dm^{-3})**	p-MBA	p-CBA	p-NBA
		1	2	3
		⟵ 10^4 k_1 (S^{-1}) ⟶		
1	**0.00**	8.17	4.63	4.36
2	0.50	8.39	4.81	4.54
3	1.00	8.45	4.92	4.70
4	1.25	8.51	5.05	4.81
5	2.00	8.62	5.15	4.91

1. para-methyl benzyl alcohol (p-MBA); 2. para-chloro benzyl alcohol (p-CBA); 3. para-nitro benzyl alcohol (p-NBA)

Table2. *Dependence of rate on the concentration of metal ions catalyst $MnSO_4$*

10^3 [NBP] (mol dm^{-3}) =2.50 (1, 2, 3);

10^2 [substrate] (mol dm^{-3}) = 4.00 (1) 2.50 (2, 3);

10^2 [H^+] (mol dm^{-3}) = 1.0 (1, 2, 3);

HOAc– H_2O %, (V/v) = 20 (1, 2, 3);

Temp. K = 308 (1, 2, 3).

S. No.	**[$MnSO_4$ $5H_2O$] $\times 10^3$ (mol dm^{-3})**	p-MBA	p-CBA	p-NBA
		1	2	3
		⟵ 10^4 k_1 (S^{-1}) ⟶		
1	**0.00**	8.17	4.63	4.36
2	0.50	8.00	4.52	4.24
3	1.00	7.80	4.40	4.20
4	1.25	7.63	3.95	3.98
5	2.00	7.52	3.85	3.80

1. para-methyl benzyl alcohol (p-MBA); 2. para-chloro benzyl alcohol (p-CBA); 3. para-nitro benzyl alcohol (p-NBA)

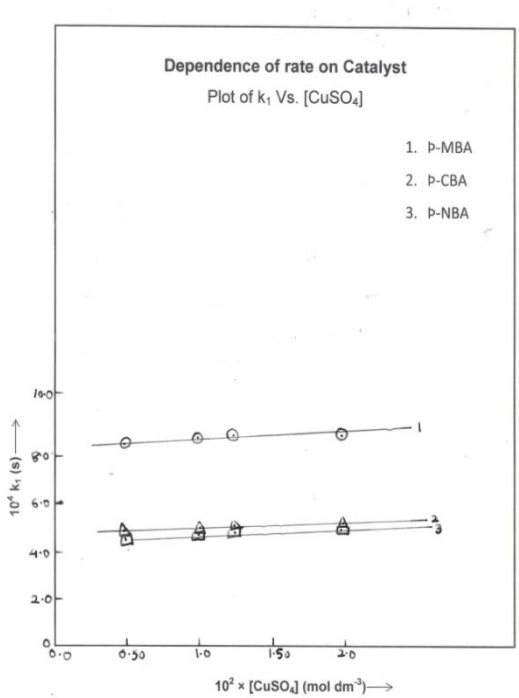

Fig. 1 10^3 [NBP] (mol dm^{-3}) = 2.50 (1, 2, 3) ;
10^2[Substrate] (mol dm^{-3}) = 4.0 (1), 2.50 (2, 3) ;
10^2 [H^+] (mol dm^{-3}) = 2.50 (1,2,3) ; HOAc-H_2O, % (V/v) = 20 (1, 2, 3) ;
Temp. K = 308 (1, 2, 3)

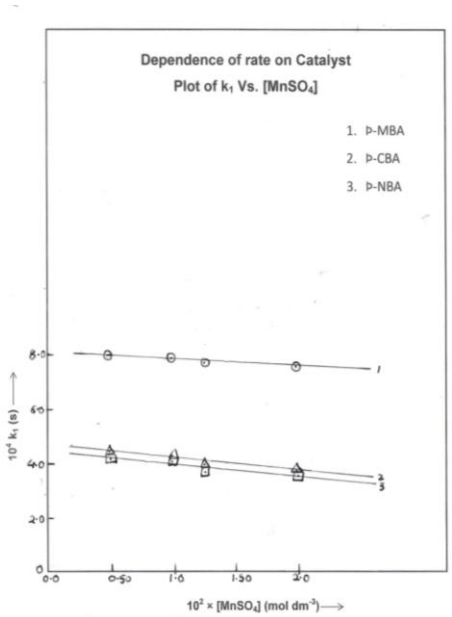

Fig. 2 10^3 [NBP] (mol dm^{-3}) = 2.50 (1, 2, 3) ; 10^3[Substrate] (mol dm^{-3}) = 4.0 (1), 2.50 (2, 3) ; 10^2 [H^+] (mol dm^{-3}) = 2.50 (1, 2, 3) ; HOAc-H_2O, % (V/v) = 20 (1, 2, 3) ; Temp. K = 308 (1, 2, 3)

4. Conclusion

The effect of catalyst ions of varying concentration of $CuSO_4$ and $MnSO_4$ to the reaction mixture of substrate by oxidant is binary composition of acetic acid at constant temperature was studied. It shows that the effect of increasing concentration of Cu^{++} ions accelerate the reaction velocity, while Mn^{++} ions lead retardation in the rate of oxidation of reaction.

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