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Effect of $CuSO_4$ and $MnSO_4$ on the Reaction Rate of 2-Alkanones by Isoquinolium Bromochromate (IQBC)

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Abstract: ***Effect of $CuSO_4$ and $MnSO_4$ (catalyst) on the reaction of rate IQBC with 2-butanone, 2-pentanone, 3-methyl-2-butanone were study in present study. The effect of catalyst on the reaction of rate isoquinolinium bromochromate with 2-Alkanones was carried out at 303 and 308^{0}K. The follows pseudo first order kinetics each in [IQBC] and [2-Alkanones] and reaction is acid catalyzed. Oxidation reductions are very sensitive to metal catalyst. In order to study the effect of catalyst ions were chosen as $CuSO_4$ and $MnSO_4$ were taken as the cat ions sources of Cu^{++} and Mn^{++} ions. The effects of these ions were studied by adding varying concentration of Cu^{++} and Mn^{++} to the reaction mixtures, keeping the concentration of substrate, oxidant and composition of acetic acid water and temperature constant.***

Keywords: Involvement, consistent, composition, deterioration, catalyst

1. Introduction

Chemical kinetics is the branch of physical chemistry which concerns itself with the study of velocity of chemical reaction and with the elucidation of the mechanism by which they proceed. Thermodynamics considers how far a reaction will proceed. The study completely discarded the form at ion of complex and rules out involvement of cations. Catalytic oxidation methods, which employ a variety of metal-containing catalyst such as Cu (I) [1, 2], Ni (II) [3, 4], Co (II) [5, 6], Pd (II) and manganese oxide[7, 8] developed quickly in recent decades. However, most of the metal catalysts are expensive and may led to the environmental pollution with the overgrowing environmental and economic concerns the development of benign catalytic process for alcohol oxidation is becoming increasingly important.9[-11]

2. Experimental

All the chemicals employed in this investigation were of analytical grade. The solution of Isoquinolinium bromochromate [Loc cit][12] was obtained by (99% purity) whose melting point was found to be 105-106^{0}C was obtained by dissolving its weighed quantity in 100% acetic acid and kept in either amber colored flask or black paper wrapped around it to save it from the action of diffused day light which alters appreciably its concentration i. e. to avoid occurrence of photochemical deterioration. Other solutions required in the study such as $CuSO_4$, $MnSO_4$, CH_3COOH, KI, hypo $K_2Cr_2O_7$ acrylo nitrile prepared and standardized as laid methods prescribed in analytical chemistry.

3. Results and Discussion

Oxidation reduction reactions are very sensitive to metal catalyst. In order to study the effect of catalyst copper and manganese ions were choosen and sulphate were taken as the cations sources of copper and manganese ions. The effects of these ions were studied by adding varying concentration of copper sulphate and manganese sulphate to the reaction mixtures, keeping the concentration of substrate, oxidant and composition of acetic acid-water and temperature constant.

The results of the effect of the copper sulphate, and manganese sulphate on the rate of reaction are summarized in the following Table: (1, 2).

Table I: Summary: Dependence of rate on the concentration of metal ion catalyst ($CuSO_4 \cdot 5H_2O$)
[IQBC] × 10^{-3} (mol dm^{-3}) = 2.50 (1, 2, 3);
[Substrate] × 10^{-2} (mol dm^{-3}) = 2.0 (1, 2), 2.5 (3);
[H^+] × 10^{-3} (mol dm^{-3}) = 1.0 (1, 2, 3);
HOAc-H_2O % (v/v) = 20 (1, 2, 3);
Temp. K = 303 (1), 308 (2, 3)

S. No.	[$CuSO_4 \cdot 5H_2O$] ×10^3 (mol dm^{-3})	2 – butanone (1) ←	2 – pentanone (2) 10^4 k_1 (s^{-1})	3-methyl-2-butanone (3) →
1	0.00	3.76	2.61	1.79
2	0.50	3.89	2.73	1.92
3	1.00	3.98	2.93	2.04
4	2.00	4.01	2.98	2.18
5	2.50	4.23	3.21	2.35

From the tables it is clear that the effect of increasing concentration of Cu^{++} ions shows acceleration in the reaction velocity while added Mn^{++} ions exhibits retardation in the rate of reaction.

Table II: Summary: Dependence of rate on the concentration of metal ion catalyst ($MnSO_4 \cdot H_2O$)
[IQBC] × 10^{-3} (mol dm^{-3}) = 2.50 (1, 2, 3);
[Substrate] × 10^{-2} (mol dm^{-3}) = 2.0 (1, 2), 2.5 (3);
[H^+] × 10^{-3} (mol dm^{-3}) = 1.0 (1, 2, 3);
HOAc-H_2O % (v/v) = 20 (1, 2, 3);
Temp. K = 303 (1), 308 (2, 3)

S. No.	[$MnSO_4 \cdot H_2O$] ×10^3 (mol dm^{-3})	2 – butanone (1) ←	2 – pentanone (2) 10^4 k_1 (s^{-1})	3-methyl-2-butanone (3) →
1	0.00	3.76	2.61	1.79
2	0.50	3.67	2.48	1.66
3	1.00	3.53	2.36	1.53
4	2.00	3.44	2.24	1.46
5	2.50	3.39	2.11	1.39

4. Conclusion

Addition of catalyst $MnSO_4$ retards the reaction velocity whereas catalyst $CuSO_4$ accelerates the reaction rate. The effect of these ions was studied by adding varying concentration of $CuSO_4$ and $MnSO_4$ to the reaction mixture, keeping the concentration of substrate, oxidant and composition of acetic acid and temperature constant. From above Table: I and Table: II. it is clear that the effect of increasing concentration of Cu^{++} ions show acceleration in the reaction velocity while Mn^{++} ions show retardation in the rate of oxidation reaction as shown. The effect of increasing concentration of Cu^{++} ion shows acceleration in the reaction velocity and Mn^{++} ions was found to retard in the rate of reaction.

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