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Investigation of Oxidaizing Character of Potassium Permanganate and Mechanism of Oxidation of Monosaccharide in Acidic Medium

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Abstract:- **Investigation of oxidizing character of potassium permanganate and mechanism of oxidation of monosaccharide has been done spectrophotometrically by using Systronic Spectrophotometer-105 at maximum wavelength 545nm at 305K. The first order kinetics was observed with respect to the concentration of added salt. Experimental data of rate constant indicates that rate of reaction does not depends on the concentration of salt. Insignificant figure of k was measured. It has been found that carboxylic acid derivative of monosaccharide produced as a final product of the oxidation reaction**

I. INTRODUCTION

The most few decades have witnessed an unfaltering The carbohydrates are very essential for life on the Earth. In carbohydrate metabolism pentoses and hexoses are involved. In food science carbohydrates are known as food. Bread, cereals and pasta rich in starch carbohydrate and also simple sugars are exists in desserts, jams and candy, table sugar, milk etc. Carbohydrates are backbone of RNA, DNA[1,2].

Monosaccharide consists at least three or moe than three carbon atoms with aldehyde or ketone group. Aldose sugars are easily oxidized to aldonic acid. A number of quantitative and qualitative test are used to detect the reducing sugar. Generally, each of them is related to oxidation reactions. Srivastava and Chaudhary [3] has been investigated kinetics and mechanism of some simple reducing sugars by potassium permanganate in alkaline medium. They reported the formation of enediol during the oxidation of reducing sugars. Anitha and co-workers[4] has been worked on anodically generated manganese (II) sulphate for the oxidation of aldo and keto hexoses: a kinetic and mechanistic study. They assumed that in absence of H+ ion hexoses are converted to enidol and forms corresponding compound of carboxylic acid as a final product of oxidation of aldoses.

Samuel and co-workers [5] studied kinetics and mechanism of Cu(II) inhibition towards oxidation of simple sugars by hexacyanoferrate (III) ion in alkaline buffer solution. They examined that NaNO3 does not alter the rate of reaction i.e. rate of reaction did not depend on concentration of salt resulting the formation of an ion and neutral molecule at the rate determining step.

Although, it has been found from the literature of oxidation reaction of carbohydrates so many results are given by the researchers about the mechanism of the oxidation reactions of the monosaccharide by different oxidants in different reaction medium but very less work has been done by acidic potassium permanganate. Here potassium permanganate is used as an oxidant to describe the oxidation behavior of potassium permanganate in acidic medium.

II.EXPERIMENTAL

All the stock solutions of potassium permanganate , D-xylose, potassium chloride, sulphuric acid used for the present investigation were made by using doubly distilled water. All reactants are kept in a thermostat water bath to attain a temperature at 305K. Systronic Visible Spectrophotometer -105 was used for collection of experimental data at maximum wavelength 545nm [5].

III. RESULT AND DISCUSSSION

The effect of salts has been determined by varying the concentration of potassium chloride from 1×10^{-1} mol dm^{-3} to 5×10^{-1} mol dm^{-3} while kept constant the concentration of other reactants.

The oxidation of D-xylose by potassium permanganate is selected as example of monosaccharide and effect of

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salt KCl concentration is given here because of ionic strength play an important role for getting information about the path of the reaction. The rate constant of oxidation reaction was calculated from the slope of log A against t. The first order kinetics of oxidation reaction was confirmed from the linear plot of [KCl] against k_{obs} (figure-1), indicates that the concentration of potassium chloride did not affect the rate of reaction. On the basis of such result and also from the literature of oxidation of sugars, it was assumed that a molecular species is formed during the reaction.

Table 1. Effect of variation of [KCl] and the observed value of rate constant k [$KMnO_4$] = $1x\ 10^{-3}$ mol dm^{-3}, [H_2SO_4] = $1x\ 10^{-3}$ mol dm^{-3}, [xylose] = $2x\ 10^{-2}$ mol dm^{-}

Run No.	**[KCl] x 10mol dm^{-3}**	**k x 10^4 s^{-1}**
1.	**1**	**1.8**
2.	**2**	**1.9**
3.	**3**	**2.1**
4.	**4**	**2.2**
5.	**5**	**2.5**

3

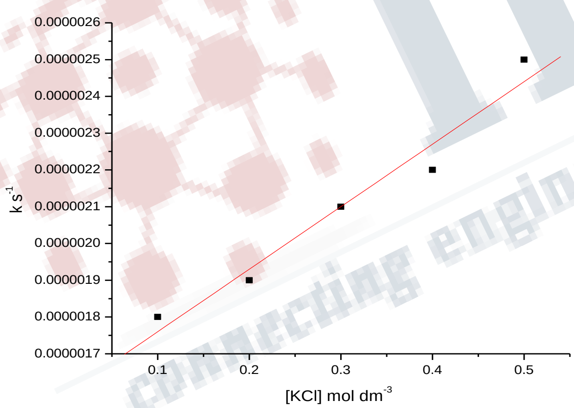

Figure 1. A plot of [KCl] versus k

The mechanism of oxidation reaction is very interesting and useful for the field of biochemistry, food chemistry and kinetic study because it has been assumed that potassium permanganate produces permanganic acid in sulphuric acid medium. This permanganic acid is highly reactive and ionized into permanganate ion.

$$HMnO_4 \longrightarrow MnO_4^- + H^+$$

Since D-xylose have carbonyl and alcoholic groups with one of them is terminal hydroxyl group. From the literature [5] it is cleared that molecular species is formed in rate determining step. Therefore it is assumed that the permanganate ion reacts with terminal alcoholic group of monosaccharide (D-xylose) and produces an intermediate complex. This complex is unstable and at the end of the oxidation reaction converted to acid. Here the general path of the oxidation reaction is given as follows.

D-xylose + permanganate ion

↓

Corresponding Acid derivative

IV. ACKNOLEGEMENT

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