FINAL REPORT OF
MINOR RESEARCH PROJECT
ON

SUBSTRATE INHIBITION IN THE OXIDATION OF POLYETHYLENE GLYCOLS

FINANCIALLY ASSISTED BY
UGC-SERO, HYDERABAD
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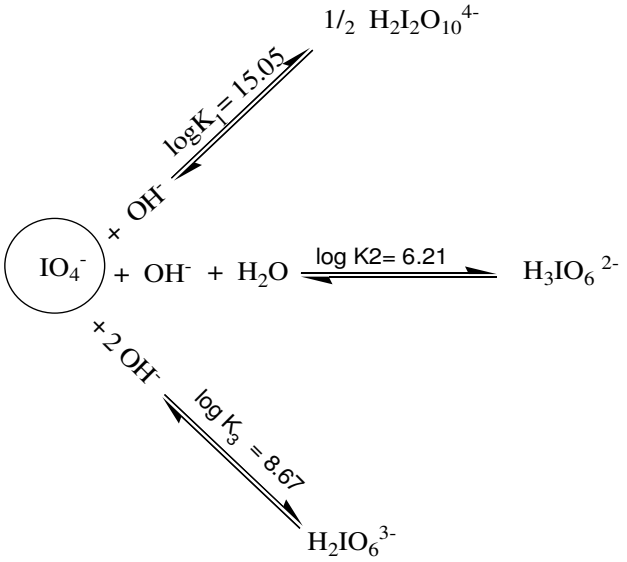
SUMMARY

Polyethylene glycols (PEGs) are well-known biodegradable pharmaceutical polymer and have a spectrum of applications in pharmaceutical field and other fields of industry. In order to understand the stability of PEGs and to derive the reaction rate law, kinetics of oxidation of PEGs (200, 300, 400 and 600) oxidation by potassium periodatewas studied in alkaline medium. Reactions were carried out in alkaline medium and measured the kinetics by iodometry. One oxygen atom loss or two electrons transfer was observed per each molecule of periodate i.e., the rate of reaction was measured periodate converts to iodate because, the formed iodate species is unable to oxidize the substrate molecules. First order dependence of reaction on periodate was observed. Rate of the reaction was found to be independent of substrate concentration. A retardation of reaction rate with an increase in hydroxide concentration shows an inverse fractional order in it.Based on the studies of temperature dependence of reaction, evaluated the activation parameters.



A suitable rate law was proposed as given below based on the observed experimental results and taking into consideration of above equilibria.

$$\text{Rate} = \frac{[IO_4^-]_T \{k_1K_2K_4 + k_2K_3K_5[OH^-]\}}{\{K_2K_4 + K_3K_5[OH^-]\}}$$

In the case of Ru(III) catalyzed oxidation of PEGs by DCICA in aqueous acetic acid – perchloric acid medium, first order dependence on [DCICA] and rate dependence on [substrate]. Flory's assumption of equal reactivity can be used to explain equal reactivity. Inverse fractional order was observed w.r.t. acid concentration. Addition of acetic acid decreased the rate of reaction. The reactions were first order in [Ru(III)] in the oxidation of four PEGs. The following rate law is proposed based on experimental results.

$$\text{Rate} = \frac{k[\text{Ru(III)}]\,[\text{HOCl}]_T}{\{1 + K_2[H^+]\}}$$

LIST OF PUBLICATIONS OF K.V.S.KOTESWARA RAO

Published:

- **RAO, K.K.,** NADH, R.V. and RATNAM, K.V., 2019. PERIODATE OXIDATION OF PEG–600, AN ESSENTIAL PHARMACEUTICAL POLYMER. *Int J App Pharm*(SCOPUS Indexed, *ISSN* : 0975–7058), *11*(5), pp.251-256. DOI: 10.22159/ijap.2019v11i5.34591.

- **KVS, K.R.,** 2019. KINETICS OF PERIODATE OXIDATION OF POLYOXYETHYLENE–300, A BIODEGRADABLE PHARMACEUTICAL POLYMER. *International Journal of Research in Pharmaceutical Sciences* (ISSN: 0975-7538, **SCOPUS listed**), *10*(4), pp.2830-2836. DOI: https://doi.org/10.26452/ijrps.v10i4

- **Rao, K.K.** and Nadh, R.V., 2019. OXIDATION OF POLYETHYLENE GLYCOL-200 BY POTASSIUM PERIODATE IN ALKALINE MEDIUM: A KINETIC STUDY,Rasayan Journal of Chemistry (SCOPUS Indexed, ISSN: 0974-1496; e-ISSN: 0976-0083), 12(4), pp. 1681 – 1687, DOI: 10.31788/RJC.2019.1245433.

- **RAO, K.K.,** NADH, R.V. andNarasaiah, M, 2019. A KINETIC STUDY ON THE OXIDATION OF PHARMACEUTICALLY SIGNIFICANT PEG–400 BY PERIODATE, Research Journal of Pharmacy and Technology (SCOPUS Indexed, ISSN: 0974-360X (online), 0974-3618 (print)), 12(12)(2019) 5899–5903,

DOI: 10.5958/0974-360X.2019.01023.0

Papers presented at conferences:

- "Substrate Inhibition in Oxidation of Polyols by KIO_4 in Alkaline Medium" at DST Sponsored National Conference on "Recent Challenges in Chemical & Biological Sciences" organised by Division of Chemistry, Vignan's Foundation for Science, Technology and Research, Vadlamudi during 28-29 July -2014 .
- "Periodate Oxidation of Trehalose : A Kinetic Study" at UGC SERO, Hyderabad Sponsored National Seminar on "Recent Trends in Chemistry Research" organised by Department of Chemistry, Government Degree College, Kodur, Kadapa on 30th July- 2014 .
- "Oxidation of Glycols by Potassium Periodate in Alkaline Medium" at UGC Sponsored National Seminar on "Advances in Chemical Science (NSACS-2015)" organised by Department of Chemistry, K B N College, Vijayawada during 18-19 September -2015.
- "Oxidation of Polyethylene Glycols by Periodate" at "A.P. Science Congress – 2016 Focal Theme: Science and Technology for Health" organised by Dr. N.T.R Health University, AcharyaNagarjuna University & Krishna University during 07-09 November-2016.
- "Oxidation of Polyethylene Glycols by Potassium Periodate in Acid Medium" at UGC-SERO Sponsored National Seminar on "Recent Trends in Chemistry & Physics of Materials (RTCPM-2017)" organised by Department of Chemistry, SRR & CVR Govt. Degree College, Vijayawada during 15-16 September-2017.
- "Substrate Inhibition Ruthenium (III) Catalysed Oxidation of Propane-1,3 diol by Periodate in Acid medium-A kinetic study" at DST Sponsored National conference on "Recent Advances in Material Science for Sustainable Development – 2019" Organised by Division of Chemistry, Department of Science & Humanities Vignan's Foundation for

Science, Technology and Research, Vadlamudi during 31st August and 1st September-2019.

- "Oxidation of Polyethylene Glycols by DCICA" at UGC Sponsored National Seminar on "Modern Applications of Chemistry in Engineering and Sciences" organised by Department of Chemistry, JMJ College for Women (Autonomous), Tenali on 22nd November-2019.
- "Ruthenium (III) Catalysed Oxidation of Glycols by Potassium Periodate in Alkaline Medium" at UGC Sponsored National Seminar on "Recent trends in Research Methodologies in Chemistry" Organised by Department of Chemistry, Ideal College of Arts & Sciences, Kakinada During 15-16 November-2019.