



# IJRASET

International Journal For Research in  
Applied Science and Engineering Technology



---

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

---

**Volume: 2      Issue: XII      Month of publication: December 2014**

**DOI:**

**[www.ijraset.com](http://www.ijraset.com)**

**Call:  08813907089**

**E-mail ID: [ijraset@gmail.com](mailto:ijraset@gmail.com)**

# The Effect of Various Factors on Hydrolysis of Thiophosphate

Nimisha Misra

**Abstract:** *The nucleophilic hydrolytic reactions of Mono-isobutyl phosphate ester & Mono-2,4,6 tribromo thiophosphate ester have been discussed in this paper. Study of the hydrolysis of these monoesters have been made in the region .1 to 8 mol dm<sup>-3</sup> HCl acid & p<sup>H</sup> 1.24 to 7.46 at 65<sup>o</sup>C & 50<sup>o</sup>C respectively. Detailed study of the hydrolysis has been made at constant ionic strength, temperature, effect of solvent & concentration etc. The concept such as Hammett acidity function<sup>1</sup>, Bunnett Parameters<sup>2</sup>, Zucker-Hammett hypothesis, isokinetic relationship<sup>3</sup> etc. have been applied to determine the probable reactions. It is clear from the experiment that the reactivity of monoesters is more than di- & tri- esters but di-negative sps. of monoester have very less contribution to the overall rate of hydrolysis.*

**Key words:** *Nucleophilic, hydrolytic reactions, monoesters, bunnett parameters, isokinetic relationship.*

## I. INTRODUCTION

Hydrolysis of an ester<sup>4</sup> may proceed either through uni-molecular nucleophilic substitution [SN<sub>1</sub>] path depending on the structure & the set of experimental conditions used.

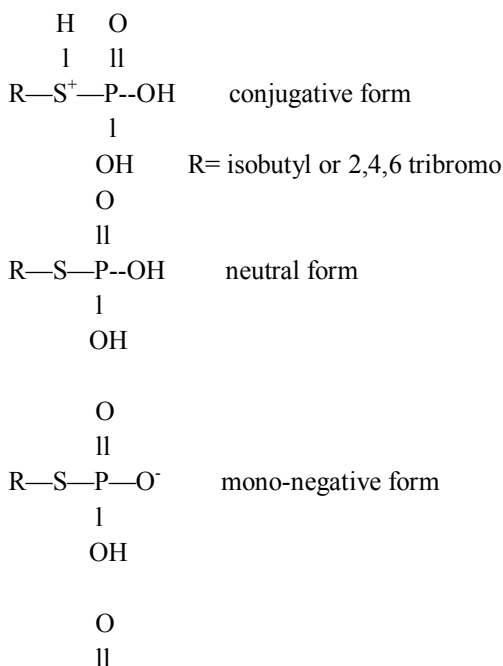
There are a no. of solvents may be used as nucleophilic reagents.

The following main factors required to be determined for studying the most suitable mechanism of hydrolysis of an ester.

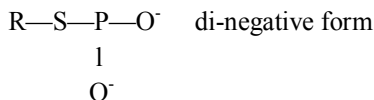
- [1] Reactive species
- [2] Molecularity
- [3] Bond rupture

There are four reactive species:

Conjugative, neutral, mono-negative & di-negative.

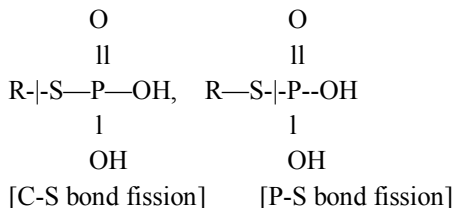


## International Journal for Research in Applied Science & Engineering Technology (IJRASET)



Molecularity may be either uni or bi, even though hydrolysis is basically a double decomposition reaction between substrate ester & water.

Bond rupture may either be C-S or P-S depending upon the point of attack of nucleophile, can be shown by figure:



Berreau, M.L.<sup>5</sup> examine a binuclear Zinc hydroxide complex for thio-ester hydrolysis reactivity. The result suggest that a terminal Zn-OH moiety may be required for hydrolysis reactivity with a thio-ester substrate, also<sup>6</sup> catalyze the hydrolysis of a thio-ester substrate & have been found to coordinate a variety of di-methyl combinations including Fe, Zn within the enzyme active site. Donald<sup>7</sup> examine the hydrolysis of S-N-butyl phosphoro-thioate in aqueous solution at constant ionic strength has a rate maximum at pH 3.25 as the acidity is increased to 10 M perchloric acid & at 8 ml HCl the rate decreases. Chlebowski, F.J.<sup>8</sup> studied the hydrolysis of phosphate & O-phosphoro-thioate monoesters by Zn & Co, Although the rate of hydrolysis of O-phosphoro-thioate is slower than phosphate ester.

## II. RESULT & DISCUSSION

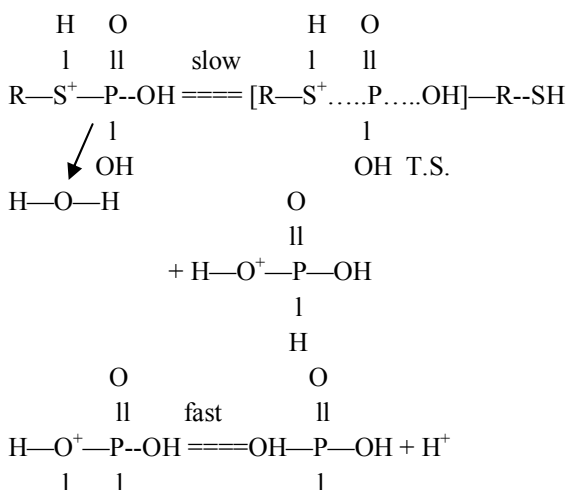
Keeping up the various factors the possible reaction pathways for the hydrolytic breakdown of monoester can be summarized as below:

### A. Mechanism of Hydrolysis of conjugative sps

Hydrolysis of the conjugative sps. Whether uni-molecularly or bi-molecularity would involve a transition state [T.S.] .

Thus analysis of experimentally observed rate values and all the above mentioned consideration show the following possible mechanism via conjugative sps in mono ester:

Bimolecular P-S bond fission:



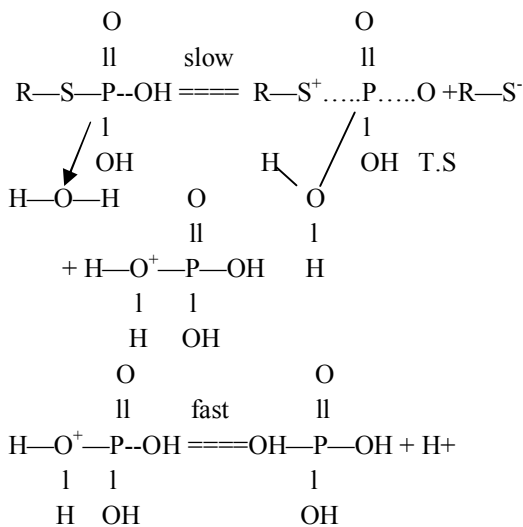
## International Journal for Research in Applied Science & Engineering Technology (IJRASET)

H OH                      OH

### B. Mechanism of Hydrolysis of neutral sps

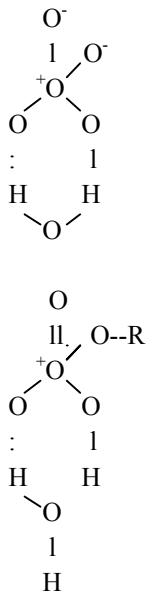
Arrhenius parameters support the bimolecular hydrolysis of these monoesters:

Bimolecular P-S bond fission:



### C. Mechanism of Hydrolysis of mono-negative sps

A hydrogen bond structure formed with water for the mono-negative form of the monoester.

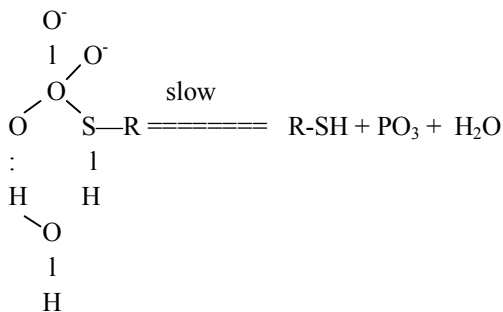
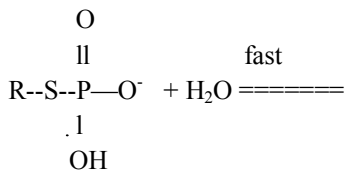


More convenient structure

The following is the most suitable pathway of the mechanism of present monoester via the mono-negative sps with P-S bond cleavage.

Rapid formation of cycle intermediates out of mono-negative sps & water molecule:

# International Journal for Research in Applied Science & Engineering Technology (IJRASET)



## REFERENCES

- [1] Long, F.A & Paul, M.A. *chem.Revs.* 2-14, 57 [1957].
- [2] Bunnet, J.F. *j.Amer.chem.soc.*, 83, [1961]
- [3] Bunnet, J.F., vol. VIII, ed., A. *Weissberger, part-1, ch. VI*, [1961], p177.
- [4] Bunton, C.A, *Elsevier publishing Co.* [1963].
- [5] Lisa, B.M., *Research Gate*, 2/2006:10/1039.
- [6] Lisa, B.M., *Research Gate*, 10/2009, 48/23.
- [7] Donald, C.D, *JOC*, 1963, 28, PP1273-1278.
- [8] Chlebowski, F.J, *JBC*, vol. 249, no 22, nov. 30, pp 7192-7202.





10.22214/IJRASET



45.98



IMPACT FACTOR:  
7.129



IMPACT FACTOR:  
7.429



# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089  (24\*7 Support on Whatsapp)