International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.13 No.03, pp 69-72, 2020

Estimation and Removal of Hazardous Aromatic Amines by the Oxidation with $NaIO_4$ Spectrophotometrically : A Review

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Abstract : Many aromatic amines are the toxic in nature and impact a harmful effect in the body. Conversion of such carcinogenic aromatic amines in to other non carcinogenic compound by the oxidation process through sodium meta periodate is a good attempt in this way. Spectrophotometric method have been used for achieve the optimum condition and the estimation of aromatic amines.
Keywords : aromatic amines, periodate, oxidation products .

Introduction

Decades of industrial activity have resulted in the synthesis of toxic chemicals in to the biosphere. However management of these wastes cannot be equated with safe disposal. Continuation of this trend may have catastrophic impact on human health and environment. Therefore, effective means of solving this pollution problem must be developed to preserve the quality of life for future generations. Aromatic amines are the most important classes of synthetic industrial chemicals and are often present in the industrial effluents from various manufacturing operations [1]. Numerous chemical industries, sending these toxic chemicals in the environment are coal conversion, petroleum refining, textile, timber, dyes and other organic chemicals[2]. The pollutants such as aromatic amines play an important role in ecological balance of some compartments of soil and water [3]. The presences of these chemicals in ground water or in drinking water pose a significant health risk. Studies have shown that aromatic amines, including benzidine can migrate from clothing, textiles and leather articles and may be absorbed through the skin exposing consumers to carcinogens.

Expert authorities such as the World Health Organization (WHO) International Agency for Research on Cancer (IARC) have classified some of these aromatic Amines such as aniline and o-toluidine as known or suspected human carcinogens. Some aromatic amines which behave as carcinogens are aniline, p- toluidine, p-anisidine and 2,5-xylidine.

DOI= http://dx.doi.org/10.20902/IJCTR.2019.130301

Kaushik *et al*. reported the kinetic-mechanistic studies on the periodate oxidation of m-toluidine [4], p-toluidine [5], o-toluidine [6], p-phenetidine [7], in acetone-water medium. In addition, they reported the studies on the role of solvent in the periodate oxidation of few aromatic amines. They used some of these studies for kinetic-spectrophotometric microgram/ nanogram determination of few types of aniline in microgram in aqueous/ mixed media kinetic-spectrophotometrically [8].

Numerous methods have been tried in recent years to remove or to transform these molecules. One of the most promising way to estimate and remove these substances , is spectrophotometric method based on catalyzed or un catalyzed oxidation of aromatic amines by sodium meta periodate. By the process of oxidation of aromatic amines by sodium meta periodate different products are formed which are generally the non carcinogenic compound. So this method is a good attempt for removal of these harmful chemicals from our environment.

Materials and methods

Aromatic amines are transformed to the other compounds by the oxidation with sodium meta periodate where optimum conditioned are obtained through kinetic study of these reactions by spectrophotometric method.

1. Optimum conditions in terms of dielectric constant of medium, pH, temperature, ionic strength etc shall be worked out by making detailed kinetic studies on the uncatalysed/ catalysed periodate oxidation of few aromatic amines. The absorbance of reaction mixture shall be recorded at the absorption maxima (λ_{max}) of reaction mixture. For improving the sensitivity, double beam spectrophotometer shall be employed.

2. Initial rates in terms of change in absorbance with time, $[dA/ dt]_i$ shall be evaluated from absorbance vs. time plots by using plane mirror method of Latshaw [9]. The rate constants (*k*) shall be evaluated by using Guggenheim's method [10]. The calibration curves shall be tried in terms of Absorbance vs. [aromatic amines] or $[dA/ dt]_i$ vs. [aromatic amines] or *k* vs [aromatic amines] plots.

3. An attempt shall also be made to isolate, separate and identify the main reaction products by using solvent extraction, thin layer chromatography, GC-MS and spectroscopic techniques like UV-VIS, IR and NMR spectroscopy.

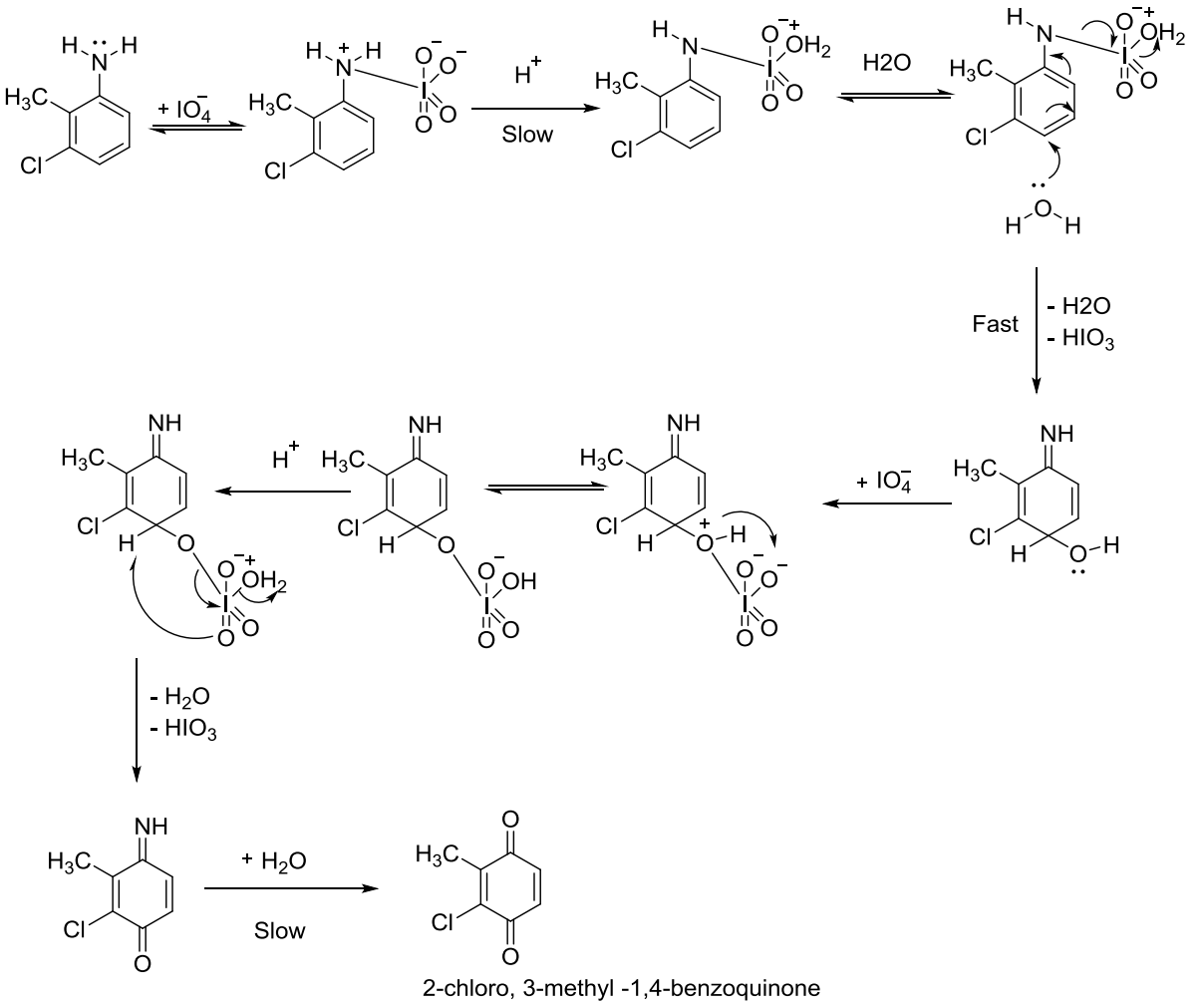
Results

For the estimation of different aromatic amines compounds optimum condition are obtained by observing the λmax of particular compound. The observed λmax of these compounds and main reaction product of different reactions of these aromatic compounds are found to be as given in Table-1.

Table-1:

S No	Aromatic amines	λmax of for max yield (in nanometer)	Main reaction product
1	Aniline	360	2,5-dianilino-p-benzoquinoneimine
2	o-toluidine	525	Methyl-1,4-benzoquinone
3	p-toluidine	474	4-methyl-1,2-benzoquinone
4	p-anisidine	475	4-methoxy-1,2-benzoquinone
5	2,5- xylidine	472	2,5-dimethyl-1,4-benzoquinone
6	3-chloro, 2-methylaniline	514	2-chloro, 3-methyl -1,4-benzoquinone

The proposed mechanism of compound 3-chloro, 2-methylanilinein given by Kaushik *et al* given as below **(Scheme 1).**



Scheme 1

Conclusion:

Oxidation through NaIO4 , aromatic amines can be transformed in to some other compounds generally quinines and imines and those are mostly non carcinogenic compounds. So it is a good attempt for the removal of hazardous aromatic amines from the industrial wastes and for the betterment of environment.

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