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Effect of pH and doses of H_2O_2 on degradation of p-nitobenzoic acid

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ABSTRACT

The present study was used to probe the treatment of simulated wastewater containing p-nitobenzoic acid by photoperoxidation processes. Experiments were conducted in a batch photoreactor to examine the effects of operating variables like pH and ratio of H_2O_2/COD. A pseudo-first order kinetic model was adopted to represent the photooxidative degradation of p-nitobenzoic acid. The degradation of p-nitobenzoic acid acid was found to be maximum at pH 4.5 and ratio of H_2O_2/COD equal to 4.

Keywords: p-nitobenzoic acid, photoperoxidation, pseudo-first order.

INTRODUCTION

In recent years, various studies have reported the occurrence of a large number of pharmaceuticals in surface water, but also in ground water. Surface water and ground water are widely used as water resources for drinking water. Therefore, the widespread occurrence of pharmaceuticals may have a negative impact on purity of drinking water. Complete removal or reduction of hazardous organic pollutants present in wastewater to an acceptable level prescribed by the environmental protection agencies is of prime importance in wastewater treatment. Advanced oxidation processes(AOPs) are the most promising technologies for destroying toxic organic contaminants [1-3].Consequently, AOPs are of high interest to the scientific and industrial communities involved in water treatment and have been successfully applied to the detoxification of water polluted with a wide variety of chemicals such as pesticides , phenols, hydrocarbons, surfactants, dyes and pharmaceutical wastes [4-10].

p-nitrobenzoic acid is produced from oil industry, petroleum refining, etc. It is used as a solvent carrier in paints, inks, thinners, coatings, adhesives, degreasers, pharmaceutical products, printing industry, leather finishing industry, rubber coating industry, shoemakers, etc. p-nitrobenzoic acid is produced as an industrial waste from olive oil distillation industries, chemical and pharmaceutical industries. The objective of this study is to degrade p-nitrobenzoic acid by photo –peroxidation, to examine the effects of operating variables like pH and ratio of H_2O_2/COD and to show that it follows a pseudo-first order kinetics.

METHODOLOGY

Chemicals

Analytical grade p-nitrobenzoic acid was purchased from Merck, India; and was used as received without any further purification and stock solution of 0.01M of p-nitrobenzoic acid was prepared. Initial concentration of p-nitrobenzoic acid used during the experimental runs was 0.08 mM. Stock solution of H_2O_2 was prepared by diluting 30% w/v of peroxide (Qualigens) with distilled water. All stock solutions were stored in amber colored light resistant pyrex glass bottles. Sodium hydroxide (1N) and sulphuric acid (1N) were used for pH adjustments.

Experimental procedure

Batch experiments were conducted at room conditions to determine the effect of pH and H_2O_2 concentration during degradation of p-nitrobenzoic acid. All experiments were conducted out in a photoreactor (Fig. 1) equipped with low pressure mercury lamp (8W, UV-C manufactured by Phillips, Holland) placed in its centre. During the reaction, the solution was stirred by magnetic pellet to ensure its homogeneity.

Synthetic wastewater containing 0.08 mM solution of p-nitrobenzoic acid in double distilled water was used in this study. 750 ml. of this synthetic wastewater was taken in the photoreactor and irradiated with UV lamp of 8W. Various experiments were carried out using UV light with oxidant at various stoichiometric ratios of oxidant/pollutant. The overall degradation reaction was carried out for 3 h with H_2O_2 as oxidant.

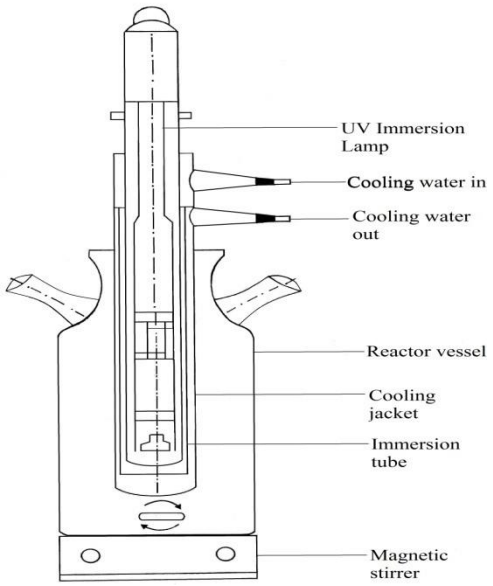

Fig. 1 Photoreactor

Analyses

The initial pH of the solution was measured using Elico pH meter LI-120 equipped with a combined calomel-glass electrode. The H_2O_2 concentration in the stock solution and in samples was determined by standard iodometric titration method described in Jeffery et al. (1989). The UV-visible spectrophotometric method was used for measurement of p-nitrobenzoic acid and H_2O_2 concentration in aqueous solution. A UV-visible spectrophotometer (Spectrascan UV 2600, Chemito, India) was used for this purpose. A calibration plot between absorbance and concentration of p-nitrobenzoic acid was plotted experimentally, which gave a high linear regression coefficient of 0.9982 at 274nm (Fig. 2).

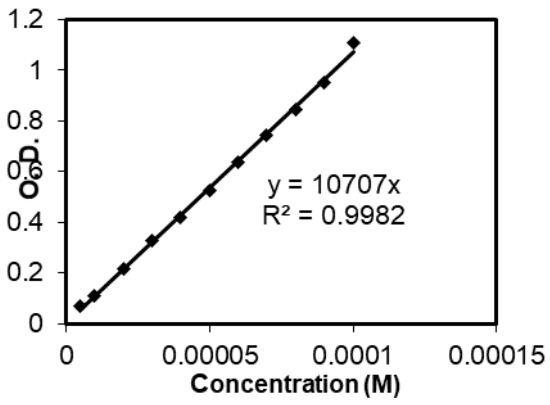

Fig. 2. Beer's law plot of p-nitrobenzoic acid

RESULTS AND DISCUSSION

The results of the various studies in the present investigation are presented subsequently.

Effect of pH

pH is one of the most important parameters to be studied. The rate of degradation of p-nitrobenzoic acid at different pH was observed by carrying out the experiments at different pH conditions namely plain water, 3, 4.5, 7 and 9.2. As depicted in the Fig. 3, in case of H_2O_2 /UV, the maximum degradation of p-nitrobenzoic acid was achieved at neutral pH 4.5 and shows decreasing trend of degradation at higher and lower pH.

Effect of dose of H_2O_2/COD ratio on degradation of p-nitrobenzoic acid

By carrying out a series of experiments of p-nitrobenzoic acid (with different ratio of H_2O_2/COD namely 2, 3, 4, 5, 6); the optimum H_2O_2 stoichiometric ratio was found to be H_2O_2 /COD=4(Fig. 4).

The kinetic study

The semilogarithmic graph of the concentration of p-nitrobenzoic acid with time yield a straight line indicating the reaction is of pseudofirst order (eq. A)

$$-d[C(x)]/dt = k \cdot C(x) \quad \text{..... (A)}$$

Where C(x) is the concentration and k (min^{-1}) is reaction rate constant.

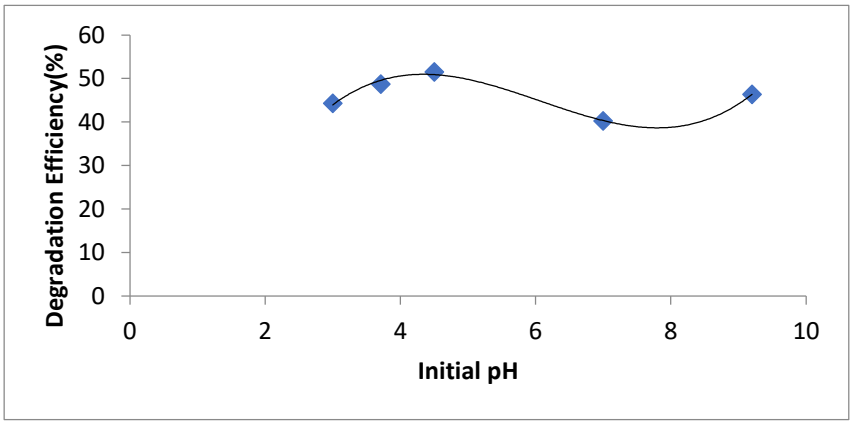

Fig. 3. Effect of initial pH on degradation efficiency for p-nitrobenzoic acid (conditions: [PNBA] = 0.08 mM, H_2O_2 /COD = 4)

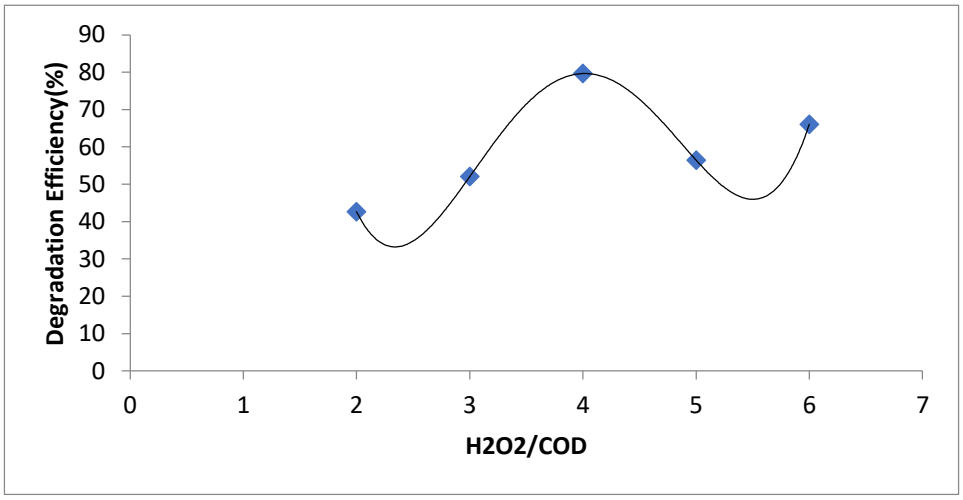

Fig. 4. Effect of initial H_2O_2/COD on degradation efficiency for p-nitrobenzoic acid (conditions: [PNBA] = 0.08 mM, pH = 7)

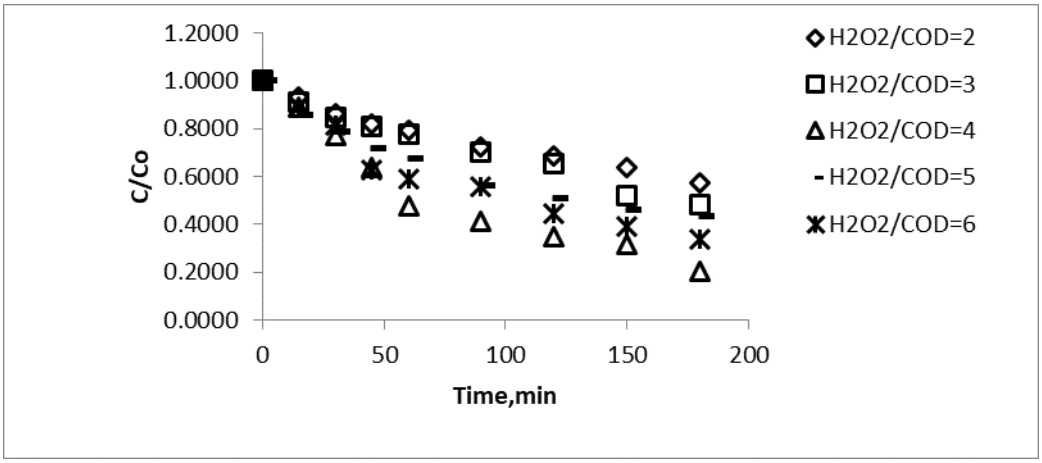

Figure. 5- Concentration decrease p-nitrobenzoic acid as a function of time

CONCLUSION

- Treatment of simulated wastewater containing p-nitrobenzoic acid by simple photoperoxidation has been evaluated in the present study. The obtained results lead to following conclusions:
- The optimum operating conditions for photoperoxidation of treated water was H2O2/COD =4 and pH 4.5. Under this condition the maximum degradation of 80% in 3 hrs. was obtained.
- The present AOP studied adhered to pseudo-first-order kinetics. This is justified since peroxide in case of photoperoxidation (UV/H2O2) is in excess as compared to the substrate concentration.

Conflicts of interest: The authors stated that no conflicts of interest.

REFERENCES

1. Anipsitakis G., Dionysiou D.D., Environ. Sci. Technol. 37(2003) 4790-4797.
2. Huber, M.,2003. Environ. Sci. Technol. 37, 1016-1024.
3. Susmita A. Mandavgane, Nita P. Mohabansi, Mahesh Kumar N. Yenkie; Emerging Material Research; 2014; 3(3), 144-148.
4. Rahat Javaid, Umair Yaqub Qazi, , 2019, International journal of Environmental research and public health, 16 ,2066.
5. Mandavgane Susmita A., Yenkie M. K. N., Degradation of salicylic acid by UV, UV/ H2O2, UV/O3, photofenton processes in Rasayan Journal of Chemistry- International, Vol 4, No 3, 2011, 640-647.
6. Carbala, M., Omill, F., Lema, J., 2005. Removal of cosmetics ingredients and pharmaceuticals in sewage primary treatment. Water Res. 30, 4790-4796.
7. Gogate, P. R., Pandit, A. B., A review of imperative technologies for wastewater treatment I: oxidation technologies at ambient conditions, Adv. Environ. Res. 8(3-4) (2004) 501-551.
8. Lang, K., Brodilova, J., Lunak, S., Photochemical hydroxylation of salicylic acid with hydrogen peroxide; mechanistic study of substrate sensitized reaction, Collect. Czech. Chem. Commun., 61, 1729-1737 (1996).
9. J. Hollender, S. G. Zimmermann, S. Koepke et al., (2009), Environmental Science and Technology, vol. 43, no. 20, pp. 7862–7869.
10. Zanjanchi M. A., Ebrahimian A. and Arvand M. (2010). Journal of Hazardous Materials, 175, 992-1000.
11. Guinea, E., Arias, C., Cabot, P. L., Garrido, J. A., Rodríguez, R. M., Centellas, F.and Brillas, E., (2008). Water Research, 42, 499-511.