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Oxidative degradation of atrazine in aqueous solution by UV/H_2O_2/Fe^{2+}, UV/$S_2O_8^{2-}$/Fe^{2+} and UV/HSO_5^-/Fe^{2+} processes: A comparative study

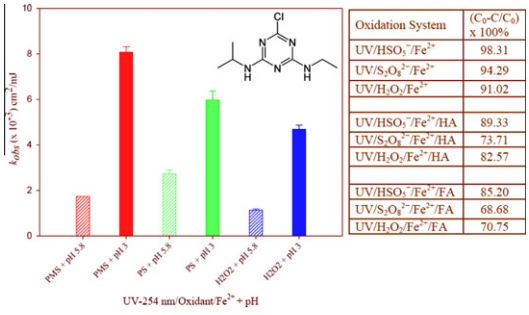
Javed Ali Khan [a,b], Xuexiang He [b], Hasan M. Khan [a], Noor S. Shah [a,b], Dionysios D. Dionysiou [b,c,*]

[a] Radiation Chemistry Laboratory, National Centre of Excellence in Physical Chemistry, University of Peshawar, Peshawar 25120, Pakistan
[b] Environmental Engineering and Science Program, University of Cincinnati, 705 Engineering Research Center, Cincinnati, OH 45221-0012, USA
[c] Nireas-International Water Research Centre, University of Cyprus, Nicosia 20537, Cyprus

HIGHLIGHTS

- Removal of atrazine was studied by UV/H_2O_2/Fe^{2+}, UV/$S_2O_8^{2-}$/Fe^{2+} and UV/HSO_5^-/Fe^{2+}.
- UV/HSO_5^-/Fe^{2+} was found to be the most efficient at pH 3.0 in degrading atrazine.
- UV/$S_2O_8^{2-}$/Fe^{2+} showed to be the most efficient at pH 5.8.
- Natural organic matter negatively impacted the efficiency of these processes.
- The stability of $S_2O_8^{2-}$ possibly led to a higher removal of TOC by UV/$S_2O_8^{2-}$/Fe^{2+}.

GRAPHICAL ABSTRACT



Oxidation System	$(C_0\text{-}C/C_0)$ x 100%
UV/HSO_5^-/Fe^{2+}	98.31
UV/$S_2O_8^{2-}$/Fe^{2+}	94.29
UV/H_2O_2/Fe^{2+}	91.02
UV/HSO_5^-/Fe^{2+}/HA	89.33
UV/$S_2O_8^{2-}$/Fe^{2+}/HA	73.71
UV/H_2O_2/Fe^{2+}/HA	82.57
UV/HSO_5^-/Fe^{2+}/FA	85.20
UV/$S_2O_8^{2-}$/Fe^{2+}/FA	68.68
UV/H_2O_2/Fe^{2+}/FA	70.75

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ABSTRACT

The degradation of atrazine, a widely used endocrine disrupting, carcinogenic and persistent herbicide, was investigated by photo-Fenton and photo-Fenton-like advanced oxidation technologies (AOTs): UV/H_2O_2/Fe^{2+}, UV/$S_2O_8^{2-}$/Fe^{2+} and UV/HSO_5^-/Fe^{2+}. The study was carried out at two pH value conditions, i.e., pH 3.0 and pH 5.8. At pH 3.0, UV/HSO_5^-/Fe^{2+} was found to be the most efficient technology whereas UV/$S_2O_8^{2-}$/Fe^{2+} was observed to be the most effective at pH 5.8. The degradation of atrazine followed *pseudo-first-order* reaction with the highest observed rate constant of 2.00×10^{-2} cm^2/mJ in UV/HSO_5^-/Fe^{2+} system at the initial concentrations of 4.64 μM atrazine, 46.4 μM HSO_5^- (PMS) and 35.81 μM Fe^{2+}. The UV fluence required for the complete removal of 4.64 μM atrazine at initially 92.80 μM of oxidant and 8.95 μM of Fe^{2+} concentrations at pH 3.0 was found to be 480, 720 and 960 mJ/cm^2 in UV/HSO_5^-/Fe^{2+}, UV/$S_2O_8^{2-}$/Fe^{2+} and UV/H_2O_2/Fe^{2+} systems, respectively. Humic and fulvic acids were found to negatively impact the degradation of atrazine. The removal of TOC was not significant unless a high UV fluence was applied. At an initial concentration of 18.56 μM atrazine, 1856.00 μM oxidant and 17.91 μM Fe^{2+}, a 62.94%, 47.10% and 44.09% decrease in TOC was achieved at a UV fluence of 6000 mJ/cm^2 in UV/PS/Fe^{2+}, UV/PMS/Fe^{2+} and UV/H_2O_2/Fe^{2+} systems, respectively. Nevertheless, it is suggested in this study that photo-Fenton and photo-Fenton-like technologies are capable of removing atrazine from water efficiently.

1. Introduction

Pesticides are among the most widely used organic chemicals in the world and they are the most frequently found organic contaminants in soil, surface and drinking waters [1,2]. Large quantities of pesticides for agricultural and a relatively small amount for health purposes are used throughout the world [3,4]. Most of the pesticides that were used in the past are toxic to both humans and ani-

* Corresponding author at: Environmental Engineering and Science Program, University of Cincinnati, 705 Engineering Research Center, Cincinnati, OH 45221-0012, USA. Tel.: +1 513 556 0724; fax: +1 513 556 2599.
E-mail address: dionysios.d.dionysiou@uc.edu (D.D. Dionysiou).

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