Available online at www.sciencedirect.com

ScienceDirect

Procedia Technology 24 (2016) 645 – 653

Procedia Technology

International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST - 2015)

Removal of Dicofol from Waste-Water Using Advanced Oxidation Process

Sibhi Mohammed[a], Fasnabi P.A[b]*

[a]*Department Of Chemical Engineering, GEC Trichur, Thrissur Kerala 680009 India*
[b]*Professor, Department Of Chemical Engineering, GEC Trichur, Thrissur Kerala 680009 India*

Abstract

Water is perhaps our most valuable resource and thus should be recycled. Many of the current waste water treatment only concentrate on the pollutant without degrading it or eliminating it. In this sense, Advanced Oxidation Processes (AOP) are possibly one of the most effective methods for the treatment of wastewater containing organic products. It uses different methods to produce hydroxyl radicals which are responsible for oxidation of pollutants. This work deals with the study on Fenton process and UV/ H_2O_2 process for the removal of dicofol present in waste water. Dicofol is an organochlorine pesticide which is structurally similar to DDT and used extensively in a wide variety of crops. The effects of pH, H_2O_2 concentration and Fe^{2+} concentration for AOP processes are studied for water sample containing dicofol. Kinetic studies were conducted for Fenton, UV/H_2O_2 and H_2O_2 processes at the optimized conditions, which show the applicability of first order kinetics.

Peer-review under responsibility of the organizing committee of ICETEST – 2015

Keywords: AOP; Fenton

1. Introduction

The last century saw a glut of new chemical industries rising up to successfully meet the escalating requirements of commodity chemicals like detergents, dyes, pesticides and so on. Treatment of effluents of such industries has always been tenacious and cumbersome. Currently these are centered on solvent extraction or adsorption rather than biological treatment of effluents which can be lethal to the microbes involved.

*Tel.: +91 9495464599;
E-mail address: fasna@gectcr.ac.in

Peer-review under responsibility of the organizing committee of ICETEST – 2015
doi:10.1016/j.protcy.2016.05.160

Pesticide is any substance or mixture of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals, causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies.

Pesticides that are applied correctly may wash away from the application site. Rain falling on a treated area before the pesticide binds or degrades may carry the pesticide to surface water sources. Pesticides can seep into and through the soil during recharge of groundwater and get into aquifers. Pesticides are sometimes applied directly to lakes or wetlands for control of aquatic weeds, insects, or fish. However, these products are labeled to avoid use near drinking water systems [1].

We use a wide variety of pesticides throughout the world for the different crops and pests Here we are concentrating on dicofol, an organochlorine miticide or acaricide used extensively in agriculture and horticulture to control spider, mites and soft-bodied mites in apples, pears, soft fruit, cucumbers, tomatoes, hops, vines, lettuce and ornamentals[2]. Dicofol is structurally similar to DDT. It is cumulative in the environment. Dicofol has a chemical formula of $C_{14}H_9Cl_5O$ with IUPAC names 2,2,2-Trichloro-1 and 1-bis (4-chlorophenyl) ethanol[3].

1.1. Advanced Oxidation Process

Advanced Oxidation Processes (AOPs) are a group of oxidation processes carried out to remove harmful persistent organic pollutants (POPs) from water. AOP can be done in various ways. In all cases, the production of $HO^{\bullet}$ radicals which are highly reactive attacks most of the organic molecules. The general equation involved in AOP is [4].

$$RH + HO^{\bullet} \rightarrow HR^{\bullet} + H_2O$$

1.2. H_2O_2/UV process

This is a non-catalytic Advanced Oxidation Process, which involves the generation of hydroxyl radicals from hydrogen peroxide through photolysis of H_2O_2 and other corresponding propagation reactions. Photolysis occurs with the help of UV radiation as shown in the equation below.

$$H_2O_2 \ (h\nu) \rightarrow 2OH^{\bullet}$$

Propagation reactions are the following [5]:

$$H_2O_2 + OH^{\bullet} \rightarrow OH_2^{\bullet} + H_2O$$

$$H_2O_2 + OH_2^{\bullet} \rightarrow OH^{\bullet} + O_2 + H_2O$$

$$2OH_2^{\bullet} \rightarrow H_2O_2 + O_2$$

Decomposition of Hydrogen peroxide:

$$H_2O_2 + OH^{-} \rightarrow H_2O + OH^{\bullet} + O_2$$

And the radical recombine as shown below:

$$2OH^{\bullet} \rightarrow H_2O_2$$

1.3. Fenton Process

The Fenton process was reported by Fenton already over a hundred years ago for maleic acid oxidation. Fenton reaction is a very efficient chemical reaction for the removal of organic pollutants, in which the overall reaction is a simple redox reaction where Fe(II) is oxidized to Fe(III) and hydrogen peroxide is reduced to hydroxide ion and