Abstract

Recently, much attention has been paid to pharmaceutical residues known for their potential effect on environmental pollution, mainly due to their high content of bioactive chemicals. Also, pharmaceuticals are considered emerging pollutants in wastewater, as they are still unregulated.

Antihistamines are drugs that treat allergic rhinitis and other allergies. Their widespread use in the therapeutic field also results in their dissemination in the environment, which generates risks of resistance to biodegradation. It is therefore necessary to monitor their evolution in contaminated environmental media and to develop economically viable depollution techniques.

Currently, advanced oxidation processes (AOPs) can be an alternative to conventional methods for the treatment of wastewater and for the improvement of drinking water production processes.

The Fenton process is considered one of the most powerful advanced oxidation processes. The Fenton reaction is based on the production of hydroxyl radicals ($^{\bullet}OH$) resulting from the reaction of hydrogen peroxide (H_2O_2) with catalyst ferrous ions (Fe^{2+}) under acidic conditions.

The main objective of this study is to test the effectiveness of two processes: the heterogeneous photo-Fenton system (UV/CPH/Magnetite/H_2O_2) and the heterogeneous photo-Fenton oxalate system (UV/CPH/Magnetite/Oxalic acid) in the removal of a pharmaceutical compound, Cyproheptadine (CPH), from water. This study aims to compare and optimize the conditions maximizing the elimination of Cyproheptadine by these two processes. A comparison between the evolution of the dissociation of H_2O_2 by the (UV/CPH/Magnetite/H_2O_2) system and the formation of H_2O_2 by the (UV/CPH/Magnetite/Oxalic acid) system was established with a determination of the level of the $^{\bullet}OH$ radical formed by each of the two systems. Then, the rate of H_2O_2 and Fe(II) ions formation in the (UV/CPH/Magnetite/H_2O_2) was studied under various conditions. Total organic carbon (TOC) and chemical oxygen demand (COD) methods were also used to estimate the degree of mineralization of Cyproheptadine molecules. The structural properties of magnetite (MGN) were determined by X-ray diffraction (XRD).

The evaluation of heterogeneous photo-Fenton reaction in the presence of Magnetite (MGN) shows a gradual decrease in the Cyproheptadine concentration as a function of the irradiation time during the reaction, a complete degradation of 100% was obtained after 120 minutes of treatment and a gradual decrease in COD values as a function of treatment time confirm that the degradation of Cyproheptadine by the heterogeneous photo-Fenton process led to the decrease in the amount of organic matter.

It was found that Cyproheptadine was completely degraded after 60 min during heterogeneous photo-Fenton oxalate process (UV/CPH/Magnetite/Oxalic acid) and the degradation rate constant of Cyproheptadine by this process is more than 5, 3 times and 13.5 times higher than that obtained by heterogeneous photo-Fenton and homogeneous photo-Fenton processes, respectively. TOC measurements showed 80% mineralization of a 10 mg L^{-1} CPH solution after 180 min of heterogeneous photo-Fenton oxalate treatment, while for the same length of treatment time, measurements of COD showed 99.5% removal. The study of the influence of the experimental parameters on the degradation of Cyproheptadine made possible the optimization of the two processes studied conditions (UV/CPH/Magnetite/H_2O_2) and (UV/CPH/Magnetite/Oxalic acid).

Keywords: Cyproheptadine; Magnetite; Heterogeneous Photo-Fenton; Heterogeneous photo-Fenton oxalate; Oxalic acid; H_2O_2.