Impact of microplastics occurrence on the removal of emerging pollutants by Fenton oxidation

Neus López Aragó*[1], Marina Clemente[1], Macarena Munoz[1], Zahara Martínez De Pedro[1], and Jose A. Casas[1]

[1]Universidad Autonoma de Madrid – Ciudad Universitaria de Cantoblanco · 28049 Madrid, Spain

Abstract

Advanced Oxidation Processes (AOPs) are regarded as promising treatments for the removal of emerging pollutants like hormones, pharmaceuticals, or pesticides, at wastewater treatment plants (WWTPs). Nevertheless, WWTP effluents are usually loaded with microplastics (MPs), which could somehow hinder the efficiency of AOPs as tertiary treatments. In fact, WWTPs were recently identified as a major source for the introduction of microplastics (MPs) into the aquatic environment, being MPs the main kind of suspended solids present in their discharges. In this work, the effect of MP nature (polystyrene (PS) and low-density polyethylene (LDPE)), size (20–1000 μm), and concentration (50–250 mg L-1) on the degradation of sulfamethoxazole (SMX) by Fenton oxidation was evaluated. Oxidation tests were performed in a glass stirred reactor (100 mL, 500 rpm) at 25^{o}C and pH0=3. The initial SMX concentration was set at 500 μg L-1, and H2O2 and Fe3+ doses at 10 mg L-1. The MP nature showed a remarkable effect on SMX degradation. While LDPE did not show any impact on the oxidation rate of SMX, the presence of PS significantly hindered its degradation. In both cases, dissolved iron concentration remained practically unchanged and thus, hydroxyl radicals consumption by MPs seems to be the main reason for the activity decay. PS preferentially consumed hydroxyl radicals due to the presence of aromatic rings in its structure, while LDPE, formed by alkanes, was not susceptible to being attacked. On the other hand, the decrease of MP size as well the increase of MP concentration led to a decrease on the SMX oxidation rate due to the higher exposed surface of the plastic particles and thus, the greater consumption of hydroxyl radicals. These results prove that, although MPs do not prevent the Fenton oxidation of emerging pollutants, operating conditions optimization could be required to warrant their complete degradation.

Keywords: Microplastics, wastewater treatment, advanced oxidation processes, Fenton oxidation

*Speaker