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Oxidation of sulfamethoxazole by rice husk biochar-activated persulfate: factors affecting the process's efficiency

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Valorization of biomass can be performed with a variety of processes. An interesting process is the production of fuels during pyrolysis. The solid remaining of this process is called biochar. Biochar, a carbonaceous material, has unique physicochemical properties and, as a result, it can be used in several processes. In this study, biochar from rice husk was produced under different pyrolysis temperatures and used as persulfate activator for the oxidation of sulfamethoxazole.

Specifically, biochar from rice husk was synthesized pyrolyzing the raw material for 1 hour under limited-oxygen atmosphere at four different pyrolysis temperatures: 400, 550, 700, and 850°C, and employed as catalyst of persulfate activation for the removal of sulfamethoxazole (SMX). SMX degradation experiments were performed mainly in ultra-pure water (UPW) using various biochar, persulfate and SMX concentrations and altering solution pH ($3 < pH < 10$). More complex matrices, besides UPW, were also tested, namely treated wastewater (WW) and bottled water (BW). Also, synthetic matrices were prepared by spiking UPW with some possible inhibitors of the process.

The presence of the biochar was crucial for the process as it contributes to the SPS activation resulting in faster and higher removal of the target compound. Adsorption and oxidation rates increase when biochar, produced at higher pyrolysis temperature, is used. The maximum removal is observed in the case of the highest pyrolysis temperature ($T = 850°C$) biochar.

Acidic environment generally facilitates the adsorption of the micro-pollutant compared to the basic environment, while the oxidation reaction decelerates accordingly to the complexity of the water matrix. The addition of alcohol has only a slightly negative effect on the efficiency of the process contrary to the addition of sodium azide which causes a major reduction. This may indicate that the reaction pathway is under electron transfer / singlet oxygen control rather than the active radicals' one.

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