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Oxidation of sulfamethoxazole by biochar-activated persulfate: Influence of the preparation temperature on the activity of biochar from spent coffee grounds

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ABSTRACT

Biochar is a carbonaceous material prepared by pyrolysis of raw biomass. Due ti its unique physicochemical properties biochar can be used in several processes. In this study biochar from spent coffee grounds was produced under different pyrolysis temperatures and used as persulfate activator for the oxidation of sulfamethoxazole.

Specifically, biochar from spent coffee grounds was synthesized under five different pyrolysis temperatures −300, 400, 600, 700, and 850°C for 1 h, and employed as catalyst for the removal of

sulfamethoxazole (SMX) by persulfate activation. SMX degradation experiments were performed mainly in ultra-pure water (UPW) with a biochar (catalyst) concentration of 100 mg /L, a persulfate concentration of 500 mg/L and a substance concentration of 500 μg/L and in pH at different pH values (3 <pH <10). Real matrices, besides UPW, were also tested, namely treated wastewater (WW) and bottled water (BW), while synthetic solutions were prepared spiking UPW with bicarbonate, chloride, humic acid or alcohols.

The presence of the biochar is important for the process as it contributes to the activation of the SPS resulting in faster and greater removal of the substance. The rate of adsorption and oxidation, which follows a pseudo-order kinetic model, increases when biochar, produced at higher pyrolysis temperature, is used for the experiment. The maximum removal is observed in case of the highest pyrolysis temperature (T= 850 °C) biochar.

The presence of an acidic environment generally facilitates the adsorption of the micro-pollutant compared to the alkaline environment while the oxidation reaction is slowed down when a real aqueous matrix is used. The addition of alcohol has a small effect on reducing the efficiency of the process, which may indicate that the reaction pathway is under electron transfer control instead of active radicals.

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