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Removal of chloroform from water and wastewater using various sorbents

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Water and wastewater chlorination can cause the formation of toxic by-products such as chloroform. Drinking water limits for chloroform is 100 μg/L. Most of the studies in the literature that study the removal of chloroform from water were performed at higher concentrations than the limit. In the present research, the kinetics of chloroform removal were studied in distilled water (1D) and in secondary treated effluents (WW) of the wastewater treatment plant of the University of Patras at initial concentration equal to the drinking water limit. Various sorbent materials such as a commercial activated carbon, an agro-industrial by-product biomaterial (coffee residue) and four biochars were used. Biochars, were produced by pyrolysis at 850 0C in a restricted oxygen environment in specialized vessels to create large surface areas and micropores. Different raw materials were used to produce biochars such as malt spent rootlets, coffee residue, olive and grape seeds. Batch tests were employed to study the chloroform removal kinetics using different materials. Chloroform initial concentration was 100 μg/L, the mass of our sorbents was 3 mg and the volume of the solution was 15 mL in 20 mL vials. We analyzed our samples with the headspace technique using GC- ECD Agilent 6890. Our samples were a blank sample with the chloroform solution only and a sample with the chloroform solution and the sorbent. In particular, the 1st order rate constant (k) and the half-life time for each material were calculated in order to determine the material with the fastest kinetics. For our biomaterial (coffee residue) the removal k were 0.032 and 0.025 min-1 for 1D and WW, respectively. For the activated carbon, the removal k ranged between 0.016 and 0.020 min-1 for 1D and WW, respectively. For the biochars, the removal k ranged between 0.009 to 0.018 min-1 and between 0.018 to 0.023 min-1 for 1D and WW, respectively, with the biochar made from grape seeds (Gse) being the fastest in 1D. In 1D, the removal of chloroform, was faster for the biomaterial (KES0 k = 0.032 min-1) and one of the biochars (Gse k = 0.018 min-1) compared to the activated carbon (AC1 k = 0.016 min-1). In WW, similar trends are observed among materials. For the activated carbon and most biochars, a faster removal of chloroform was observed in WW than in 1D.

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