

Micropollutants removal in water with sol-gel carbon xerogel adsorbents regenerated *in situ* by H₂O₂ electro-generation

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The intense industrialization of last century has resulted in the emergence of Refractory Organic Compounds (ROCs) such as dyes, aromatics, pesticides, solvents or pharmaceutical products causing disturbances of aquatic life and risks to human health [1, 2]. These contaminants mostly escape conventional wastewater treatments. In order to limit the dispersion of these organic contaminants in the environment, wastewater must be subjected to more advanced (and yet to be developed) pollution abatement treatments. Adsorption on highly porous materials has proven very effective for ROCs removal [3]. One of the main drawbacks of adsorption with carbon materials is the need for regeneration usually performed at temperature up to 800 °C and degrading carbon adsorbent properties [4]. An alternative to these processes, which is currently under study, is the direct production of H₂O₂ via water electrolysis with a two-electrode cell [5, 6]. Indeed, H₂O₂ presents strong disinfecting and oxidizing properties, and is able to convert toxic organics into less harmful molecules [5, 6]. The effectiveness of degradation by H₂O₂ can be increased under UV illumination and with some metallic nanoparticles or ions leading to a higher conversion of H₂O₂ in hydroxyl radicals by photocatalysis [7,8].

The process developed in this study is based on adsorption with carbon xerogels, coupled with *in situ* regeneration of the adsorbent by H₂O₂ electro-generation and its enhanced decomposition in •OH radicals thanks to UV illumination. The *in situ* regeneration of the carbon materials aims at replacing the usual thermal regeneration, which is costly and degrades gradually the adsorption properties.

First, carbon xerogels were synthesized by sol-gel process and molded as 5x1 cm cylinders. Their physico-chemical properties such as their specific surface area, pore texture and surface composition, were determined. Then, the adsorption of three model pollutants on these carbon xerogel cylinders was performed. In parallel, the electro-generation of H₂O₂ within these cylinders illuminated by UV light, which aims at producing *in situ* a powerful oxidant capable of eliminating the adsorbed pollutant, was studied. Finally, *in situ* regeneration of saturated carbon cylinders was performed.

Cylindrical carbon xerogels were synthesized with four different pore sizes from resorcinol and formaldehyde with sol-gel process. Their adsorption properties towards three different model pollutants (i.e. methylene blue (MB), p-nitrophenol (PNP) and ibuprofen (IB)) were determined. Long-time exposure was performed to determine the adsorption kinetics and capacities for each case. Concentrations of pollutants higher than those commonly found for micropollutants in wastewater were selected in order to reach UV-visible spectroscopy detection levels.

Concerning H₂O₂ electro-generation, a constant concentration of H₂O₂ of 4 mg/L can be obtained at low current (0.1 A) with the best carbon material. Finally, first results showed that the regeneration of an PNP-saturated cylinder could be done in 5 h thanks to H₂O₂ electro-generated and UVA illumination.

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