

ADSORPTION OF REPRESENTATIVE PHARMACEUTICAL COMPOUNDS FROM HOSPITAL WASTEWATER BY CARBON MATERIALS

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Pharmaceuticals are a class of emerging environmental contaminants that are extensively and increasingly being used in human and veterinary medicine. The worldwide consumption of these substances has increased in both hospitals and households, which represents a major concern in terms of their potential harmful effects on the environment and human health [1]. Thus, fluoroquinolone antibiotics are widely used in human medicine and animal breeding for preventing and curing diseases. Ciprofloxacin is a wide-spectrum fluoroquinolone antibiotic extensively used in the world, which can generate high contributions to public sewers. Meanwhile, carbamazepine, one of the most widely prescribed psychoactive drugs, shows important endocrine disrupting effects and it is frequently detected in high concentrations in both WWTPs effluents and river water. Because of the removal efficiency of these compounds in the conventional wastewater treatment plants is not complete (ranging from 7-8% for carbamazepine), it is necessary the implementation of tertiary technologies in order to achieve WWTPs effluents with a better quality. Adsorption onto carbon materials has proven as an efficient treatment in the removal of a broad spectrum of micro-pollutants.

This work has been focused on the study of equilibrium adsorption of carbamazepine (CBZ) and ciprofloxacin (CPX) from ultrapure water at 30 °C using carbonaceous materials. Commercial carbon materials (AC-F400 activated carbon, multi-walled carbon nanotubes, MWNT, and carbon nanofibers, CNF) and lab-synthesized activated carbons from peach stones (AC-PS) and rice husk (AC-RH) as precursors have been used. Moreover, carbon adsorbents have been used to treat a real hospital wastewater containing 55 different pharmaceutical compounds. Among them, both CBZ and CPX were found at concentrations of 162.55 and > 40 ng.L⁻¹, respectively. The removal efficiency of quality macroscopic parameters (Total Organic Carbon concentration, TOC, Total Nitrogen concentration, TN, carbonates, CO₃²⁻, and aromaticity) and each of the pharmaceuticals contained in the wastewater was evaluated. Large adsorption capacities of CBZ and CPX (around 240 and 200 mg.g⁻¹) were found in 4 hours, using adsorbent doses ranging from 2-3 g.L⁻¹, natural pH, temperature of 30 °C and stirring rate of 250 rpm. In addition, competitive adsorption experiments using both pollutants in ultrapure water have been performed. The bi-component adsorption systems were reasonably well-fitted by the extended Freundlich model equation.

In the treatment of the hospital wastewater, a maximum TOC reduction of 96.5% ([TOC]₀ = 110 mg L⁻¹) was achieved by adsorption onto AC-RH activated carbon, since all the studied macroscopic parameters were too efficiently removed. Moreover, by the adsorption treatment, the complete disappearance of all the pharmaceutical compounds (except two of them) was observed.

References

[1] S. Ortiz de García, G. Pinto Pinto, P. García Encina, R. Irusta Mata, Consumption and occurrence of pharmaceutical and personal care products in the aquatic environment in Spain, *Sci. Total Environ.* 444 (2013) 451–465.