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Cetylpyridinium chloride/magnetic alginate beads: an efficient system to remove p-nitrophenol from wastewater

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The adsorption process is one of the most efficient methods to remove pollutants from wastewater provided that suitable adsorbents are used. In order to produce environmentally safe adsorbents, natural polymers have received increasing attention in recent years. Thus, alginate, a polysaccharide extracted from brown seaweeds, is extensively used as inexpensive, non-toxic and efficient biosorbent. Furthermore, it has been shown that the encapsulation of magnetic materials in alginate beads facilitates their recovery from wastewater after the adsorption step, by the use of an external magnetic field gradient, obtained with a magnet or an electromagnet [1, 2].
In the present work, we have studied the adsorption affinity of magnetic alginate beads (called magsorbents)for p-nitrophenol (PNP), used as a hydrophobic pollutant, in presence of cetylpyridinium chloride (CPC), a cationic surfactant.
First, the effect of different parameters (pH solution, contact time, surfactant initial concentration…) on the adsorption of CPC on the alginate beads was investigated. Adsorption of the surfactant occurs due to electrostatic attractions between its cationic head groups and negative carboxylate functions of the alginate beads. At larger surfactant concentrations, adsorption is also due to the interaction between the hydrocarbon chains of CPC forming aggregated structures capable of solubilizing hydrophobic solutes.
In a second step, we showed that PNP can reach up to 95% of adsorption in the beads in presence of CPC, although the pollutant is poorly adsorbed by alginate in absence of the surfactant. At highest CPC concentrations, desorption occurs as micellar solubilization is preferred over coadsorption.
Our magsorbents appear to efficiently remove both cationic surfactant and hydrophobic pollutants and we hope that this fundamental research will be helpful for the future development of magnetically assisted processes in water treatment plants.

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