P65

Carbon xerogels for the removal and photodegradation of Yellow-5 under solar irradiation

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Introduction

Environmental pollution and the production of clean energy are two major goals for the XXI century. Photocatalysis has emerged as a sustainable process for water remediation using active carbons with high microporosity [1]. However, in water treatment processes the so called feeder pores play an important role. Synthetic carbons with very well controlled porous structure were produced with analogous surface chemistry and microporosity, being the feeder pore size the only difference. The role of the mean pore size on the adsorption capacity and photodegradation of yellow-5 (Y-5) was evaluated.

Experimental

Organic xerogels were synthesized from polymerization of resorcinol (R) and formaldehyde (F) mixtures in water under microwave heating. Porous structure can be design by tuning the synthesis variables [2]. A series of organic xerogels with different pore size (i.e. 5, 10, 20, 40 and 100 nm) were obtained. The polymers were carbonized under nitrogen flow at 1000ºC and denoted as CX (for Carbon Xerogel). The kinetics of adsorption and photodegradation under solar irradiation of yellow-5 (Y-5) were performed. Results were compared as a function of the surface density of molecules and the textural properties of the carbon xerogels.

Results and discussion

An optimum feeder pore size for Y-5 adsorption in the dark (i.e. 20 nm) was found. The narrow mesopores (i.e. 5 nm) inhibit the diffusion of Y-5; while the samples with wider pores (i.e. 40 and 100 nm), showed a low uptake. Contrary to nanoporous carbons [1], CX exhibit very low photocatalytic activity, but a synergistic effect was found TiO_2-P25, improving the disappearance of Y-5. This synergy effect is highly dependent of the initial concentration of Y-5 suggesting mass diffusion from bulk of solution is the driven force for the adsorption and the photocatalytic activity.

Conclusions

The mean pore diameter of CX influences the uptake of Y-5, and the maxima photocatalytic activity was found for pores of ca. 20 nm. The photoactivity was highly affected by the initial concentration of Y-5 suggesting that intraparticle diffusion model play an important role on the diffusion of Y-5 molecules from the bulk of solution.

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