Adsorption study of acid orange 8 dye using silica nanoparticles obtained from sugarcane ash

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Developing of new adsorbents becomes a very important need, especially because of the increase of contaminants present in rivers, oceans and any other water body capable of became potable. Biosorbents has a special feature, because they can solve two problems at the same time, once they are prepared from a natural source, giving a utility for wasted materials, and bioremediate a water body, adsorbing contaminants on their surface. In this context, the properties of a biosorbent prepared from sugarcane ash by surfactant mediated synthesis has been studied to the adsorption of acid orange 8 dye, a model molecule, aiming future applications for removal of emerging contaminants of water. According to the results of adsorption kinetic (Fig. 1A), the acid orange 8 dye removal was higher than 89% and 95% in 4 h of contact time for an initial concentration of 200 and 150 mg L^{-1}, respectively. FTIR-ATR analyses (Fig. 1B) indicated the presence of bands: at 799 and 446 cm^{-1} are due to symmetric stretching of siloxane groups, at 1058 cm^{-1} is due the Si–O–Si asymmetric stretching, at 2925 cm^{-1} and 2850 cm^{-1} are due to the bending of $–CH_3$ and $–CH_2$, respectively, for silica-CTAB sample and additionally, at 1031, 689 and 641 cm^{-1} are due sulfur groups (S=O), out-of-plane deformation of ring and aromatics groups, respectively, of acid orange 8 dye. In TGA analysis (Fig. 1C), the peak between 150 to 235 °C for silica-CTAB sample has been attributed to the unbound CTAB less stabilized bonding sites on the silica surface due to hydrophobic–hydrophobic interactions of interdigitated CTAB and the peak around 256 °C indicates a stronger bonding of the surfactant to the silica surface due to the electrostatic binding of the ammonium cation head group to the electronegative silica surface [1]. For the silica-CTAB + dye sample, the substitution of the interdigitated CTAB of a second layer by dye was observed by the disappearance of the DTG peak between 150 to 235 °C. The displacement the DTG peak of 256 for 300 °C and appearance of the DTG peak around 435 °C are related to the dye adsorption. These aspects demonstrate the potential of silica nanoparticles obtained from sugarcane ash as new biosorbent for removal of organic compounds, such as, dye from aqueous solution and can be used to alleviate environmental problems.

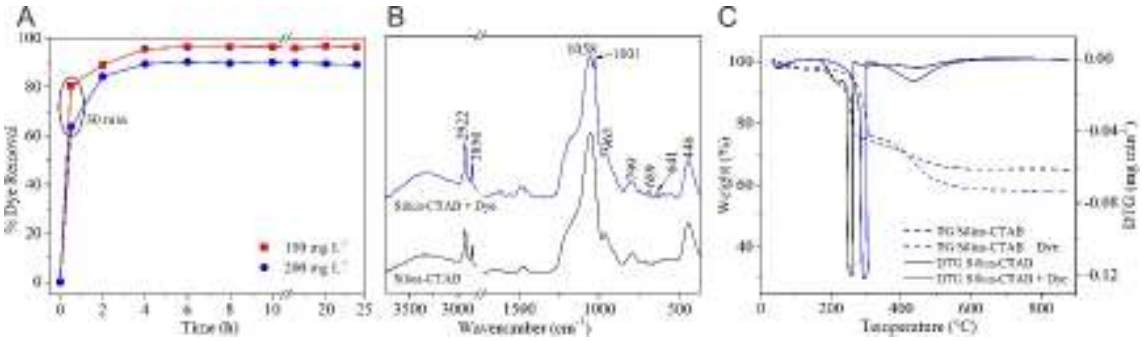

Figure 1. Adsorption kinetic of acid orange 8 dye $C_{initial}$ = 150 and 200 mg L^{-1} (A), FTIR-ATR spectra of silica-CTAB in black and silica-CTAB + dye in blue (B) and curves of TG and DTG of silica-CTAB in black and silica-CTAB + dye in blue (C).

[1] Guan, H. *et al.*, *Journal of Hazardous Materials*, 183, 616-621, **2010**.