Adsorption, Desorption and Recovery of Orange II using organofunctionalized Sepiolite.

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Introduction

The use of industrial dyes has been highlighted as an important environmental problem, due to the large volume of waste generated, which in most cases are not properly disposed of. Adsorption is one of the most effective separation techniques for removal of pollutants and also offers great potential for the regeneration, recovery and recycling of the adsorbing materials. These treatments are required because of industrial applications and environmental protection, associated also to low cost of adsorbents and processes. Thus, in this work we describe adsorption, desorption and reuse of hybrid materials based on sepiolite applied to adsorption of industrial dyes.

Results and Discussion

In this study we used a natural fibrous clay, sepiolite, from Vallecas (Madrid, Spain), which was purified by the dispersion and sedimentation method, based on the Stokes law. Characterization results showed that the impurities were completely removed, resulting in a highly pure clay. The silylation reaction based on previous work of Detellier et al.[1] has been used for functionalization of clays; the clay is kept in contact with an excess of APTES (3-aminopropyltriethoxysilane) in an alkoxide:clay molar ratio of 5:1 at 190ºC under an inert atmosphere. After washing and drying overnight at 100ºC, the solid (Sep-APTES) was submitted to adsorption tests using the anionic dye Orange II, the process being followed by UV-Vis spectroscopy. After determining the amount of dye in the supernatant liquid, this was discarded and the solid submitted to desorption experiments. After evaluating the desorption capacity of the material, the supernatant liquid was again discarded, and new adsorption tests were performed. The adsorption kinetics and equilibrium studies using Orange II and organofunctionalized sepiolite are shown in Figure 1. The materials resulting from the adsorption studies, containing the adsorbed dye, were submitted to desorption in the following solutions: water, methanol (MeOH), NaCl in water (0.1 mol.L^{-1}), NaCl in MeOH (0.1 mol.L^{-1}), using the same time (30 min) in all cases, the contact time of each extraction solution was choice based on the kinetic and equilibrium experiments. The larger removal capacity of the dye from the adsorbing material was found with distilled water, a low-cost solvent acceptable from the Green Chemistry viewpoint. Studies re-using Sep-APTES were performed with the highest concentration of dye solution used in the equilibrium studies. The adsorption capacity of the material was maintained, confirming the reproducibility of the adsorption, in both cycles the adsorption efficiency was 47% in the first, second and third cycles.

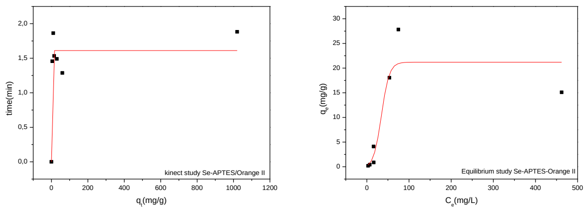

Figure 1: Kinetics and equilibrium studies of Sep-APTES material with dye Orange II.

Conclusion

The adsorption studies reveal the potential application of sepiolite-APTES hybrid material, with excellent adsorption capacity, as well as its multifunctionality; the easy desorption in water allows to recover the solid and the dye and makes this material a good candidate for technological applications, the adsorbent shown higher affinity with anionic dye and shown the higher stability of the matrix and also the recovery and reusability properties.

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