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Swellable organic-inorganic silicas for the removal of dyes from water media

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Abstract

Many anthropogenic activities unfortunately release pollutant dyes in the environment that deteriorate the quality of water, one of the essential life components. Various methods can be used to remove such pollutants (*e.g.*, filtration, precipitation, electrochemical methods, bioremediation, catalysis, etc.), but adsorption onto solids (such as clays, zeolites, porous silicas) is considered an advantageous, cost-effective, and high-performance solution [1]. For this purpose, interest is directed towards the study of an organic-inorganic hybrid silica material named Swellable Organically Modified Silica (Silica-SOM), which possesses the unique property of swelling, *i.e.*, expanding porous volume under appropriate conditions, being potentially capable of removing significant amounts of pollutants [2]. Silica-SOM is synthesized by sol-gel method involving the polycondensation of bis(trimethoxysilylethyl)benzene[3]. The physico-chemical properties of the Silica-SOM were determined by means of a multi-technique approach. The adsorption performance of Silica-SOM against two soluble organic dye pollutants in the aqueous phase (Rhodamine B and Methyl orange) was studied. The sample showed very promising removal capacities: after 1 hour of contact 99.5% of Rhodamine B (Fig. 1) and more than 98% of Methyl Orange was removed. Adsorption cycles of Rhodamine B were carried out, after desorption of the pollutant in alcohol solution by sonication. These tests showed that Silica-SOM is fully regenerable and reusable under the studied conditions.

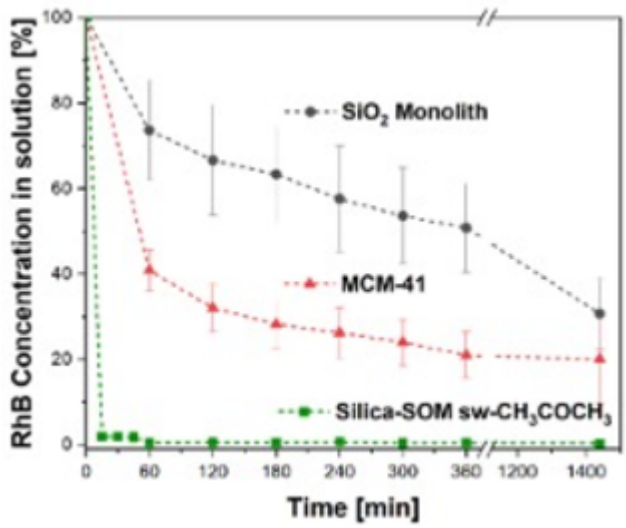

Figure 1: Rhodamine B residual percentual concentration in solution over time. A comparison of different materials studied under similar conditions: Silica monoliths (●), MCM-41 (▲) and Silica-SOM pre-swollen with acetone (∎).

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[2] Burkett, C.M.; Edmiston, P.L., J. of Non-Crystalline Solids. 2005, 351 (40–42), 3174–3178.

[3] Edmiston, P.L.; Underwood, L.A., Separation Purification Technol. 2009, 66(3), 532–540.