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POLYCATENAR COMPOUNDS AS ADSORBENTS FOR CONGO RED DYE

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Abstract: *The adsorption capacities for two polycatenar compounds, a benzoic acid and its silver salt were determined. Both compounds showed relatively good adsorption in the removal of Congo Red dye from aqueous solutions. The adsorption capacity of the silver salt was found to be slightly lower than its acid precursor.*

Keywords: Adsorption. Congo Red. Polycatenar compounds.

INTRODUCTION

Water pollution caused by industrial activities gives rise to severe environmental issues, especially in developing countries. Dye pollutants are considered as highly problematic for several reasons: i) high quantity of coloured wastewaters produced by different industries (textile, cosmetics, paper, rubber, leather, food); ii) even a trace of dye can remain highly visible; iii) are carcinogenic and mutagenic; iv) are inert and non-biodegradable (Pereira *et al.*, 2012). Therefore, efficient dye removal is highly required.

Lately, adsorption and photocatalysis were proposed as advantageous strategies of removing dyes from wastewaters, in alternative to the conventional methods of precipitation, ion exchange, filtration or electrochemical treatment (Guo *et al.*, 2013; Khaniabadi *et al.*, 2017; Iryani *et al.*, 2017).

Moreover, the design of adsorbents that may have other actions like water treatment, disinfection, etc. can be a winning strategy to obtain highly pure water by recycling wastewater. Recently, organogels based on polycatenar compounds were reported to remove pollutants from water (Cheng *et al.*, 2018). Moreover, silver is known from ancient times to have antimicrobial properties, being used to store and disinfect water (Melaiye *et al.*, 2005).

Herein, two polycatenar compounds, a benzoic acid (**BzOH**) and its ionic Ag salt (**BzOAg**) whose chemical structures are presented in Figure 1, were tested as adsorbents for Congo Red (CR) dye in water.

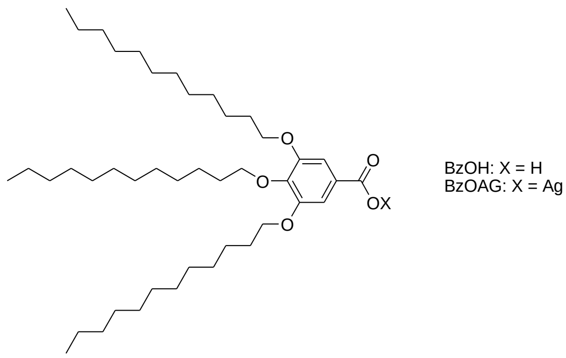

Figure 1. Chemical structure of the polycatenar compounds tested as adsorbents for CR.

MATERIALS AND METHODS

The synthesis and characterisation of the compounds were reported previously (Rowe *et al.*, 1998; Szerb *et al*., 2013).

The adsorption studies of CR were carried out discontinuously, at constant temperature (25±2°C) and speed rates (200 rpm), using a Julabo SW23 shacking water bath. A stock solution of 1 g/L of RC was prepared. The lower concentrations were obtained by dilution from the stock solution with distilled water. The concentration of CR was determined by absorption using a UV-VIS Varian Cary spectrofotometer. The calibration curve and the equation used to determine the residual CR concentration of the solutions which have undergone absorption, at 498 nm wavelenght are presented in Figure 2.

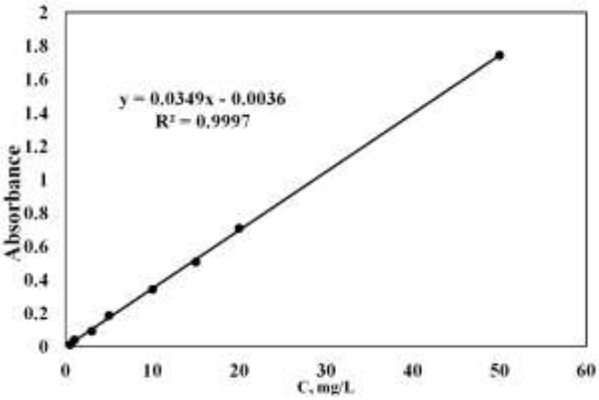

Figure 2. Calibration curve for CR.

The adsorption capacity of compounds **BzOH** and **BzOAg** for CR removal from water was calculated using Equation 1.

$$q = \frac{(C_0 - C_e) \cdot V}{m} \quad (1)$$

where: q - quantity of CR adsorbed (mg/g); C_0 and C_e - initial and respectively the equilibrium concentration of CR in solutions (mg/L); V – volume of the solution (L); m – mass of adsorbent (g).

The time necessary to obtain equilibrium time between the adsorbent and adsorbate was determined using a solution of 10 mg/L CR at a ratio of S:L = 1 g/L (Solid: Liquid ratio). The two species were kept in contact in a time range between 18-180 min. Consequently, the solutions were filtrated and the residual concentration of CR was determined from the solution.

The equilibrium studies were determined using different CR concentrations (10-700 mg/L), keeping the other parameters constant (S:L = 1 g/L), pH = 8.75, shacking time 45 minutes).

RESULTS AND DISCUSSIONS

The absorption spectra of the solutions used for determining the equilibrium time for the two compounds under discussion (**BzOH** and **BzOAg**) are presented in Figure 3.

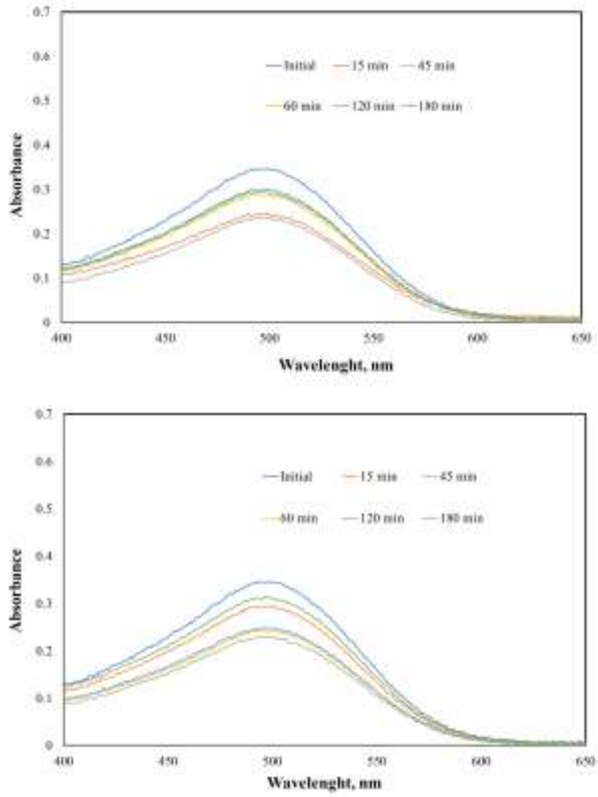

Figure 3. Variation of the absorption spectra of the adsorbed CR over contact time for: up – **BzOH** and down: **BzOAg**.

The experimental data show for both systems a decrease of the absorption maxima with increasing contact time until 45 minutes, following an increase of the absorption maxima in time, probably because of the desorption process of the CR from the adsorbent surface.

The adsorption capacity of both materials (**BzOH** and **BzOAg**) for the removal of CR from water as a function of time is presented in Figure 4.

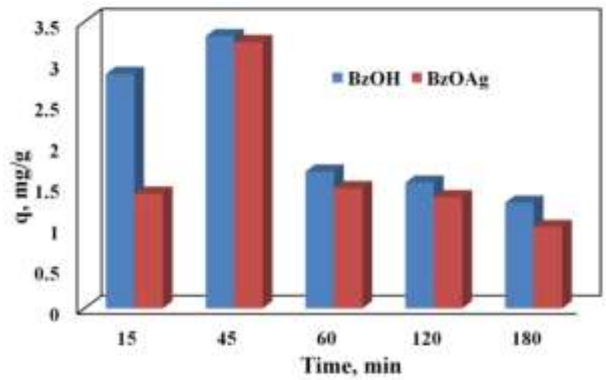

Figure 4. Adsorption capacities of the two adsorbents under consideration.

The best adsorption time resulted to be 45 minutes. It is not reccomended an increased contact time to avoid de consequently desorption of the dye. At this optimum contact time equilibrium studies were performed. The equilibrium isotherms are presented in Figure 5.

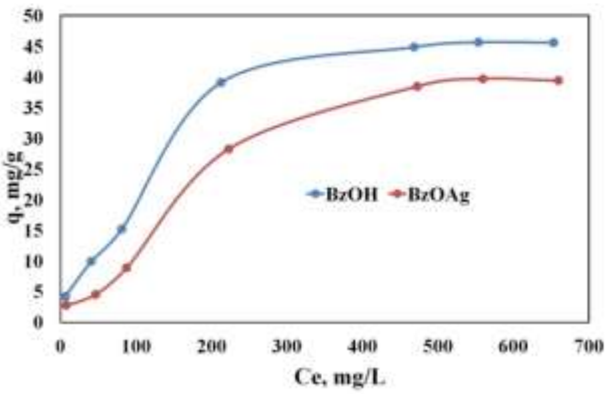

Figure 5. Variation of the amount of the adsorbed CR over optimum contact time.

The equilibrium isotherms show that the adsorption capacities of both compounds under study increase with concentration until a constant value is reached. The maximum adsorption capacities are 45.6 mg/g for **BzOH** and respectively 40.0 mg/L for **BzOAg**. The values found are lower than the ones reported in literature for some zeolites (97.08 mg/g, Iryani *et al*., 2017) or chitosan (94.39 mg/g, Rouf *et al*., 2015), but with lower contact times (100 min. and respectively 240 min.).

CONCLUSIONS

The adsorption capacities of two polycatenar compounds, a benzoic acid (**BzOH**) and its Ag(I) salt (**BzOAg**) were determined. The adsorption capacities for **BzOAg** resulted slightly lower than of its acid precursor. However, being a silver salt, further studies will be performed in order to determine other actions of the **BzOAg** like photocatalysis or antimicrobian activities for wastewaters.

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