1st International Congress on Analytical Chemistry, Electrochemistry and Separation Techniques

October 15th-16th, 2022, tlemcen Algeria

REMOVAL OF DYES IN AQUEOUS SOLUTIONS BY RECYCLED MATERIAL

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ABSTRACT

Polystyrene (PS), one of the most used polymers in everyday life, has a low recycling rate due to its inexpensive virgin resin. In order to make polystyrene waste (WPS) recycling advantageous, it is possible to change it chemically, introducing heteroatoms in the polymer chain thus transforming the waste into a material with more added value. In this work, sulfonation reactions of polystyrene waste (expanded polystyrene - EPS) were carried out using sulfuric acid as a sulfonating agent and then characterized by infrared spectroscopy (FTIR) and thermal analysis (ATG/DTG) and applied for removal of different dyes from water. The adsorbent showed good adsorption performance due to its functional groups and strong adsorption forces with methylene blue (MB) and congo red (CR) and AB113 in different concentrations.

Introduction

- Dye stuff has becoming a global environmental issue owing to its carcinogenic and mutagenic effects to human and other living organisms.. Thus, it is important to remove dyes from wastewater before discharging. Many technologies for removing toxic dye stuffs from aqueous solution have been developed, including ion exchange [1], adsorption [2,3], electrochemical treatment [4], biological treatment [5].
- To solve these above problems, a novel multifunctional magnetic PSS were prepared and investigated in this work, which possessing sufficient acidic functional groups simultaneously. Highly selective adsorption of cationic dyes except for anionic dyes were realized using this adsorbent.

Materials and methods

- **Materials** :

Waste expanded polystyrene (EPS). Sulfuric acid (H_2SO_4 97% biochem), acetic anhydride ($(CH_3CO)_2O$ biochem), Dichloromethane (CH_2Cl_2 biochem), and distilled water.

- **Methods:**

The homogeneous sulfonation was prepared according to the procedure outlined by Martins et al.[3] for 4h and for the quantities of the products as follows : dichloromethane (40ml), acetic anhydride (10ml) and sulfuric acid (2ml), wast expanded polystyrene (5g),

- **Adsorption kinetics:**

The obtained product is tested for their efficiencie in the adsorption of the dyes at free pH (Vdye= 20 mL; mPSS=20 mg and Cdye=20 mg/L) in a period between of 2 min -2h. Finaly, the ensuing supernatant was analyzed using a UV-Vis spectrophotometer (OPTIZEN 1412 UV/VIS).

The removal efficiency was calculated using the following equation:

Removal=((Ci-Cf)/Ci)*100 (1)

Where Ci and Cf are initial concentration and final concentration of MB,CR and AB113

Results and discussion

FTIR characterization FTIR analysis of PSS (Figure 1) showed the presence of the bands relative to S-O that were not present in the waste spectra. The occurrence of -SO_3 band of symmetric stretching vibration at 1040 cm^{-i} and -SO_3 - antisymmetric stretching vibration at 1180 cm^{-i}[4].

Thermal properties: The Thermogravimetric analysis shows that a increase in thermal stability occurs for sulfonated polystyrene as a function of sulfonic groups concentration, as compared to PS. (Figure 2).

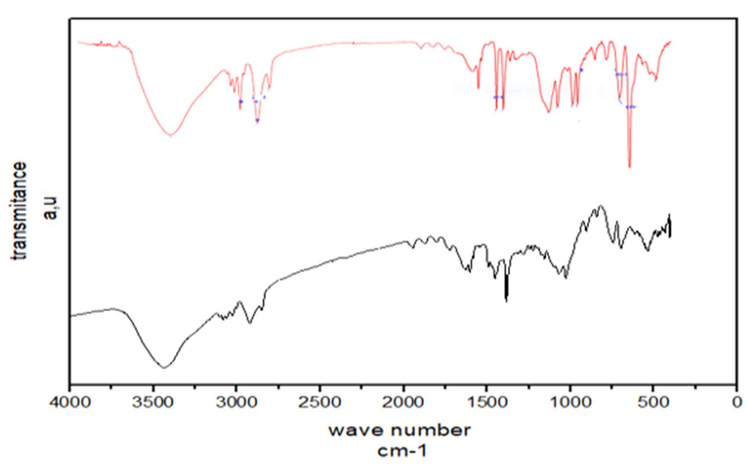

Figure 1:FTIR spectra of the: red curve – sulfonate polystyrene and black curve polystyrene

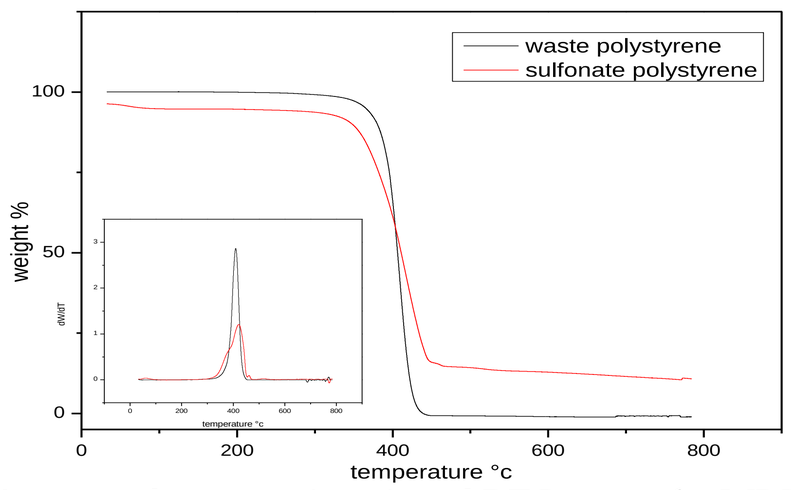

Figure 2: : thermogravimetric and DTG curves for WPS and sulfonate polystyrene

- **Effect of contact time :**the effect of contact time on the adsorption process of the dyes is shown in figure 3. it can be seen that the adsorption capacity increases sharply within 20 min for MB and 80 min for CR, and 20 min for AB113 thereafter, the removal efficiency increases slowly and then remains at steady state. the short adsorption time (30 min) demonstrates that PSS has an effective removal efficiency for MB dye compared to the other 2 dyes

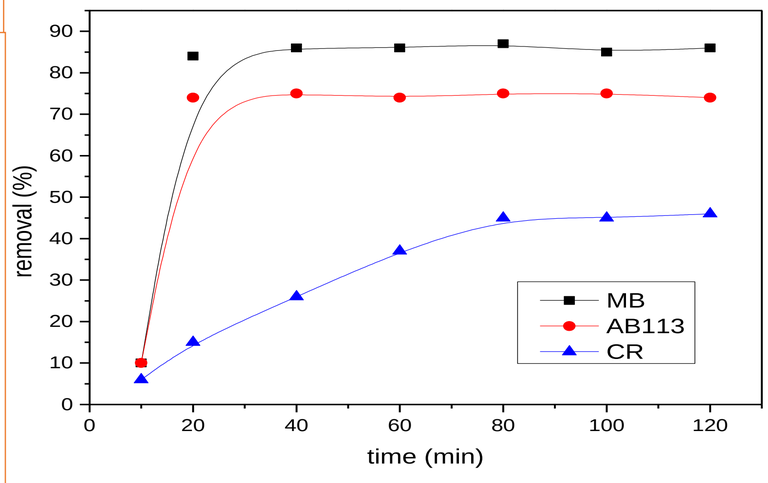

Figure 3:adsorption kinetics for removal of methylene blue, congo red and AB113

Conclusion

In this work, we succeeded in the sulfonation of expanded polystyrene waste by a chemical modification And we proved it by infrared spectroscopy and after we used this polymer for the elimination of dyes and results show high removal efficiency for MB and AB113

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