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ADSORPTION OF HEAVY METALS ONTO AMBERLITE XAD 4 RESIN CHELATED WITH ACID BLUE 193

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Introduction

The major goal of wastewater treatment process is to eliminate majority of hazardous compounds that exist in its composition. In this regard, various chemical treatments can be applied. One of the most economical and feasible alternative is the one that uses chelating resins. The applications of chelated materials are based on the selective adsorption of metal ions. Chelating resins contain functional groups that retain metal ions through covalent coordinative bonds. Thus, the mechanism of metal ion adsorption is mainly based on the formation of complexes by the resin mass. Also, chelated resins have a double function of adsorption (e.g., physical) as well as chelate formation. The functionalization is achieved by the adsorption of the chelating agent on the polymer resin support through physical forces. Thus, the polymeric support is quickly saturated with chelating agent, which at the end of the equilibrium is removed by filtration. Also, the obtained chelated resin can be used in depollution applications of highly polluted acid effluents with metal ions.
In the present study a novel chelating resin was obtained by immobilizing 4-Amino-3-hydroxynaphthalene-1-sulfonic acid (AB 193) on the Amberlite XAD4 resin (XAD4). To the author knowledge, for the first time a new chelating resin (XAD4-AB 193) has been obtained and applied for metals removal from aqueous medium.

Materials and methods

The following reagents were used for experimental part: solution of AB 193 (500 mg/L), solutions of metal ions having the concentrations of: 50, 100, 150, 200 and 250 µg/L and styrene-divinylbenzene resin with surface area of 750 m2/g, particle size 20-60 mesh and 0.98 mL/g pore volume.
The chelating resin was obtained by contacting 0.5 g of XAD4 resin with 50 mL of AB 193 solution. Subsequent the mixture was stirred to obtained a uniform adsorption of chelating agent on the styrene-divinylbenzene resin for 1h. At the end of stirring time, chelating resin was separated from liquid phases by filtration, washed with ultrapure water and dried at laboratory temperature. Adsorption of metals on the chelating resin was evaluated in batch experimental conditions. For this, samples of 0.5 g of XAD4-AB 193 were stirred with 50 mL of metal ions that contained equal concentrations of metals. After 3h of continuous stirring,

concentrations of metals were determined by atomic adsorption spectrometry (AAS) using calibration curves obtained in 100-500 µg/L range for each metal ions evaluated.

Results and conclusions

The effect of metal ions adsorption from multicomponent solutions having equal concentrations of Cr(III), Cu(II), Mn(II) and Zn(II) was evaluated on the chelating resin (see Fig. 1). Herein, under competitive conditions was found that the adsorption capacity for divalent metals was considerably lower, while the adsorption of Cr(III) remained high regardless of the studied concentration that varied from 50 to 250 µg/L. The hight affinity can be related to the chelation effect, ionic radius and absolute electronegativity. Also, it can be deducted that the azo groups from the structure of the chelating agent form stable complexes with metal ions, especialy with Cr(III). The adsorption capacity of XAD4-AB 193 varied in the following order: Cr(III)>Cu(II)>Mn(II)>Zn(II) for the highest metal ions concentration. As can be seen from the presented results, the selectivity of the chelated resin for Cr(III) is not affected by the presence of the divalent metals in the multicomponent solutions.

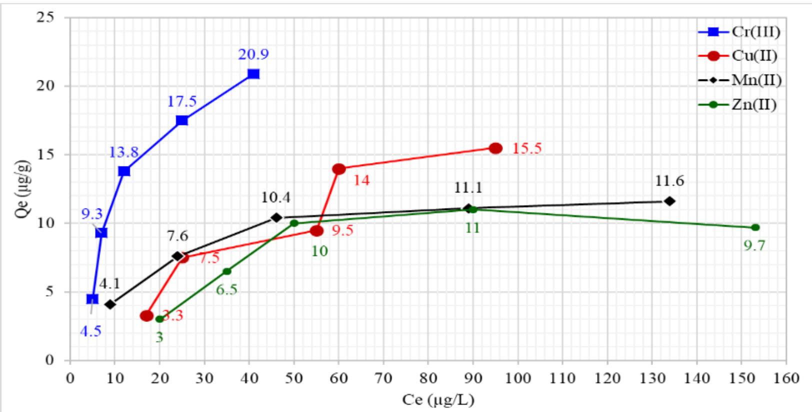

Fig. 1. Competitive adsorption of Cr(III), Cu(II), Mn(II) and Zn(II) on XAD4-AB 193 chelating resin, pH=2.5

It can be concluded that the chelating resin (XAD4-AB 193) can be a promising material for retaining Cr(III) together with divalent metal ions to improve the composition of the water quality when the technological treatment is applied

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