NATIONAL INSTITUTE OF RESEARCH AND DEVELOPMENT FOR INDUSTRIAL ECOLOGY
ECOIND
EXCELLENCE IN RESEARCH AND ENVIRONMENTAL SERVICES

INTERNATIONAL SYMPOSIUM „THE ENVIRONMENT AND THE INDUSTRY" 2023
SIMI

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

Nicoleta Mirela Marin [1,2]
[1]National Research and Development Institute for Industrial Ecology ECOIND, Street Podu Dambovitei no. 57-73, district 6, 060652 Bucharest, Romania, nicoleta.marin@incdecoind.ro
[2]Science and Engineering of Oxide Materials and Nanomaterials, Faculty of Chemical Engineering and Biotechnologies University POLITEHNICA of Bucharest, Gh. Polis 1-7, 011061 Bucharest, Romania

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. 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 XAD4-AB 193 was obtained by contacting 0.5 g of XAD4 resin with 50 mL of AB 193 solution.
- ✓ Samples of 0.5 g of XAD4-AB 193 were stirred with 50 mL of metal ions that contained equal concentrations of Cr(III), Cu(II), Mn(II) and Zn(II). Also, for the exhausted resin, regeneration studies were carried out.
- ✓ Methodology applied for obtained chelated resin and adsorption of metals is presented in Fig. 1.

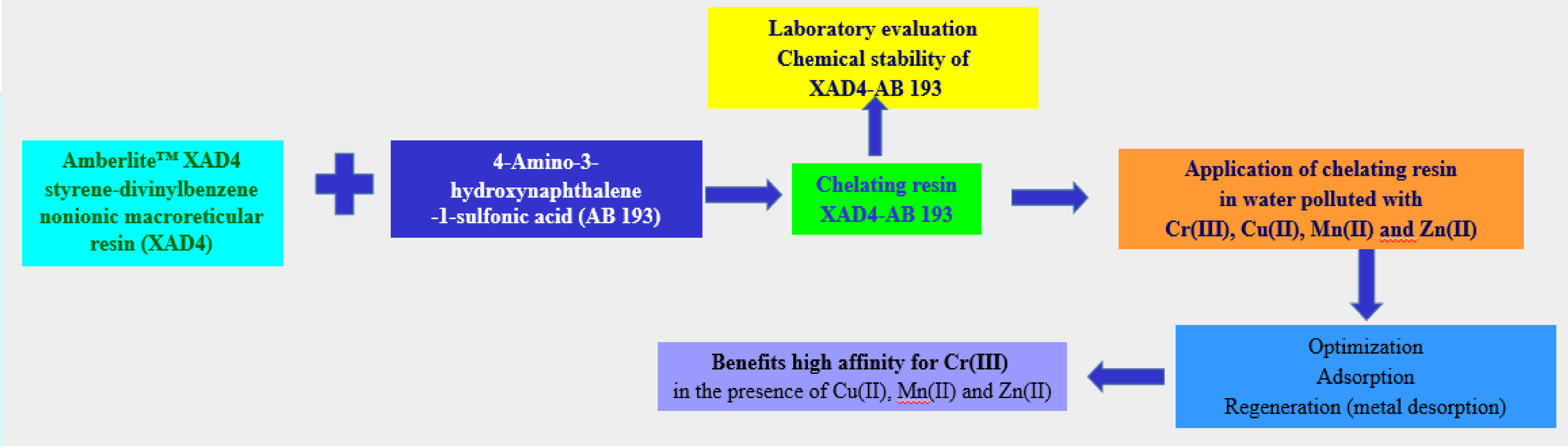


Fig. 1. Preparation of chelate resin and its application for metal ions removal

Results and Conclusions

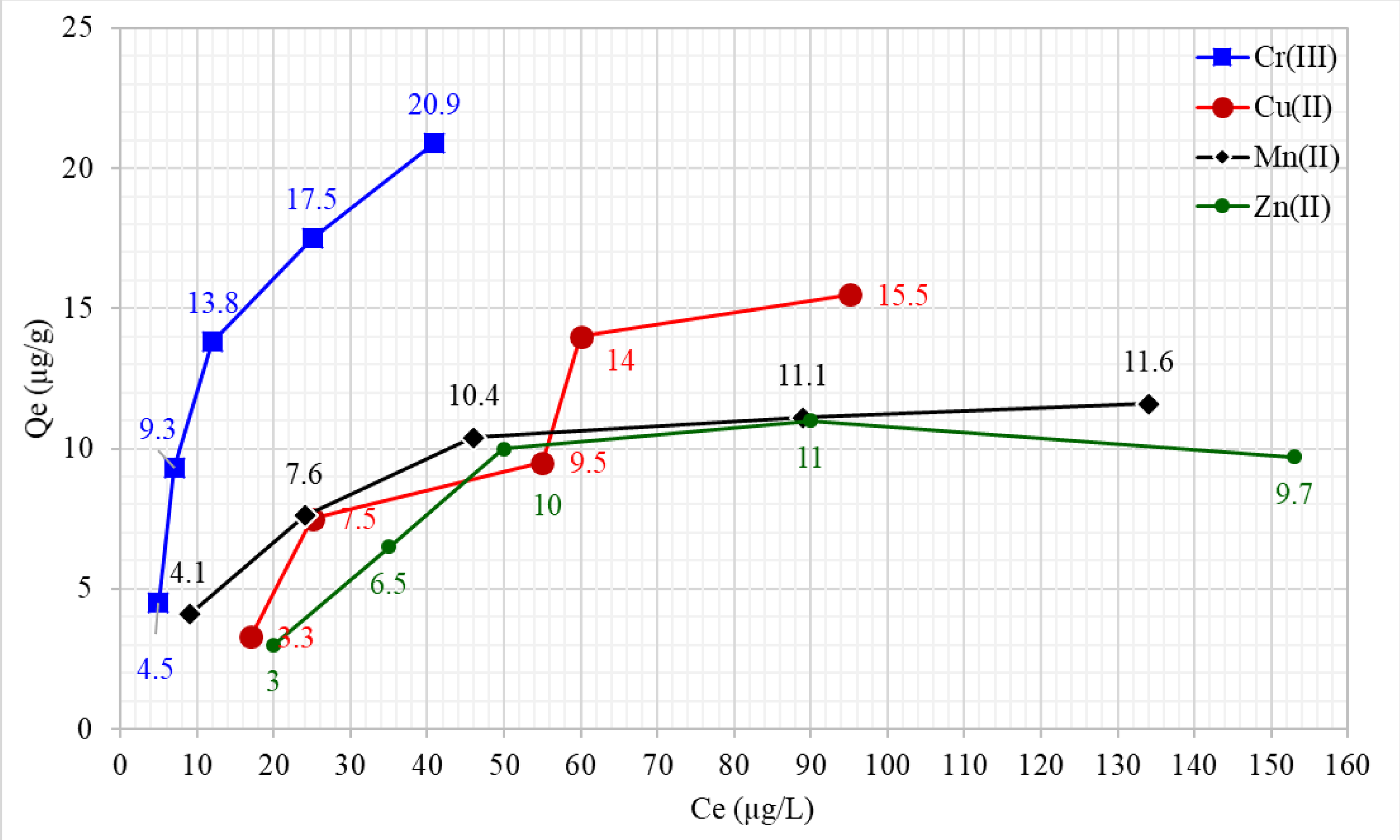
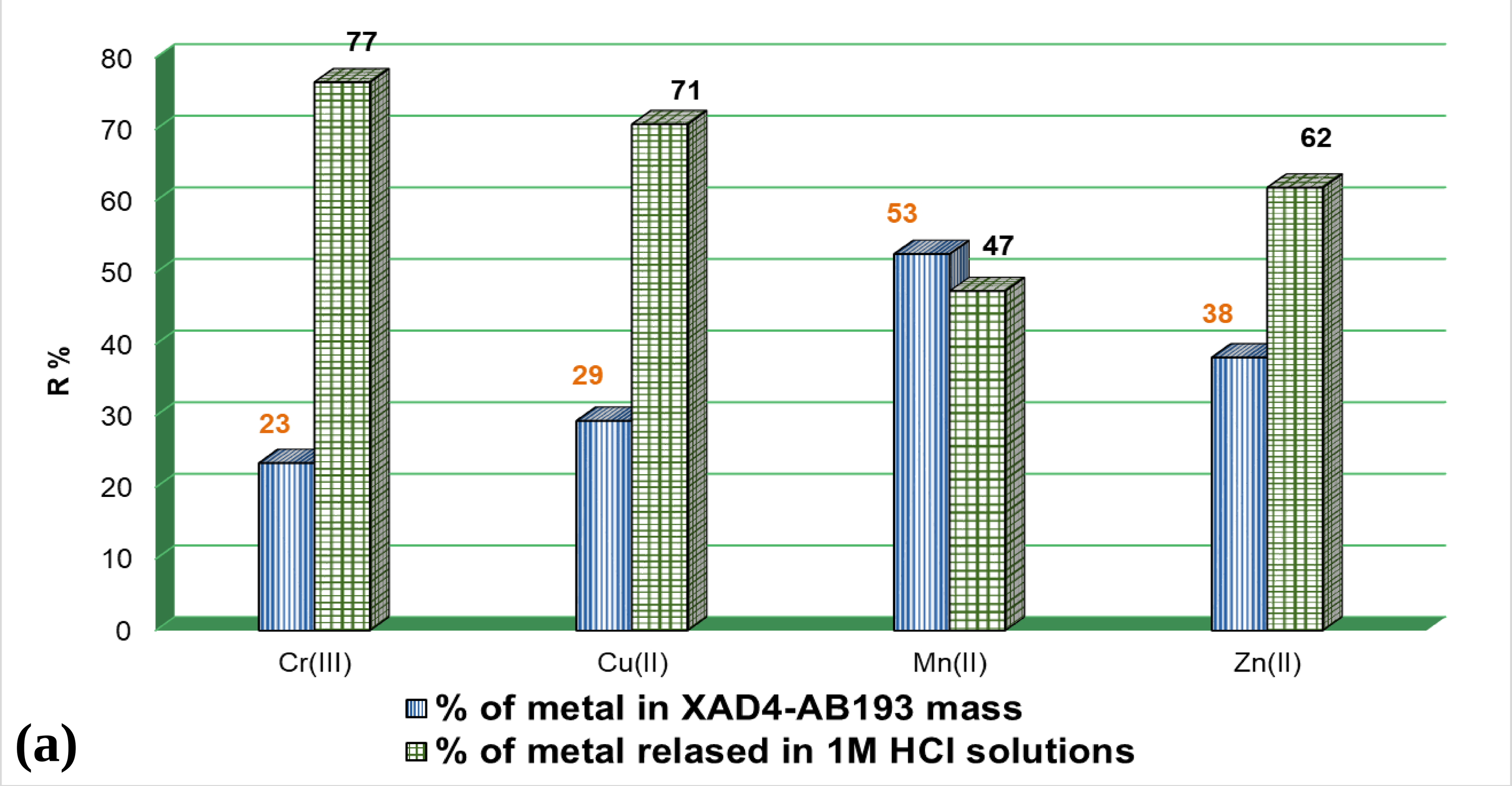


Fig. 2. Competitive adsorption of Cr(III), Cu(II), Mn(II) and Zn(II) on XAD4-AB 193 chelating resin, pH=2.5

- ❑ 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. 2).
- ❑ 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.
- ❑ Chelating resin was regenerated for metal ions recovery and for achieving concept of circular economy approach for solid waste. For this, using a simple method for regeneration of the exhausted resin with metal ions, it was found that the most efficient regeneration was obtained using 2M HCl (see Fig. 3a,b).



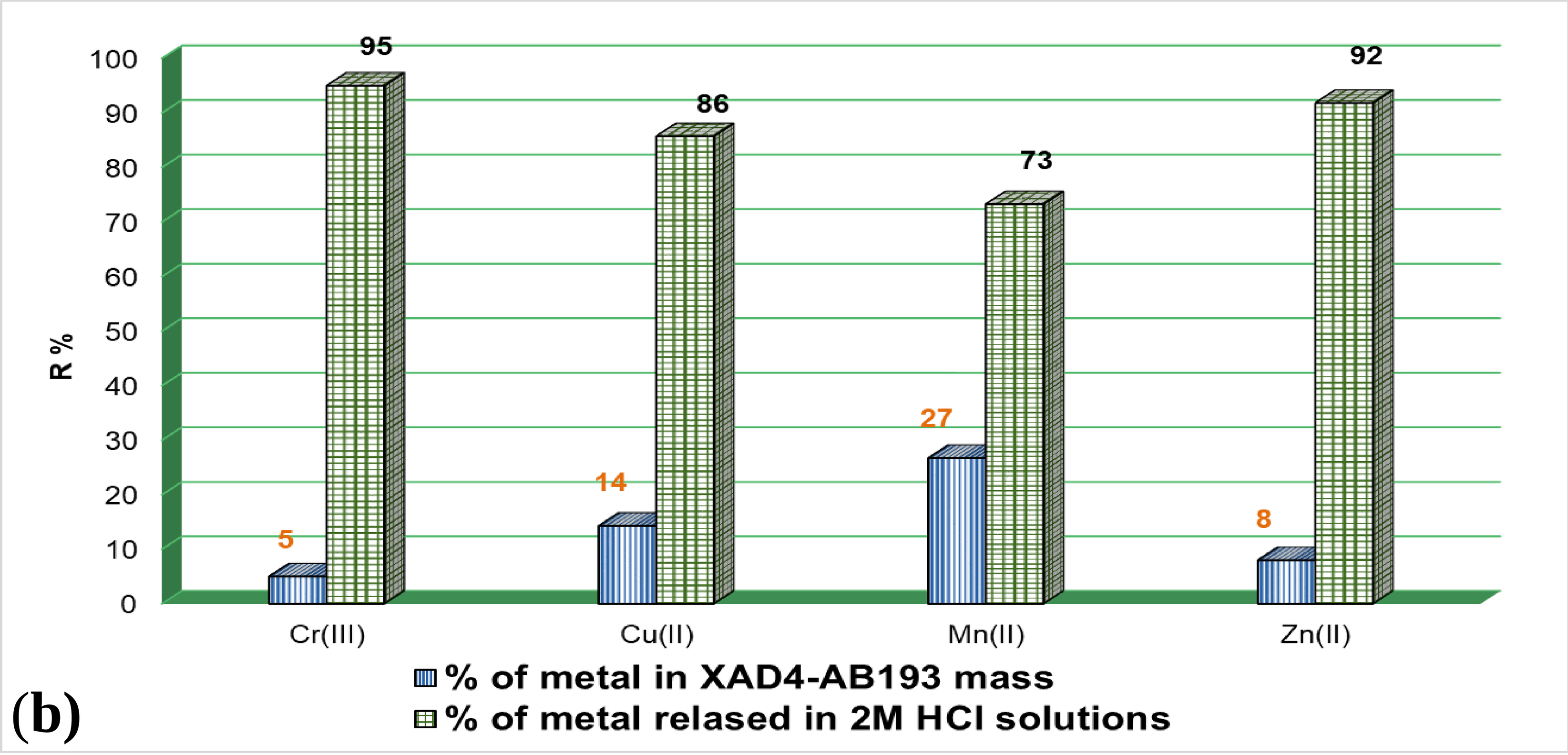


Fig 3. Effect of acid solutions using 1M HCl (a) and 2M HCl (b) on exhausted resin

Acknowledgments

This work was carried out through the "Nucleu" Program within the National Research Development and Innovation Plan 2022-2027 with the support of Romanian Ministry of Research, Innovation and Digitalization, contract no. 3N/2022, Project code PN 23 22 03 01 and and European Social Fund from the Sectoral Operational Programme Human Capital 2014–2020, through the Financial Agreement with the title "Training of PhD students and postdoctoral researchers in order to acquire applied research skills—SMART", Contract no. 13530/16.06.2022-SMIS code: 153734.