

## Removal of Pb(II) from aqueous system using Moringa Pods as Bioadsorbent

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Nowadays, water contamination by toxic heavy metals from industrial effluents is a global environmental problem. In particular, lead (Pb) is considered a highly toxic metal for health and the environment. Due to its high toxicity, accumulation and retention in the human body, Pb (II) can cause serious damage to the nervous, reproductive system, kidneys, liver and brain. Based on their toxicity, the United States Environmental Protection Agency (EPA) and the World Health Organization (WHO) have set the maximum allowable limit of lead ions in drinking water of 0.015 and 0.05 mg L<sup>-1</sup>, respectively [1]. Recently, bioadsorption has been proposed as an alternative, competitive, effective and low-cost treatment procedure [2]. Moreover, enhancement of agro-industrial waste as raw material for the production of new material is the great interest. In this sense, the aim of this study is to perform a chemical characterization of moringa pods and subsequent study as bioadsorbent for removal of Pb (II) from aqueous systems.

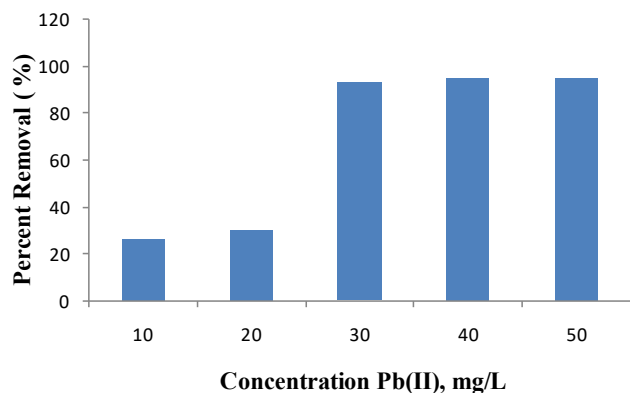
The moringa pods were washed with distilled water, dried (60 ° C), ground and sieved with a particle size of 595 µm. Adsorption studies of Pb (II) ions were carried out using the batch method under different concentrations (10, 20, 30, 40 and 50 mgL<sup>-1</sup>), biomass (0.20 g), pH (5), time of contact (120 min), volume of solution (20 mL), 150 rpm and room temperature. Then the solids were filtered and dried. The quantitative determination of Pb (II) ions in solution was performed by atomic absorption spectrophotometry. The solids obtained before and after the adsorption process were characterized by Infrared Spectroscopy with Fourier Transform (FTIR), Scanning Electron Microscopy and Energy Dispersive x-rays Spectroscopy (SEM / EDS).

Figure 1 shows the effect of the initial concentration of Pb (II) ions on the solution. It is observed that as the concentration increases the removal percentage increases until reaching the optimum removal percentage of Pb (II) at 40 mg / L (95%). No significant changes are observed at higher concentrations. Figure 2 illustrates the spectra obtained by FTIR of the moringa before and after the adsorption process of the Pb (II) ions. The positions of the absorption bands of both spectra are similar except for slight changes in the displacements and intensities of the bands attributed to the OH, NH and C = O groups, corresponding to lignocellulosic materials (cellulose, hemicellulose and lignin), which they are responsible for the link between the bioadsorbent and metal ions as reported in the literature [1-2]. The SEM images with their corresponding EDS are shown in Figure 3. The moringa pods before adsorption show a fibrous and heterogeneous surface and the presence of some deformations on the surface, from which it can be inferred that this material provides the conditions for the adsorption of metallic species in the interstices [1-2]. The EDS data indicates the presence of some minerals. After adsorption, slight changes on moringa surface can be seen and in figure 3b the presence of bright patches on the aggregates in a rounded form is clearly observed, indicating the adsorption of Pb on moringa, which is confirmed by the presence of lead in the corresponding EDS data. Similar results have been reported by the literature [3].

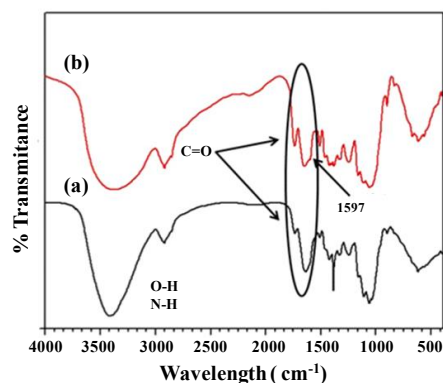
The characterization by FT-IR and MEB / EDS reveal the potential of moringa pods for adsorption of Pb (II) ions, being excellent candidates for the remediation of contaminated water at low cost, easy acquisition, efficient and environment friendly .

## References:

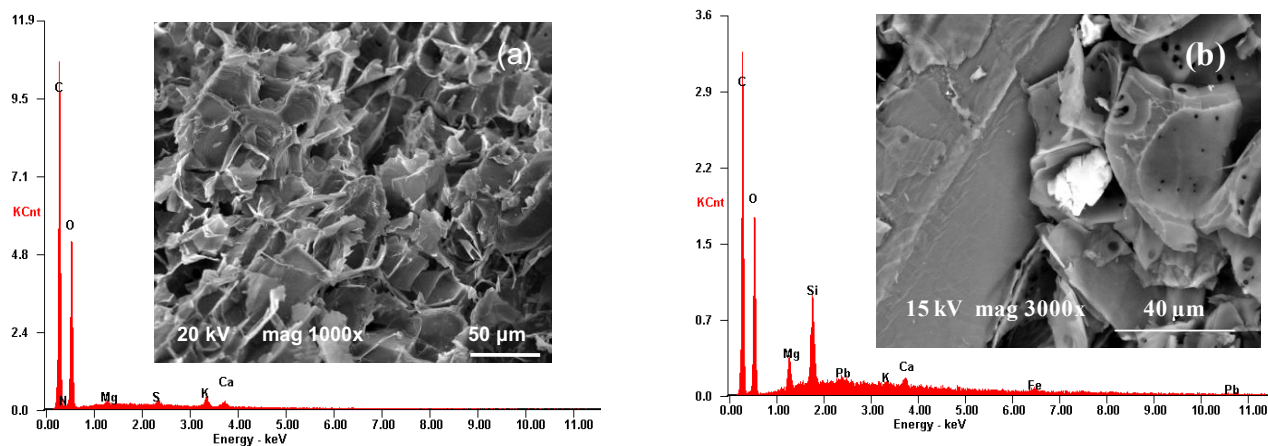
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 [3] M. Kumar Sahu et al., *Journal of Environmental Chemical Engineering* 1 (2013), p. 1315.  
 [4] The authors acknowledge especially to María Elena Gómez, Damarys Soto and Antonio Scientific Research for their valuable collaboration in the reagent donation.



**Figure 1.** Effect of initial concentration of Pb (II) adsorption on moringa pods.



**Figure 2.** FTIR spectra of moringa pods (a) before and (b) after of Pb(II) adsorption to 40 mg/L.



**Figure 3.** EDS spectra and SEM images of moringa pods (a) before and (b) after of Pb (II) adsorption to 40 mg/L.