Adsorption of Pb (II) From Aqueous Solutions by Sumac (Rhus coriaria L.) Tannins

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Heavy metals from several industrial waste, cause soil, water and air pollution. Lead pollution has been recognized as a potential threat to air, water and soil. Exposure to excessive levels of lead in the environment, the home and the workplace impose costs, with many millions of adult and children suffering adverse health effects and impaired intellectual development. High amount of lead has been found to be acute toxic to human beings.

Heavy metals can be removed from aqueous solution by adsorption and chemical reaction using some materials. Adsorption is one of the methods commonly and efficiently used for treatment for these type of wastewaters. It has been stated, the augmentation of bacteria and other organism in filter beds, where active carbon is used to remove heavy metals, results in major economical problems. Therefore optimum condition for removal heavy metals investigated by using sumac leaves those are known to contain tannins which have antibacterial, antimicrobial and anticorrosive effects, and that are widely grown in the highlands of our country.

The goal for this research is to develop inexpensive, highly available, effective metal ion adsorbents from natural wastes as alternative to existing commercial adsorbents. Therefore sumac leaves were preferred. Sumac (Rhus coriaria L.) is a shrub which reaches 3-4 m in height in the wild. The main compounds present in Rhus family are hydrolysable gallotannins. Tannins have multiple adjacent polyhydroxyphenyl groups in their chemical structure, which have extremely high affinity for proteins, metal ions, and other macromolecules like polysaccharides.

In this study, a new natural sorbent (sumac leaves) for removing Pb^{2+} ion from the aqueous solutions has been investigated. Leaves of sumac were obtained from Manisa (Kırkağaç), Turkey. The tannins were extracted with acetone:water (70:30, v/v) mixture from the leaves of sumac. For the total tannin determination Folin-Ciocalteu method was used and tannin content was found 22.5%. In batch experiments, pH profile, initial concentration of metal ions and temperature were performed to determine binding properties of adsorbent for the Pb^{2+} ions. The concentrations of the metal ions in solutions before and after adsorption were measured with an atomic absorption spectrophotometer.

In batch system, it was seen that the system came to equilibrium at about 120 minutes. It was observed that removal metal from aqueous solution depended on pH value but not temperature. It was also seen that optimum pH value in adsorption of Pb^{2+} ions was 5 relatively, for sumac leaves, pH and T data were analysed and applied to Langmuir and Freundlich isotherms and the process was checked. Freundlich model fitted the equilibrium data better than Langmuir isotherm. The experiments showed that the highest removal efficiency was 83% for lead.

References