

Magnetic Nano Particles as powerful adsorbents for removing of metal ions from aqueous solutions

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ABSTRACT:

This article reviews and discusses about the recent developments in using of Magnetic Nano Particles (MNPs) for extraction some kinds of metals from its aqueous solutions. These metals include Zr, U, Cu, V, Co, Ni, Zn, Hg, Pb, Cr, Cd, Au and Trans uranium elements. Adsorption properties of synthesized MNPs for removing of each element were compared with similar ones in conventional method of separation. Therefore it is individually noticed to the recent reported ways in solvent extraction and ion exchange methods for metals. Promising adsorption characteristics and simpler hydrometallurgical performance for each applied MNPs have been identified. For instance in Zirconium separation a functionalized MNP by tributyl phosphate (TBP) has distribution coefficient value of 44 times greater than similar extraction in SX and IX methods.

Key words: MNPs, Hydrometallurgy, Solvent extraction, Ion exchange, MACS

1- INTRODUCTION:

Techniques for removing of metal ions from its aqueous solutions have many applications in different fields. The most important instances of these applications contain as followings:

- Using in separation of hazardous heavy metal cations such as Hg^{2+} , Cd^{2+} , Pb^{2+} from waters and wastewaters.
- Hydrometallurgical methods that conduct separation and extraction of metals based on reaction in aqueous medium.
- Deposition of by-products that contains low value of metal in hydrometallurgical process. These kind of products may find usefulness in other applications. For example obtaining Hafnium in the process of purification of Zirconium.

There are some advantages that make hydrometallurgical techniques are preferred than pyro metallurgical ones. Environmentally they are more suitable, having abilities for complex and low grade ores extraction and lower capital cost. These advantages caused to be more beneficial in using hydrometallurgical methods in areas such as leaching, metal recovery, solution concentration and purification. Solvent extraction (SX) and ion exchange (IX) are the most common separation methods that are applied in hydrometallurgical techniques. In spite of this, such technical methods associated with some disadvantages too. For example using large amount of water, existence of difficulties in solid-liquid separation, time consuming for separation, impurities problems in purification process. Several alternatives are purposed for each of separation methods in investigations to overcome these problems. But it has not been achieved to any significant progress for solving such mentioned problems. Having made new possibilities by using Nano technological ways that this review article discussed. Magnetic Assisted Chemical Separation (MACS) has been already employed for removing metal ions from its aqueous solutions. This method has basically made new means by using of improvements in Nano technological synthesizing for MNPs. Nunez et al [1] had employed this method for removal of Trans uranic elements in 1995. They had reported outstanding results for distribution coefficients in comparing with solvent extraction method. Also Kaminski and Nunez [2] applied this kind of method for recovery of Cobalt and Nickel from acidic solution. They predicted this method can make promising results for other metals such as Cr, Cd, Cu, Ni, Pb and Zn based on their outstanding received results in 1999. The steps of MACS method are shown in Fig.1. The following points have to be considered for metal ion absorption in each performance of MACS method: