

Selective Adsorption of Indium Ions from Binary Solution Including Zinc Ions Using Phosphorylated Sawdust

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Indium is widely used in various industrial applications such as manufacture of liquid crystal displays, semiconductors and infrared photodetectors. Especially, indium-tin oxide(ITO) thin film is used in optoelectronic devices for transparent conducting layers and, recently, over 60% of indium production over the worlds was spent in the manufacture of ITO films. The rise in recycling for valuable metals is of increasing concern among many researchers. Many studies on the extraction of indium(III) have been performed by means of solvent extraction or ion exchange technology. Since 2000s, many studies on metal removal using various wastes such as waste wool, peanut shells, soybean hulls, rice hulls, crab shells, and cotton which are available in large quantities, may present higher potential as cheap sorbents have been carried out. Especially, the use of sawdust wastes discharged from forestry industry has showed a potential ability for metal removal. Shukla et al. (2002) studied on the removal of Pb(II), Cu(II), and Cr(VI) in aqueous solution by means of maple tree sawdust and Dorris et al. reported high adsorption ability for Cu(II), Ni(II), and Zn(II) using oak tree sawdust. Furthermore, adsorption capacity of sawdust for Pb(II) could be increased by means of chemical modification of functional groups. Unfortunately, however, there is little study on valuable metals such as indium, nickel, gold, and silver using sawdust. Furthermore, there are no study on selective adsorption to indium(III) only, from mixed wastewater using chemically modified sawdust. According to the literature survey, among functional groups, it is reported that the groups containing phosphorous such as phosphonate and/or phosphonic acid have a high selectivity to indium(III)(Volesky, 1990).

Therefore, in this study, to selectively adsorb indium(III) only from actual wastewater, phosphoric acid was introduced to surface onto sawdust by means of chemical reaction. In addition, selective adsorption characteristics for indium(III) using chemically modified sawdust were also investigated. The concentration of indium(III) and zinc(II) in real mixed wastewater was measured as about 19.07 and 140,600mg/L, respectively. The pH of wastewater was also about 3.58. As mentioned above, to selectively adsorb indium(III) only from mixed wastewater, sawdust(oak tree), tangerine peel, and coffee ground was used. As shown in Fig. 1, in the case of sawdust, removal efficiencies of indium(III) and zinc(II) were about as 15% and 9% at pH 3, respectively. When tangerine peel and coffee ground were applied, the removal efficiencies of indium(III) were lower than that of sawdust as about 4 and 2%, respectively, while efficiencies of zinc were higher than that of sawdust. It was known that sawdust have functional groups such as phenolic-OH and carboxylic groups while coffee grounds contain nitrogen of amino acid which is derived from protein and hydrolyzed protein. From the result, sawdust which has

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the highest removal efficiency for indium(III) and the lowest removal efficiency for zinc(II), simultaneously, was selected as optimum adsorbent to treat actual mixed wastewater supplied from the Toricom company. Effect of pH on removal efficiency of indium(III) and zinc(II) using phosphorylated sawdust was shown in Fig. 2 (H_3PO_4 :distilled water=1:1). As pH increased removal efficiencies of indium(III) increased while those of zinc(II) decreased regard less of H_3PO_4 contents. Especially, removal efficiency of indium(III) was about 90% and zinc(II) was not almost removed at pH 3.5. The reason why phosphorylated sawdust has high selectivity to indium(III) could thought to be effect of phosphate groups. According to the HSAB (Hard and Soft Acids and Bases) theory, hard acid strong bonds with hard base and soft acid strong bonds with soft base, respectively. Indium(III) and zinc(II) are classified as a hard acid and intermediate which depend on oxidation state of acid, respectively. Also, phosphate groups into phosphorylated sawdust are classified as a hard base. Therefore, indium(III) as hard acid very strong bonds, however, zinc(II) cannot be bonds with phosphate groups which is hard base.

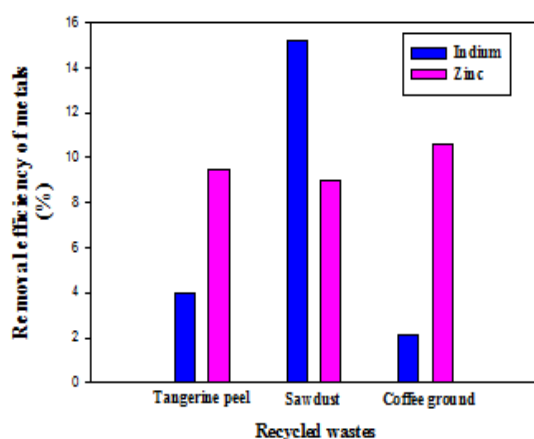


Fig.1 Removal efficiency of metals using various recycled wastes at pH 3.0 (Loading amount of adsorbent : 1.0g, Working Volume : 100mL)

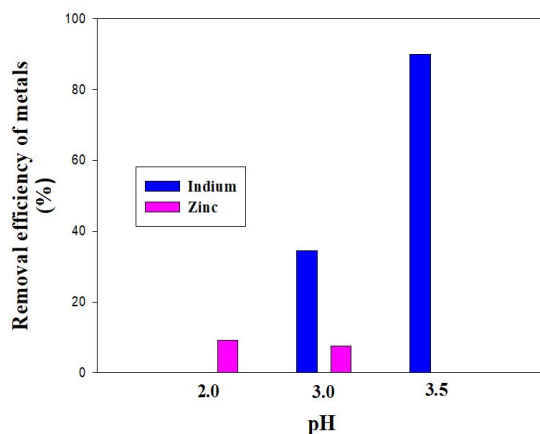


Fig.2 Removal efficiency of metals using phosphorylated sawdust (H_3PO_4 : Distilled water = 50 : 50) (Loading amount : 1.0g, Working Volume : 100mL)

참고문헌

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