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Removal of Zn(II) from Wastewater by Ion Flotation: Determination of Optimum Conditions

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ABSTRACT: Ion flotation includes removing of ions from solution by adding chemical reagents such as collectors in the presence of air bubbles. In this study, removal of Zn(II) cations was studied from low concentration synthetic wastewater by ion flotation. Sodium dodecyl sulfate (SDS) and ethylhexadecyldimethylammonium bromide (EHDABr) were used as collectors and methyl isobutyl carbonyl (MIBC) and Dowfroth250 as frothers. To investigate the effective parameters, the experimental design was performed supporting by DX7 software. Two-level factorial method was used. Sixteen experiments including 6-level variables were designed. The tests were conducted in Hallimond tube. The results showed that the optimal conditions for the removal of Zn(II) ions were: pH=3, SDS= 300 ppm, Dowfroth250= 90 ppm and air flow rate= 1.8 ml/min. Optimal results were evaluated in a mechanical flotation cell. In optimal condition, recovery of Zn(II) ions and water were more than 92% and 8.65% after 10 min, respectively. This study showed that the use of ion flotation is a very effective method for Zn(II) ions removal from industrial wastewaters.

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1- Introduction

The flotation process has a high potential in the field of wastewaters treatment due to its good performance. Ion flotation is a method used for removing heavy metal ions from aqueous solutions that introduced by Felix Sebba in 1960. It is a complex physico-chemical process which depends on the type and concentration of the collector and chemical conditions of the solution to optimize the recovery of metal ions. The process of ion flotation involves the attachment of hydrophobic ions using collector with the gas bubbles being introduce in the solution and then removal of ions by bubbles[1-4]. Polat investigated removal of heavy metal such as Cu(II), Zn(II), Co(II) and Ag(I) from waste water by used of sodium dodecyl sulfate and hexadecyltrimethyl ammonium bromid as collector. Some people have investigated about relative amount of metal and water removal [5]. Zinc compounds are widely used in industry; in consequence the industrial wastewaters contain large amounts of this ion. The ions usually enter the cycles of nature through surface and ground waters. The aime of this study was to determine the optimal parameters for the removal Zn(II) from simulated wastewater using of ion flotation.

2- METHODOLOGY

SDS and EHDABr were used as collector. MIBC and Dowfroth 250 were used as frother. zinc nitrate($(Zn(NO_3)2.7H_2O)$) was used to prepare the simulated wastewater solution. The solution pH was adjusted using NaOH and HCl. A tube Hallimond and a Denver type flotation machine were used in this study.

In this study, to obtain the type of materials and the optimal amount of them, the experiments were designed for Zn(II) ions using DX7 software in the 2-level factorial method. Various parameters such as pH, type and concentration of collector, type and concentration of frother and air flow rate were studied to determine the optimal conditions. Initial experiments were carried out in a small scale by Hallimond tube in order to evaluate different parameters and determine their optimal amounts on the ion flotation.

3- RESULTS AND DISCUSSION

The results show that the most important parameter for Zn(II) ions recovery is the pH . The order of the effects of other parameters are as follow: type of collector > type of frother > concentration of collector > the interaction between type of collector and pH. The results showed that collector SDS in the amount of 300 ppm, Dowfroth 250 in the amount of 90 ppm, pH equal to 3 and airflow rate equal to 1.8 ml/min are optimal parameters of the Zn(II) ion flotation.

In the industry, mechanical and column flotation cells are mainly used on large scale. Therefore, experiments were performed on a mechanical cell in order to investigate the effect of time on the recovery. Since one of the important factors in the removal of heavy metals from wastewater is reusing of deionized water, remaining in the cell, the recovery

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of lost water in the froth was studied. The recovery of Zn(II) ions increases by increasing the flotation time. As bubbles have limited loading capacity, more bubbles are created in cell by increasing the flotation time so it is expected more ions emit from the cell. As shown in Fig. 1Fig. , after 10 min flotation the Zn(II) ions recovery of more than 92% is obtained. The water recovery is related directly by the flotation time.

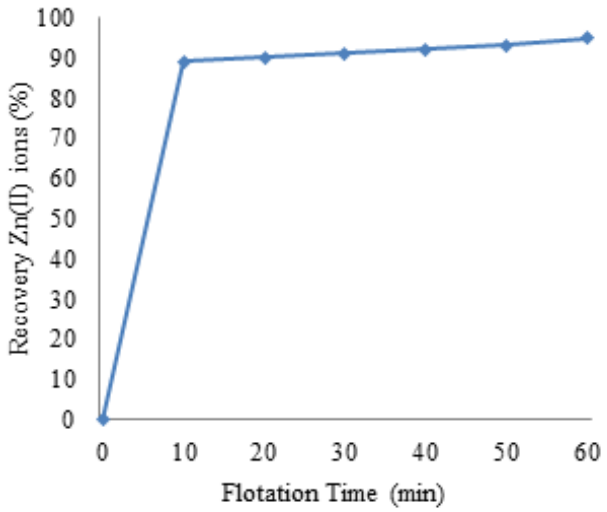

Figure 1. Zn(II) ions recovery as a function of the flotation time. (SDS=300 ppm, Dowfroth 250=90 ppm, Zn(II)=10 ppm, pH=3 and agitating speed=1000rpm)

4- CONCLUSIONS

Ion flotation experiments were carried out to investigate the removing Zn(II) ions metals from wastewaters. Several parameters such as type and concentration collector, type and concentration frother, pH and air flow rate were tested in tube Hallimond to determine the optimum flotation conditions in small scale. The results were analyzed by software DX7. The results showed that the SDS as collector, Dowfroth 250 as frother, pH=3 and air flow rate=1.8 ml/min were optimal condition ion flotation Zn (II) ions. In order to investigate the effect of time and water recovery experiments were performed in optimal conditions in the mechanical cell. In these conditions, recovery of Zn (II) was obtained 92%. The study showed that ion flotation has high performance for the removal of Zn(II) ions from the wastewaters.

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