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Recovery of Iron Coagulants From Tehran Water-Treatment-Plant Sludge for Reusing in Textile Wastewater Treatment

*F Vaezi[1], F Batebi[2]

[1]Dept. of Environmental Health Engineering, School of Public Health and Institute of Public Health Research, Tehran University of Medical Sciences, P.O.Box 14155-6446, Tehran, Iran.
[2]Ministry of Health and Medical Education, Garmsar, Iran.

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ABSTRACT

Most of the water treatment plants in Iran discharge their sludge to the environment whithout consideration of possible side effects. Since this kind of sludge is generally considered pollutant, the sludge treatment of water industry seems to be an essential task. Obviously theweight and volume of solids produced during the coagulation process are much more than other wastes of water treatment operations, and their treatment is much more difficult as well. Besides, this sludge contains metal hydroxide so disposing of it would waste considerable amounts of valuable metal salts. To face the mentioned problems, reclamation of coagulatns from waste sludges for reuse has been investigated in this research. Among different chemicals used in the experiments of recovery, sulfuric-acid showed better results from both practical and cost viewpoints. Three important phenomena were observed by sludge acidificantion: dissolution of metal hydroxide, reduction of sludge volume and finally faster settleability and dryness of remainder sludge. The salt recovered by sulfuric acid from the sludges of Tehran Water-Treatment Plant was ferric sulfate which showed good results in the treatment of two different types of wastewaters from textile industry.

INTRODUCTION

Most of the water treatment plants in Iran dispose the solids removed during the treatment processes by returning them to surface water. However, these wastes are today recognized as an industry-wide pollution problem. In most water treatment facilities, coagulation is a process that generates the bulk of the residual materials and the type and amount of coagulant used can have a significant effect on the amount of residue produced by the plant (1). There upon, recovery of used coagulants has been proposed as a suitable treatment method for the disposal of water works sludges in some European countries (4).

In order to introduce a better way of controlling water plant wastes, possibilities for reclamation of coagulants from coagulation sludges and use the recovered coagulants in textile wastewater treatment have been investigated in this study. The ironsalt recovered by acidification of these sludges has shown good results in the treatment of two different kinds of wastewaters from this industry (3).

Waterworks sludges have also revealed a beneficial application in municipal wastewater treatment including the removal of phosphorous (5).

MATERIALS AND METHODS

Source of Iron Sludge

The iron sludge was collected from these dimentation basin of 60MGD conventional water treatment plant No1 of Tehran (Jalalieh) serving the capital city of Iran. The ferric chloride coagulant is applied for treatment of a surface water supply (Karaj river) and lime is used when it is required for pH adjustment. At the time of sample collection, the iron sludge had accumulated over a period of 4 weeks.

Iron Recovery and Determination

Various amounts of sulfuric acid of known purity (about 96% technical grade) and sodium hydroxide solutions were added to the sludge in order to achieve iron recovery. The mixtures were then stirred at 40 rpm for 5 minutes. Finally, these mixtures were poured into 100 ml graduated cylinders until reaching the 100 ml mark, and then the position of solid-liquid interface was recorded at various time intervals. After 30 minutes the final sludge volume was recorded and the supernatant was analyzed for pH, solids and iron content determinations (6,7).

All tests were performed using the procedures outlined in Standard Methods for the Examination of water and wastewater (2).

Iron concentration was determined using two atomic absorption spectrophotometers models 603 Perkin Elmer and Alpha 4.

Selection of the Wastewater for Reuse Tests

Possibilities for reusing the recovered iron coagulant in industrial wastewater treamtent was investigated by choosing the textile wastes.Textile is one of the industries with high significance for water pollution in our country. According to the fibers used, textile industry can be divided into 3 main groups, namely wool, cotton and synthetic fibers. For this study wastewater samples (about 20 samples) from 2 latter groups were collected. Sampling was performed in composite basis in the spring of 2000.

*Corresponding author, Tel: +98-21-6112790; Fax: +98-21-8950188; E-mail: for_vaezi@yahoo.com

RESULTS AND DISCUSSION

In order to perform iron recovery selected concentration of sulfuric acid and sodium hydroxide solutions were added to the coagulated sludges and stirred. The sludges were then settled in 100 ml cylinders and after 30 minutes, iron contents of the supernatants were determined. Results indicated that iron recovery by NaOH was poor (less than 20%), but obviously, recovery of iron began to be accomplished as soon as the pH was lowered (Fig. 1). However, it would not be advisable to operate a recovery process at very low pH values because other substances may redissolve. In this research, the pH selected was 3. At this pH, the concentration of mg/l corresponding to Another phenomena acidification was sludge volume of final settled acid addition indicates volume occurs when pH 2). In pH 3 there was original sludge before it is not always lower pH. Becides,much needed. So the optimum observed for both iron treatment is recovered iron was 185 20.7% iron recovery. considered by sludge volume reduction.The sludge remaining after that greatest reduction in is much decreased (Fig. only17% reduction in the volume,but as mentioned reseanable to work at more acid would be recovery pH value recovery and sludge recommended to be 3.

Fig. 1. **Percent of iron recovered as a function of pH using sulfuric acid for sludge treatment**

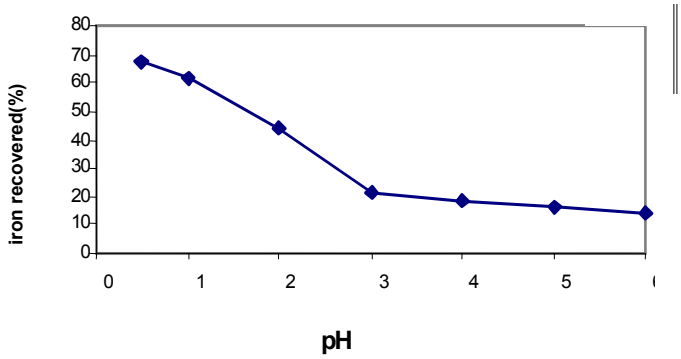


Fig. 2. **Percent of sludge vol e reduction versus pH of sludge treatme**

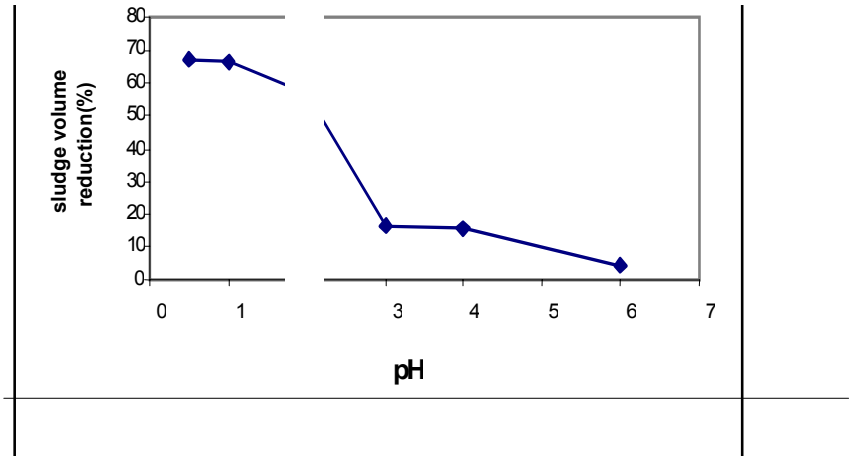


Fig.3. **Percent of COD removal versus pH of textile wastewaters treatment with recovered coagulant**

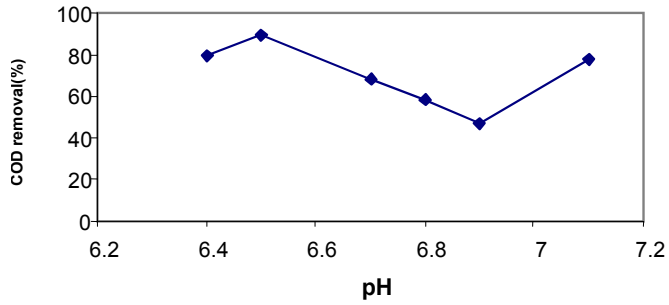


Fig.4. **Percent of SS removal versus pH of textile wastewaters treatment with recovered coagulant**

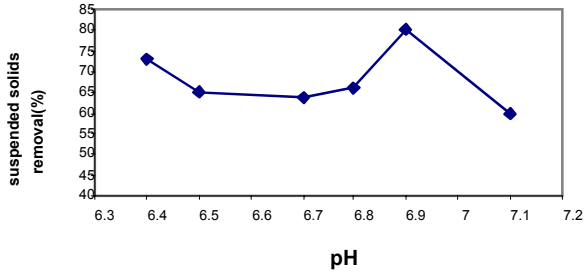
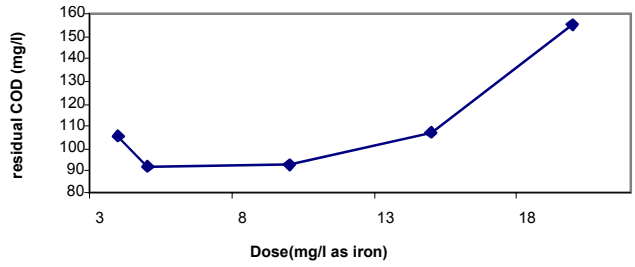


Fig.5. **Percent of COD removal from textile wastewater (sample=1) as a function of different amounts of recovered iron salt used, at pH=7**



The recovered ferric sulfate was used as a coagulant on the textile wastewater (contton and synthetic fibers) and showed equivalent or better results than fresh ferric sulfate. The optimum pH and chemical dosage for wastewater coagulation have been determined by trial and error (jar tests), and parameters considered for these were total organic materials (COD) and total suspended solids (TSS). Results obtained are as follows: by using the recovered iron salt about 40 to 85 percent decrease in total COD of two different kinds of textile wastewaters has been considered and total suspended solids removal is reported to be 60 to 82 percent (Fig. 3 and 4).

Required dosages of recovered chemical for this treatment has been determined to be about 5 to 15 mg/l as iron at optimum pH = 7(Fig.5). Comparison of results with fresh coagulant supports the following conclusion: much lower chemical is consumed when recoverd salt is employed in the treatment of textile wastewaters. It is suspected that particulates in the recovered solution were responsible for this difference. If we consider that fresh ferric compounds are more expensive, gaining an economic value of their recovery would be expected. It is therefore concluded that:

1- Sludge treatment of acidic pHs can yield simultaneous iron recovery and reduction in original sludge volume;

2-The acidic method of iron recovery is technically feasible. Every strong acid can be used for this process, but for economic reason sulfuric is superior;

3- Similar to fresh compounds, the recovered iron coagulant is efficient in treating textile wastewaters.

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