



Environmental Science

An Indian Journal

Current Research Paper

ESAIJ, 9(4), 2014 [172-176]

The feasibility of using lime-soda in reducing the hardness of effluent desalination units of mobin petrochemical

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ABSTRACT

Mobin Petrochemical Company, Executive utility petrochemical manufacturing complexes. Mobin Petrochemical Company, the largest utilities in the world focused on the NPC adopted in 2000 and was built to the detailed engineering Mobin Petrochemical Company, it is done by the French Tknyp. This project will provide the needs of all petrochemical plants in the area According to the high hardness of Mobin Petrochemical Effluent desalination units have been abandoned to the sea and the difficult problem of this study was to evaluate the effluent. In this study, the feasibility of using the lime - soda, to reduce hard water desalination units of Mobin Petrochemical has been studied. This research have been conducted through laboratory studies and for this purpose, samples of the effluent was done from the Asalooye Mobin Petrochemical desalination plant. All tests required for this study and measurement of quality parameters including total hardness, calcium hardness, magnesium hardness, alkalinity, acidity, total dissolved solids, based on the guidelines published in 1998 in the book is the standard method. The range of use of lime and soda is 10, 50, 100, 250, 500, 750, 1000, 3000 and 5000 mg/l. For this study samples of condensed water (effluent) desalination units petrochemical output analysis and the hardness was measured at different times. Then the range of hardness and various amounts of lime and soda with a stirring rate of decline of total hardness, temporary hardness and permanent hardness was found to reduce the hardness of the chemical efficiency has been determined. The side effects such as temperature, pH and speed intensity decreases more difficult to evaluate and optimize the values of these parameters were determined.

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INTRODUCTION

Today's, lake of potable water, development of industries and population growth, extend desalination units. However, published papers about the pretreatment of exit waste water from desalination units are few^[10].

Exit brine stream is usually drained into the sea ecosystem. In addition, annually an enormous quantity of

concentrated brine is discharged into the sea^[3,4]. By treatment of this saline wastewater, it is possible to decrease the hazardous effects of salinity on sea ecosystem. Additionally two beneficial matters, salt and sweet water can be produced.

During pretreatment process of wastewater to produce Sodium Chloride salt total hardness and turbidity of wastewater must be decreased^[5,7]. Coagulants are

the matters used to reduce total hardness of wastewater. The pretreatment process involves three general steps: coagulation, flocculation and sedimentation. Improving the yield of pretreatment process depends on water specifications and also the operating parameters^[1,2,9]. The optimum mixing rate of first pretreatment reactor, type of coagulant, ratio of sodium hydroxide to coagulant and sodium carbonate to coagulant are some of the important factors in operating conditions. Polyelectrolytes or mixture of coagulants can be used to promote the efficiency of total hardness removal^[6].

In this work various mixtures of three mineral coagulants were investigated quantitatively and qualitatively. To reach the goal of Zero Discharge Desalination Process (ZDDP) some experiments were conducted to decrease the total hardness of effluent stream from Mobin desalination unit. The optimum amounts of Sodium Carbonate to coagulant ratio and Sodium Hydroxide to coagulant ratio were investigated for each coagulant individually. This shows that the best ratio for Sodium Carbonate to coagulant is three and the best ratio for Sodium Hydroxide to coagulant is four, also.

MATERIALS AND METHOD

In this study the feasibility of using lime - soda to reduce hard water desalination units Mobin Petrochemical, are discussed. This project was conducted through laboratory studies, and for this purpose a sample of effluent from a desalination unit of Asalooye Mobin Petrochemical was performed. Experiments has been started from 2011 to 2013. All tests required for this study and measuring of quality parameters based on the guidelines expressed in standard method was published in 1998. In order to measure the amounts of total hardness, calcium and magnesium hardness, alkalinity used from titration method, pH by pH meter construction of Spain and TDS by TDS meter of Korea. Chemicals used in this study have industrial grade Made in the country or laboratory grade Merck Germany include of industrial lime, soda industry, NaOH, sulfuric acid, Ario Chrome Black T reagent.

RESULTS AND DISCUSSION

Phase I

TABLE 1 : Analysis of effluent from desalination units mobin petrochemical

Magnesium Hardness	Calcium Hardness (mg/l CaCO ₃)	Total Hardness (mg/l CaCO ₃)	Alkalinity (mg/l)	TDS (mg/l)	pH
8700	650	9350	250	32000	8.14

Second stage

At this stage, various concentrations of lime was added to the wastewater samples.

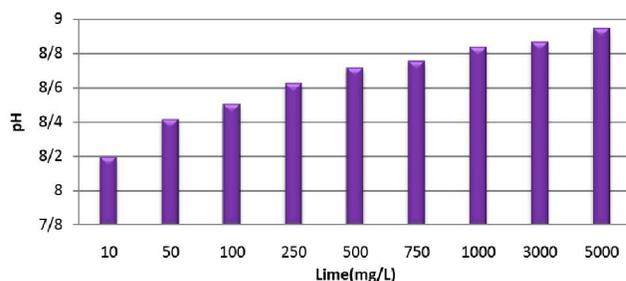


Figure 1 : PH changes in the concentrations of lime (35 rpm mixing speed, mixing time 15 minutes settling time 30 min, pH Raw wastewater samples 14/8)

As can be observed with higher concentrations of lime increases pH level so that the maximum pH value equal to 8.94 at a concentration of 5000 mg l lime and minimum of pH is 8.19 at a concentration of 10 mg/L lime. At this stage, the optimal concentration of 750 milligrams per liter of lime was determined by the pH of 8.75, respectively.

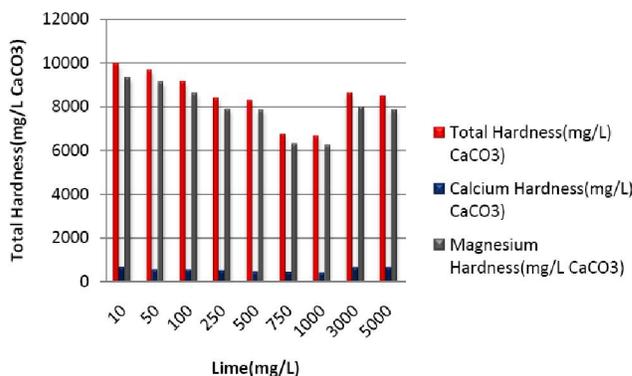


Figure 2 : Values of total hardness, calcium and magnesium in different concentrations of lime (35 rpm mixing speed, mixing time 15 minutes settling time 30 min, pH Raw wastewater samples 14/8)

The maximum amount of total hardness equal to 9933 mg per liter of calcium carbonate at a concentration of 10 milligrams per liter and minimum of total hardness was 6650 mg of calcium carbonate at 1000 mg/L. By adding lime, total hardness, calcium and magnesium

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hardness up to 1000 mg per liter decreased and then increased.

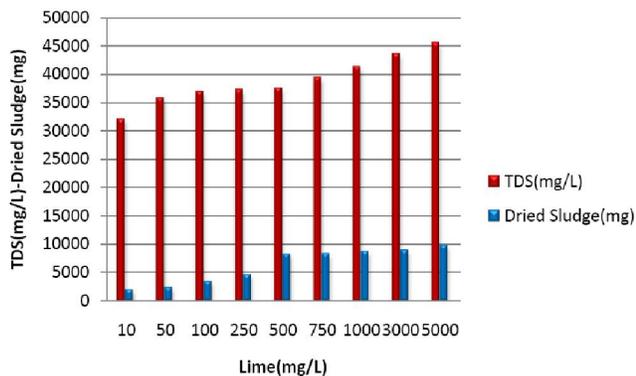


Figure 3 : The total amount of dissolved solids, sludge, lime powder in various concentrations (35 rpm mixing speed, mixing time 15 minutes settling time 30 min, pH Raw wastewater samples 14/8)

The maximum total dissolved solids equal to 45,400 mg/L at concentration of 5,000 milligrams per liter of lime and minimum of TDS equal to 32,000 mg/L of lime at concentration of 10 mg. The maximum dried sludge equal to 9763 mg at concentration of 5,000 milligrams per liter of lime and minimum of dried sludge equal to 2020 mg of lime at concentration of 10 mg. With increasing amounts of lime, dried sludge and total dissolved solids increases.

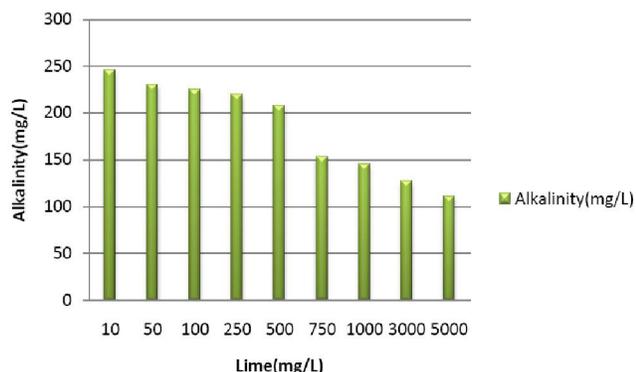


Figure 4 : Alkalinity values at different concentrations of lime (35 rpm mixing speed, mixing time 15 minutes settling time 30 min, pH Raw wastewater samples 14/8)

The maximum alkalinity equal to 247 mg/L at concentration of 50 milligrams per liter of lime and minimum of alkalinity equal to 110 mg/L of lime at concentration of 5000 mg. Studies show that increasing the concentration of alkalinity is reduced by the amount of lime.

Third stage

At this stage the optimum concentration of lime is

determined in the previous step, various concentrations Soda was added to the samples and 6 parameters, total hardness, calcium hardness, magnesium hardness, alkalinity, total dissolved solids and sludge dry weight have been measured.

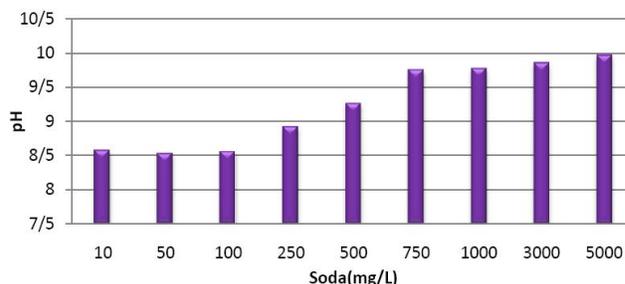


Figure 5 : PH changes in the concentrations of soda (35 rpm mixing speed, mixing time 15 minutes settling time 30 min, pH Raw wastewater samples 14/8)

The maximum pH value equal to 9.96 at a concentration of 5000 mg/L soda and minimum of pH is 8.53 at a concentration of 50 mg/L soda

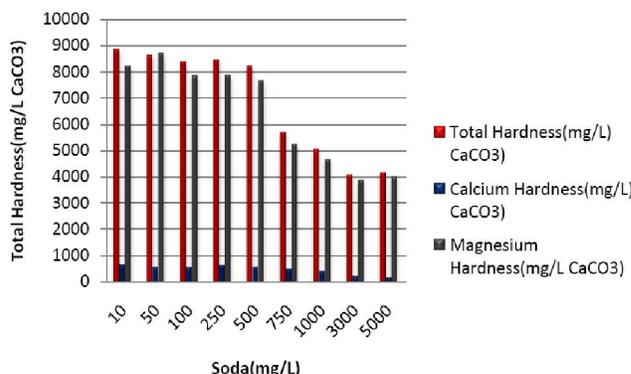


Figure 6 : Values of total hardness, calcium and magnesium in different concentrations of soda (35 rpm mixing speed, mixing time 15 minutes settling time 30 min, pH Raw wastewater samples 14/8)

The maximum amount of total hardness equal to 8833 mg per liter of calcium carbonate at a concentration of 10 milligrams per liter and minimum of total hardness was 4075 mg of calcium carbonate at 3000 mg/L. By adding soda, total hardness, calcium and magnesium hardness up to 1000 mg per liter decreased and then increased. the trend of Total hardness, has been reduced.

The maximum total dissolved solids equal to 35000 mg/L at concentration of 5,000 milligrams per liter of lime and minimum of TDS equal to 23100 mg/L of soda at concentration of 50 mg. The maximum dried sludge equal to 9180 mg at concentration of 3,000 milligrams

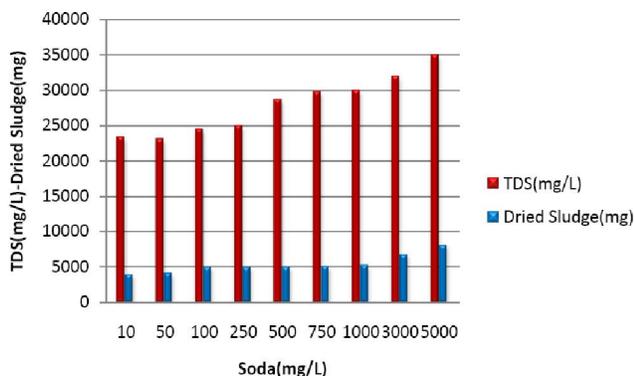


Figure 7 : The total amount of dissolved solids, sludge, soda powder in various concentrations (35 rpm mixing speed, mixing time 15 minutes settling time 30 min, pH Raw wastewater samples 14/8)

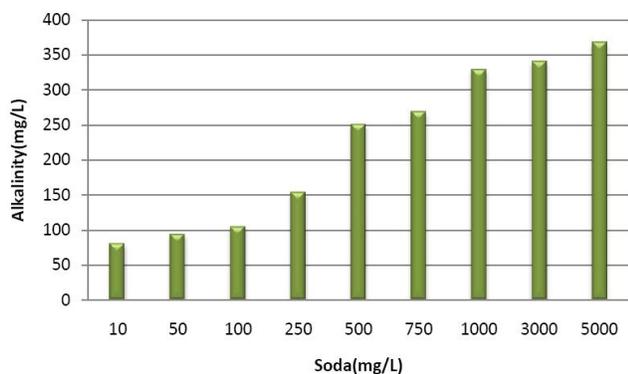


Figure 8 : Alkalinity values at different concentrations of lime (35 rpm mixing speed, mixing time 15 minutes settling time 30 min, Ph Raw wastewater samples 14/8)

per liter of soda and minimum of dried sludge equal to 1340 mg of lime at concentration of 5000 mg. With increasing amounts of soda, dried sludge and total dissolved solids increases.

The maximum alkalinity equal to 367 mg/L at concentration of 5000 milligrams per liter of soda and minimum of alkalinity equal to 80 mg/L of soda at concentration of 10 mg. Studies show that increasing the concentration of alkalinity is decreased by the amount of soda.

CONCLUSIONS

Increasing lime concentration caused by deposition of calcium carbonate and total hardness decreases with the amount of the dissolved limestone in the environment creates an alkaline environment and elevated pH environment. Lime optimal concentration was determined to be 750 mg because economically it is much affordable. Source of alkalinity are carbonate ions and

bicarbonate. 750 mg/L Soda concentration was determined as the optimum concentration. The use of caustic soda is superior compared to lime, calcium carbonate, sodium bicarbonate is produced, which is an effective substance for removing permanent hardness. When, lime and Soda are added, mineral substances form insoluble deposit.

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