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Ferric Chloride-Based Treatment for Soap Production Wastewater

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ABSTRACT

Wastewater treatment process transforms used water into a valuable resource, offering financial benefits to sectors like soap production. Actually, soap industry wastewater currently exceeds national discharge standards. Addressing this challenge requires innovative solutions to unlock the full potential of treated wastewater, promoting sustainability and cost savings simultaneously. The present work experimentally investigated treating soap factory wastewater using coagulation-flocculation with ferric chloride (FeCl3) as a coagulant. Key water quality parameters like chemical oxygen demand (COD), pH and turbidity were monitored. The process were optimized by varying the concentration, speed, and duration of coagulation and flocculation. The optimal FeCl3 dosage significantly reduced COD from 9.95 g/L to 3.51 g/L, achieving a clear and transparent water quality. The optimal parameters were found to be 1.2 g/L FeCl3, 5 minutes coagulation at 150 rpm, 20 minutes flocculation at 30 rpm, and 30 minutes settling time.

Keywords: Wastewater treatment, Ferric Chloride, Soap industry, coagulation, flocculation.

1 Introduction

Population growth and expanding industries are pushing our daily water consumption to unsustainable levels. This precious resource, now heavily polluted, demands responsible treatment before finding its way back into nature. Algeria as well as the rest of the world's countries, are leading the charge to minimize the cost of creating new water sources and shield the environment from harmful waste [1]. Waste treated water is a lower cost resource compared to drinking water. It is in a way a revitalization of this precious material. Different sectors can use it to achieve financial savings, among these sectors, there is industry, in particular that of soap production. Wastewater from this industry does not comply with the national standards Discharge Limit Requirements, particularly with regard to pH, suspended solids and COD [2]. Using ferric chloride $FeCl_3$ as coagulant on treated soap factory effluent in coagulation flocculation process can be considered for giving a satisfiying results [3].

2 Experimental

Effluents were collected from a soap production factory "PROLIPOS" located in Ain Mlila in the east of Algeria producing large quantities of effluent during the production process by saponification. After physicochemical characteristics of raw water measurements, we give an estimate of the chemical load of pollutants present in the soap effluent. Turbidity is out of norms, the pH is alkaline, the COD is very high, 9200 mg/L, a value far exceeding those recommended by Algerian legislation on discharge standards; of 120 mg/L [4]. The BOD is 662, and exceeds the standards [4], which indicates the large amount of organic pollutants in the raw water. Through a series of Jar-Test experiments [5], various parameters characterizing the wastewater treatment, such as chemical oxygen demand (COD), the pH and the solution turbidity were investigated. we optimized the parameters for coagulation and flocculation, focusing on the effectiveness

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of iron chloride (FeCl3) as coagulant.

3 Results and Discussion

Considering coagulation floculation parameters, the results of measurements after treatment using Iron Chloride (FeCl3) show a strong reduction in turbidity corresponding to the use of the concentration C=1.2 g/L, Coagulation speed 150 rpm, coagulation time 5 min, flocculation speed 30 rpm, flocculation time: 20 min and Decantation time 30 min. This means that this value of coagulant per liter of waste water sample and other parameters promote the sequence of the coagulation flocculation process. The reduction rate reached 99.68%, (figure 1)+ which indicates that the treatment was carried out under the best conditions. We notice a clear reduction in turbidity from 3235 NTU to 3.28 NTU, and in COD from 9.95 g/L to 3.51 g/L. Also the transparency of the water reflects good treatment of the soapy water sample. Figure 2 shows the difference between soap water before and after treatment.

The results of this treatment revealed that the coagulation-flocculation process, using iron chloride, was very effective. In addition to the very satisfactory treatment performance, we recovered transparent water of good quality.This concentration should be taken as the optimal parameter for next manipulations for different parameters changes as variations in coagulation and flocculation time and speed. However, the pollutant load expressed in COD (3.51g of O_2/L) exceeds the Algerian standard for reuse of treated water. For this purpose, secondary treatment is necessary in order to obtain water that complies with discharge or reuse standards.

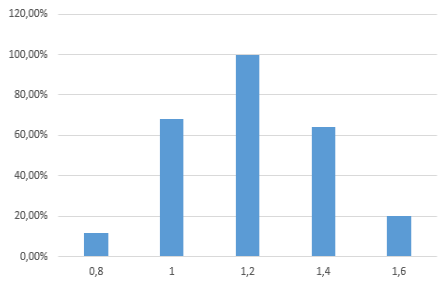

Figure1: Iron Chloride dosing effect abatement

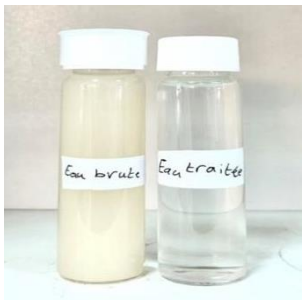

Figure2: Soap wastewater before treatment by coagulation flocculation

4 Conclusions

Soap factory waste water treatment using coagulation, flocculation represent an effective solution for ensuring good water quality. The study of the effectiveness of this treatment process by Jar-Test on PROPOLIS soap factory effluents and the analysis results obtained show that the coagulation-flocculation process, using iron chloride, was very effective with a reduction in turbidity from 3235 NTU to 3.28 NTU and a yield of 99.89%. In addition to the very satisfactory treatment performance, we recovered good quality transparent water with optimal dosing parameter 1.2 g/l of coagulant. However, the water collected was still loaded with pollutants and chemical oxygen demand. A finishing treatment by membrane filtration could be considered for further treatment as well as for Iron Chloride particles retention, to achieve a treated water which complies well with discharge standards.

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