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Water & wastewater

Treatment of paint wastewater by coagulation process

The increase in industrial wastewater poses potential health and environmental problems. Faced with the stricter environmental regulations and the increasing exhaustion of water resources, the recycling of wastewater for reuse have become a priority. This study looks into the field of treatment of industrial paint wastewater by coagulation-flocculation process.

Faced with increasingly strict environmental regulations and the increasing exhaustion of water resources, the recycling of wastewater for non-potable purposes (irrigation, domestic non-potable uses, environmental purposes) as well as the treatment of industrial waters for reuse (or just to decrease the chemical pollution) have become a priority for any industrial sector and urban community.

The paint industry is one of the most important industrial sectors in Algeria, which comprises a number of paint manufacturing companies. Among these ones, ENAP (Algerian National Company of Paints), which is located in the east of the country in Souk-Ahras city, produces a large number of paints and has an average production rate of 40,000 tonnes per year. Most of the production is intended to construction and motor industries as well as to industrial products.

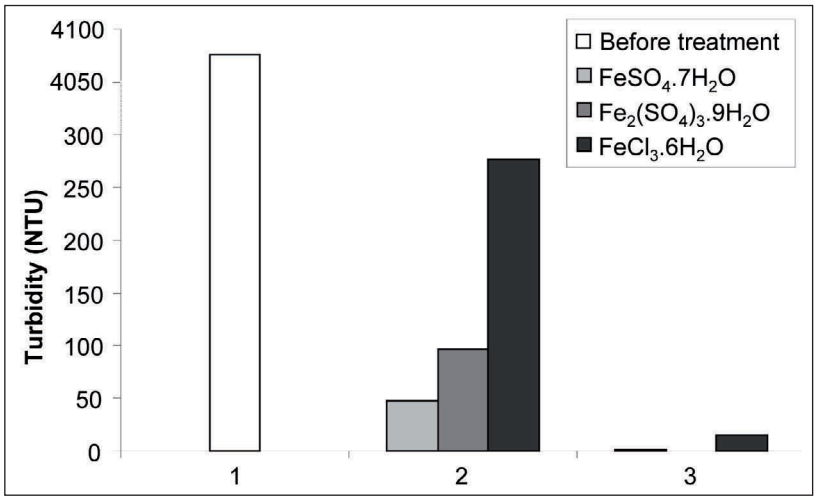


Figure 1. Histogram showing the analysis of turbidity. Abscissa: bulk solution contaminated with blanroc super (12 g L^{-1}) (1) before treatment, (2) after treatment (using $FeSO_4.7H_2O$ or $Fe_2(SO_4)_3.9H_2O$ or $FeCl_3.6H_2O$ at 3.33%) without pH adjustment, (3) after treatment (using $FeSO_4.7H_2O$ or $Fe_2(SO_4)_3.9H_2O$ or $FeCl_3.6H_2O$) with adjustment of pH.

Unfortunately, the wastewater produced by washing of reactors used for the preparation of water-based paints (blanroc super) is sent to an incineration plant without any treatment, which results in a significant loss of water volume. Therefore, recovery of water from this effluent is an attractive option to substantially reduce the fresh water consumption in the process. The blanroc super is a white substance in emulsion form intended to product the paint. It is composed of 12 % wt PVA (polyvinyl acetate), 45.5% wt $CaCO_3$ (calcium carbonate), 4% wt TiO_2 (titanium dioxide) and 35.5% wt of water.

A number of studies have focused on recovery of industrial paint wastewater in order to maintain water resources and also to preserve environment, but each one has its advantages and limitations.

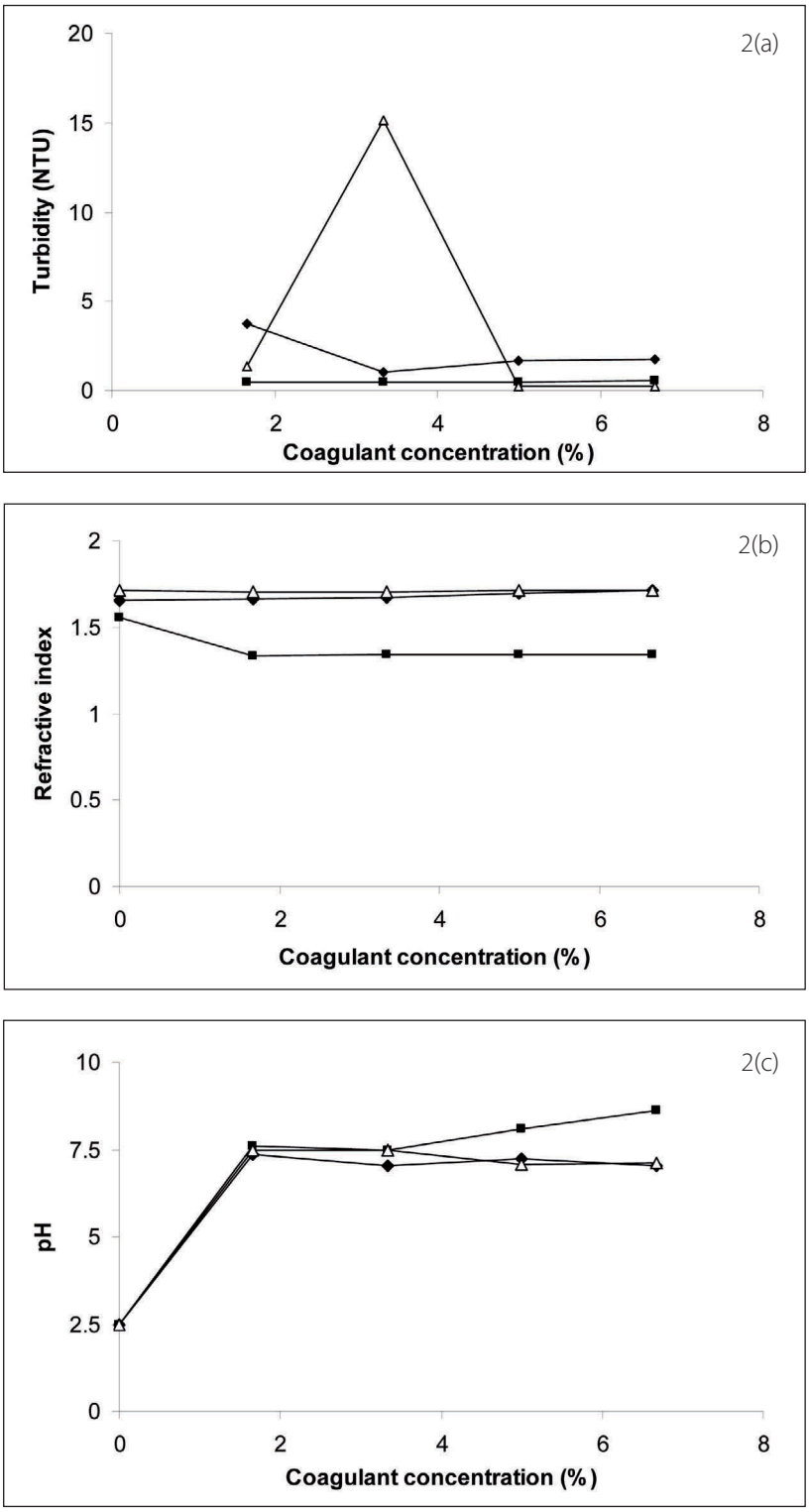
The coagulation-flocculation process, which appears as an economic and viable method due to its high selectivity, was also investigated. The objective of this work was to implement this process for the purification of paint wastewater contaminated with blanroc super, which is used in the paint manufacturing process of the company ENAP.

Water reuse

The present study focuses on the evaluation of the coagulation-flocculation process in removing the blanroc super to produce water of sufficient quality for reuse in various stages of water-based paint manufacturing. The main advantage of this method lies in its competitive technical-economic performance. Coagulants and flocculants commonly used in wastewater treatments are inorganic compounds (salts of aluminium, iron, etc) or organic polymers (polyelectrolytes), the former being widely used due to their high efficiency and low cost.

It should be noted that the choice of coagulant is not an easy task because the selected coagulant can efficiently remove the suspended solids but at the same time modify another property such as conductivity. This makes the final choice of coagulants very dependent on the relative importance assigned to each measured parameter. In this paper, iron-based coagulants (ferrous sulphate, ferric sulphate and ferric chloride) were used when a multi-criteria decision analysis was proposed to help the selection of the coagulant and its concentration.

The coagulation behaviour of the blanroc super by means of these three coagulants was thus investigated, these having been widely used in water treatment due to their good performances in turbidity. The efficiency of the coagulation process for removing the blanroc super was investigated for various blancroc amounts in the wastewater.



Variation of some parameters (turbidity, refractive index, pH, conductivity) of treated water (2a - 2d) and mass of flocs produced (2e) as a function of coagulant concentration for various coagulants (♦: $FeSO_4.7H_2O$; ■: $Fe_2(SO_4)_3.9H_2O$; Δ: $FeCl_3.6H_2O$. Blanroc super 12 g L^{-1}.

Experimental

Preparation of blanroc super solutions

In the first step, in order to optimise the choice of coagulant, all coagulation-flocculation tests were conducted on blanroc super solutions at 12 g L^{-1} prepared by dissolving 2.4 g of blanroc super in 200 mL of distilled water. In the second step, in order to study the effect of the impurity dose, experiments were carried out with blanroc super solutions at 12, 36 and 108 g L^{-1} (by dissolving the appropriate mass of blanroc super in 200 mL of distilled water).

For adjustment of pH, some drops of HCl were added to the solutions that were to be treated by ferric chloride and some drops of H_2SO_4 in case of treatment by ferric and ferrous sulphates.

Preparation of coagulant solutions

$FeSO_4.7H_2O$, $Fe_2(SO_4)_3.9H2O$ and $FeCl_3.6H_2O$ of analytical grade (Biochem) were used as coagulants reagents. Single-salt solutions at 5, 10, 15 and 20%