VALORIZATION OF INDUSTRIAL WASTEWATERS AS COAGULATION REAGENTS

Javier Mena (P), Lourdes Rodriguez and José Nuñez

Research and Development Centre for the Recuperation of the Environment (CIDRA). Alquimia Soluciones Ambientales. P. I. Daimiel Sur, C/ Calidad 3, 13250 Daimiel (Ciudad Real), SPAIN * Corresponding author. Tel.: +34-926879565; fax: +34926-879525; e-mail: jmena@alquimiaimasd.com

INTRODUCTION

Coagulation is a very common physical-chemical process used in the depuration of different wastewaters. The objective of coagulation is to modify the properties of some pollutant substances present in the wastewater in order to increase their separation of the liquid phase. This modification consists of the destabilization of a colloid caused by the compression of the double layers that surround the particles in order to favour, with agitation, the collisions and aggregation of fine particles to obtain particles with a size susceptible to be removed by sedimentation, filtration, etc. Coagulation is known to remove colloidal material as well as metals, phosphates, etc. One of the disadvantages of this treatment is the use of a reagent, hence, increasing the cost. In order to reduce this cost of reagent and taking advantage of their composition, some wastewaters can be used as a reagent source. The key is to use a wastewater with a very high content of a cation, that can destabilize the colloids charges, in comparison with the others pollutants present in the second wastewater.

The aim of this work is to prove some wastewaters as a source of coagulation reagent studying the efficiency of turbidity or absorbance and COD removal in different artificial and real wastewaters.

MATERIALS AND METHODS

Two different wastewaters were treated with three different coagulation reagents using different dosages in order to eliminate turbidity or absorbance and COD. The first wastewater (1) was an artificial one where colloidal material was simulated with NET, which is a compound that absorbs the light at 575 nm. The second one (2) was a real one, a water wash coming from a painting booth. The reagents were Fe^{3+} (Fe), coming from a prepared solution of $FeCl_3$; Al^{3+} (Al), coming from a rich-Al wastewater (51600 mg Al l^{-1}) of an industry of aluminium extrusion; and Ti^{4+} (Ti), coming from a rich-Ti wastewater (97600 mg Ti l^{-1}) of an industry of fabrication of titanium catalyst.

The coagulation experiment with wastewater A and reagent 1 were not carried out. All the experiments (1Al, 1Ti, 2Fe, 2Al and 2Ti) were carried out in the same way: 500 ml of sample (1 or 2) were introduced in different glasses, different dosages of reagents (Fe, Al and Ti) were added and pH was controlled to a value of 7 with $Ca(OH)_2$ and HCl. Once the reagents were added, the wastewater were mixed vigorously during 3 minutes (r.p.m. = 150) and slowly during 12 minutes (r.p.m. = 30). The reagents dosages added were for wastewater 1: 50, 75, 100 and 200 mg l^{-1}, and for wastewater 2: 10, 50, 100, 250, 500 and 1000 mg l^{-1}.

***Figure 1**. Jar-test installation*

RESULTS

The removal efficiencies of turbidity in each experiment are shown in figure 2.

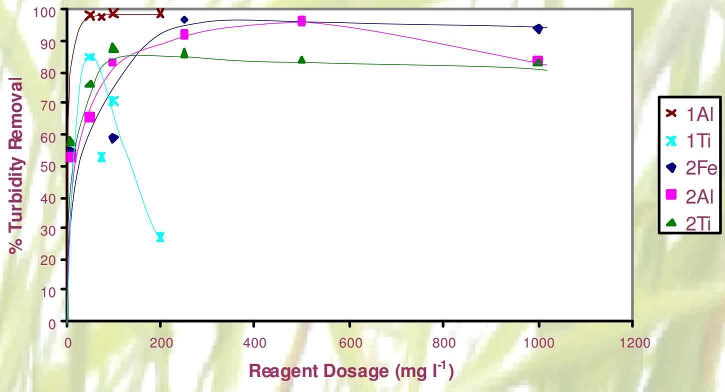

Figure 2. Percentage of turbidity eliminated in each wastewater adding different dosages of reagents

COD concentration of the dosage with more turbidity removal efficiency in each experiments with different reagents treating the real wastewaters were measured. The COD efficiency removals were 17,6 % (250 mg Fe l^{-1}), 27,9 % (1000 mg Al l^{-1}) and 8,4 % (100 mg Ti l^{-1})

DISCUSSION AND CONCLUSIONS

- Wastewater 1 (artificial wastewater):

In figure 2, it can be seen that very good results were obtained with the Al-rich wastewater, between 97 and 99% of removal efficiency of turbidity, meanwhile with the Ti-rich wastewater there was a peak at 50 mg l^{-1} and then the efficiency decreased. Bearing in mind that the Ti has four positive charges, one more than aluminum, that decrease could be because the Ti added was too much for this low loaded wastewater and the particle could be charged positively (positive zeta potential) and would disperse again. In both experiments, the optimum dosage was 50 mg l^{-1}.

- Wastewater 2 (water wash):

In figure 2, it can be seen that all the coagulants obtained good results, between 54 and 97 %, between 52 and 97 % and between 58 and 88 % of removal efficiency of turbidity. Fe-solution obtained the higher efficiencies, followed by the Al-rich wastewater and finally the Ti- rich wastewater, but at low dosages the behavior was the opposite: Ti-rich one obtained the highest efficiency. It can be observed that the only coagulant that decreased its efficiency when its concentration was increased was the Al, so this one is the only that disperses the particles again. The optimum dosages of coagulants were 250, 500 and 100 mg l^{-1} of Fe, Al and Ti respectively.

CONCLUSIONS

- Good results were obtained using rich aluminum and titanium wastewaters as a source of coagulation reagent.
- Because of the low concentrations of the others pollutants present in the Al and Ti rich wastewaters and because of the low volume added, there is no extra contamination using this wastewaters as a source of coagulation reagent.
- Despite Fe obtained best results with less dosage and taking into account that the Al comes from a waste, the best source of coagulation reagent is the Al-rich wastewater.

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