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COAGULATION CHARACTERISTICS OF AN ELECTROCHEMICALLY PREPARED POLYALUMINIUM CHLORIDE ON AMMONIUM ION REMOVAL FROM WATER

Adina Pacala[1], Ciprian Radovan[2]

[1]National Research and Development Institute for Industrial Ecolog – ECOIND, Timisoara Subsidiary, 115 Bujorilor Street, 300431, Timisoara, adina.pacala@ecoind.ro, Romania
[2]West University of Timisoara, Faculty of Chemistry, Biology and Geography, Department of Chemistry, 16A Pestalozzi Street, 300115 Timisoara, Romania

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Introduction

Nitrogen is an essential element for life and undergoes many chemical and biochemical processes in water. It appears mainly as ammonium, nitrite, nitrate, gaseous nitrogen and fixed in organic compounds, groups between which there are continuous transformations / transits, forming the "nitrogen cycle". The excess leads to eutrophication, contamination of aquifers, possible damage to human health: methemoglobinemia in children, gastric cancer, etc. The presence of ammonium ion in the composition of a surface water indicates a degree of its pollution. Ammonium sources in waters are natural and anthropogenic. These "natural" sources are often indirectly also anthropogenic. Anthropogenic sources have been described as punctiform (wastewater discharges containing ammonium) and diffuse sources, mainly nitrogen compounds from agriculture, chemical fertilizers, and natural fertilizers.

The removal of nitrogen compounds from drinking water is expensive and complicated. Chemical (ion exchangers) and biochemical techniques have been experimented, mixing contaminated waters with others with a lower concentration of ammonium/nitrogens. Here are some aspects that were the basis for choosing the ammonium ion introduced as ammonium nitrate as a pollutant in a synthetic water in order to compare the efficiency of removing this type of pollutant through the coagulation-flocculation process with aluminum sulfate (alum), polyaluminium chloride (PAC) and a new electrochemically prepared polyaluminium chloride (E-PAC).

Materials and methods

For comparison purposes, commercially available PAC (8.8 % Al_2O_3, basicity 65, density 1.22 kg/dm^3) was a Donau Chemie product (Austria). Alum stock solution was prepared from liquid aluminium sulphate (approximately 7.5% as Al_2O_3) obtained from a local Bega water treatment plant.

A new method for the preparation of electrochemically obtained PAC (E-PAC) in an electrochemical reactor, equipped with plain-plate Al anodes and stainless steel cathodes, and $AlCl_3$ aqueous solution as electrolyte, was applied successfully in our laboratory.

The synthetic model water consisted of a stock ammonium nitrate (NN) solution prepared by adding commercial ammonium nitrate powder (NN, Merck Company, Germany) into deionized water. After that, this stock solution was stirred for 5 min., at 300 rpm.

Results and conclusions

Coagulation behaviors of E-PAC and conventional coagulants as alum and commercial product PAC were compared, using the so-called „Jar test" procedure, in accordance with water treatment standards, to remove the introduced ammonium ion as ammonium nitrate from deionized water with addition of 1mg/L of ammonium nitrate (commercial NN powder), selected for this study.

As part of the applied procedures, the level of residual turbidity, the amount of total organic carbon, the UV-254 absorbance and color were evaluated, in order to assess the efficiency of the coagulation process in all situations (PAC, E-PAC and alum as coagulants).

E-PAC seems to exhibit better coagulation performance than PAC and alum, especially in very low coagulant dose (e.g. 1 mg Al/L). The superiority of E-PAC can be attributed to the higher Al_{13} content, than the respective values of PAC.

Scan Spectrum Curve for domain 220-350 nm wavelength have been rendered with UV-254 nm absorbency, as shown in Figure 1.

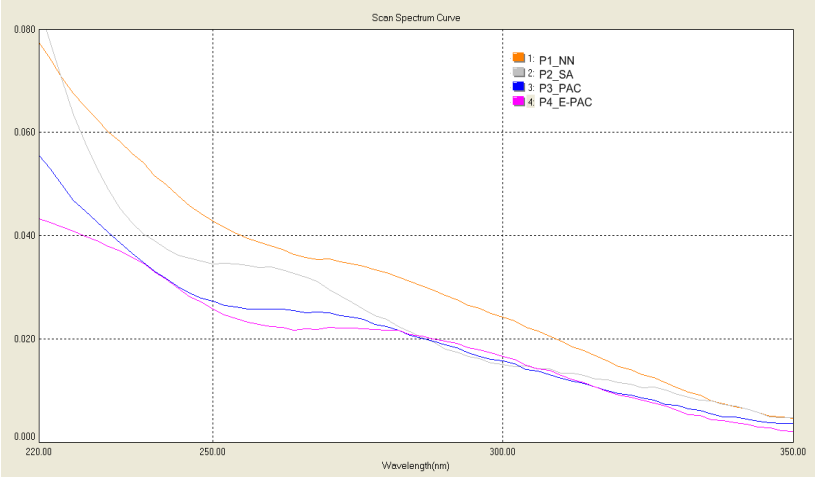

Fig. 1. UV absorbency spectrum curve

The results suggest that the electrochemically obtained E-PAC through a easily controlled electrolysis process, is a product with better properties than the commercial PAC used for comparison to remove the introduced ammonium ion as ammonium nitrate from synthetic water.