# REMOVAL OF PHOSPHATE ION BY CO-PRECIPITATION FROM WASTEWATERS

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## INTRODUCTION

Phosphorus compounds are very important for several industrial branches.[1] Wastewaters containing phosphate ions result from the process of manufacturing fertilizers.[2,3] The discharge of wastewaters induces effluent pollution. The phosphate ion stimulates aquatic plankton growth and the eutrophication process. Therefore, the removal of phosphate ion from wastewaters becomes a necessity for environmental protection.The most efficient and reliable processes for phosphate ion removal are the physical-chemical processes.[4-6]

The present paper refers to the removal of phosphate ion process by precipitation-coagulation. Ferric chloride and ferrous sulphate were used as coagulation agents and calcium hydroxide as neutralizer. The best conditions of the process for maximum separation and a minimum residual concentration in phosphate and iron ions were established. The mechanism of the phosphate ion removal was set up.

## EXPERIMENTAL

For this study the Jar-Test method was used. Water samples with 64 mg/L $P_2O_5$ were treated with doses of ferric chloride and ferrous sulphate (50, 100 and 150 mg/L Fe) and saturated $Ca(OH)_2$ solution.

The pH of the system was measured and the residual content of phosphate and iron ions were determined in the clarified water. The phosphate ion was precipitated as colloidal ferrous phosphate and hydroxylapatite. As time went by, the phosphate precipitate coagulated together with the iron hydroxides. The analyses were carried out by an UV-VIS JASCO V-530 spectrophotometer ($P_2O_5$ - analysis with vanadomolybdate, iron - analysis with 2,2-dipyridil).[7]

In addition, chemical analysis and thermal analysis were used to characterise the separated precipitates.

## RESULTS AND DISCUSSION

To achieve the objectives of this study, the influence of various factors (ferric chloride and ferrous sulphate dose, respectively, and pH) on phosphate ion separation were studied.

## The influence of ferric chloride dose and pH on the $P_2O_5$ residual concentration

The experimental data concerning the dependence of the $P_2O_5$ residual concentration on the final pH of the system, at various doses of ferric chloride, for a residual solution with an initial content of 64 mg $P_2O_5$/L are presented in Figure 1.

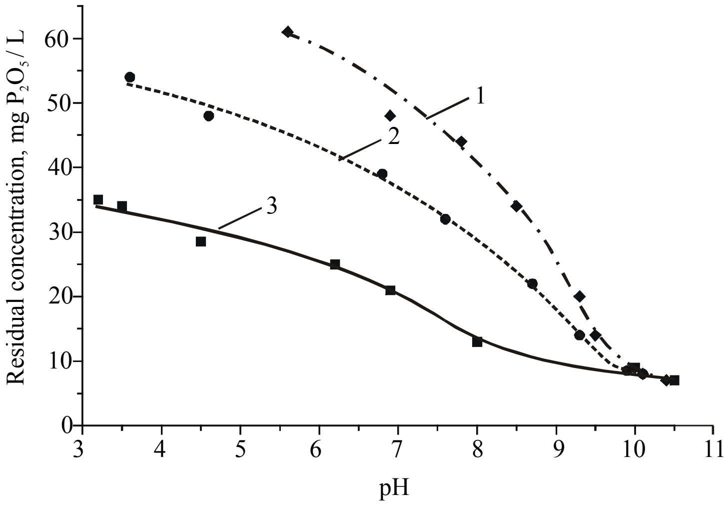

Figure 1. The dependence of the $P_2O_5$ residual concentration on the final pH of the system, at different doses of $FeCl_3$ (mg $Fe^{3+}$/L):
1 - 50; 2 - 100; 3 - 150.

These data showed that the $P_2O_5$ residual concentration decreased as the pH increased, regardless the ferric chloride. At constant pH, the $P_2O_5$ residual concentration increased as the ferric chloride dose decreased.

At pH ≥ 10, the $P_2O_5$ minimum residual concentration was approx. 7 mg/L and the iron residual concentration, at pH > 3.5, was minimal (approx. 0.1 mg/L).

## The influence of ferrous sulphate dose and pH on the $P_2O_5$ residual concentration

The experimental data concerning the dependence of the $P_2O_5$ residual concentration and of the iron residual concentration on the final pH of the system, at various doses of ferrous sulphate, for a residual solution with an initial content of 64 mg $P_2O_5$/L are presented in Figure 2 and Figure 3.

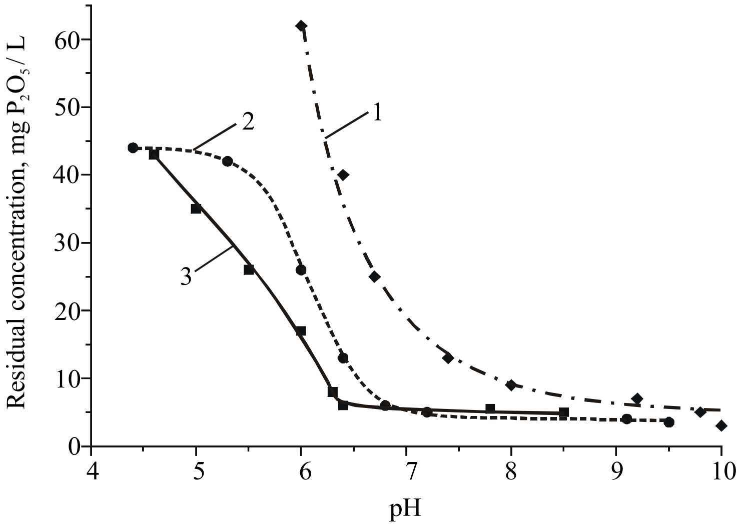

Figure 2. The dependence of the $P_2O_5$ residual concentration on the final pH of the system, at different doses of $FeSO_4$ (mg $Fe^{2+}$/L):
1 - 50; 2 - 100; 3 - 150.

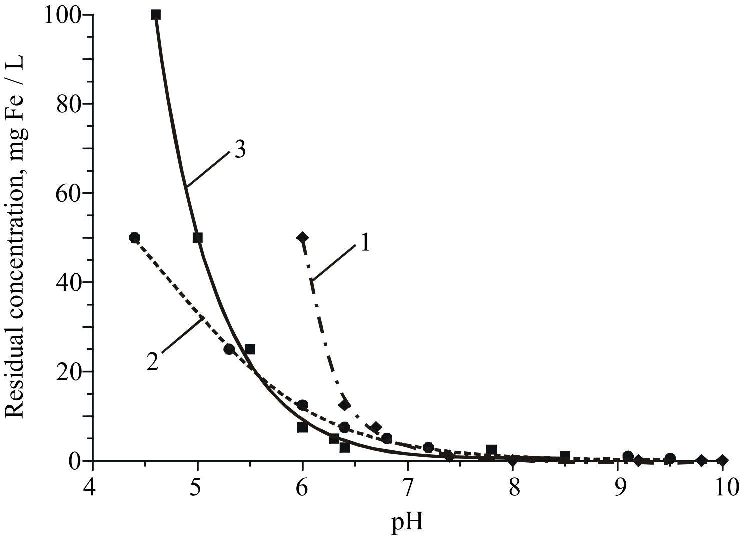

Figure 3. The dependence of the iron residual concentration on the final pH of the system, at different doses of $FeSO_4$ (mg $Fe^{2+}$/L):
1 - 50; 2 - 100; 3 - 150.

These data showed that together with the pH increase, the $P_2O_5$ residual concentration decreased to a constant value.

The pH corresponding to this minimum value depended on the ferrous sulphate dose and was lower as the ferrous sulphate dose was higher. The $P_2O_5$ minimum concentration at pH > 7 was 3-5 mg $P_2O_5$/L.

The iron residual concentration in the system decreased with the pH increase to a minimum value (under 1 mg/L). The pH value corresponding to the minimum residual concentration depended on the coagulant dose.

## CONCLUSION

The experimental data showed that the phosphate ion removal process is a complex physical-chemical process. The colloidal iron and calcium phosphates were formed in the first stage. Also, the iron hydroxides were formed. When pH increased, the colloidal hydroxylapatite appeared. As time went by, the phosphate precipitates coagulated together with the iron hydroxides. Finally, the flocks settled down. The residual concentration of phosphate was below 5 mg/L $P_2O_5$.

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