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RESEARCHES ON OBTAINING LIQUID FERTILIZERS PK WITH MICROELEMENT ZINC FROM $K_4P_2O_7 - ZnSO_4$ SYSTEM

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ABSTRACT

The purpose of this paper is to establish the optimum conditions of the process of obtaining double pirophosphats of zinc and potassium, it was watched the dependence of the reaction mass of pH and the degree of separation of zinc and potassium in solutions, from the molar ratio Zn^{2+}: $P_2O_7^{4-}$, respectively the establishing of the type of solid pirophosphat obtained.
The researches were made at the temperature of 25ºC, under continuous agitation, using potassium pirophosphat and zinc sulphat, solutions having 0,1M concentration.
The concentration of ions K^+ and Zn^{2+} was determined through spectroscopy of atomic absorption using a Varian Spectr AA 110 instrument, and also the concentration of the P_2O_5 was determined through spectrofotometry using a Varian Cary 50 instrument.

KEY WORDS

molar ratio $K_4P_2O_7$: $ZnSO_4$, degree of separation, temperature, concentration, pH

1. The purpose of the paper

In order to establish the optimum conditions of the process of obtaining double pirophosphats of zinc and potassium from sulphat of zinc and pirophosphat of potassium, it was watched the dependence of the pH and the degree of separation of zinc and potasium in solutions, from the molar ratio Zn^{2+}:$P_2O_7^{4-}$, respectively the establishing of the type of solid pirophosphat obtained.

2. WORKING METHOD

For this study were used 0,1M pirophosphat of potassium and sulphat of zinc solutions. For the preparation of the solutions were used as reactives $K_4P_2O_7$ and $ZnSO_4 \cdot 7H_2O$.

In the solution of pirophosphat of potassium (0,1M and $pH_{initial}$=10), was added, under continuous stirring, the sulphat of zinc solution (0,1M, $pH_{initial}$=5,4 and $pH_{initial}$=2,25), at different molar ratios Zn^{2+}:$P_2O_7^{4-}$ and at 25°C temperature.

The pH of the reaction mass was determined using a pH-ISE-conductivity meter, Model 250.

The precipitate formed was separated from solution by filtration under vacuum, was washed and dried.

The content of zinc and potassium from solution was determined spectrophotometric using the atomic absorbtion Varian Spectr AA 110 instrument.

It was established the chemical composition of the separated product, by determining the content in zinc, potassium and P_2O_5.

The analyze of potassium and zinc was made with the atomic absorbtion spectrophotometer and the analyze of pirophosphoric ion was realized spectrophotometric, as P_2O_5, using the method with vanadomolibdat, using a Cary 50 spectrophotometer instrument at λ=460nm.

3. EPERIMENTAL RESULTS

a) The pH of the reaction mass

The experimental data concerning the dependence of the pH of the reaction mass to the molar ratio Zn^{2+}:$P_2O_7^{4-}$, at 0,1M concentration and 25°C, are shown in tables 1-4 and figure 1-4.

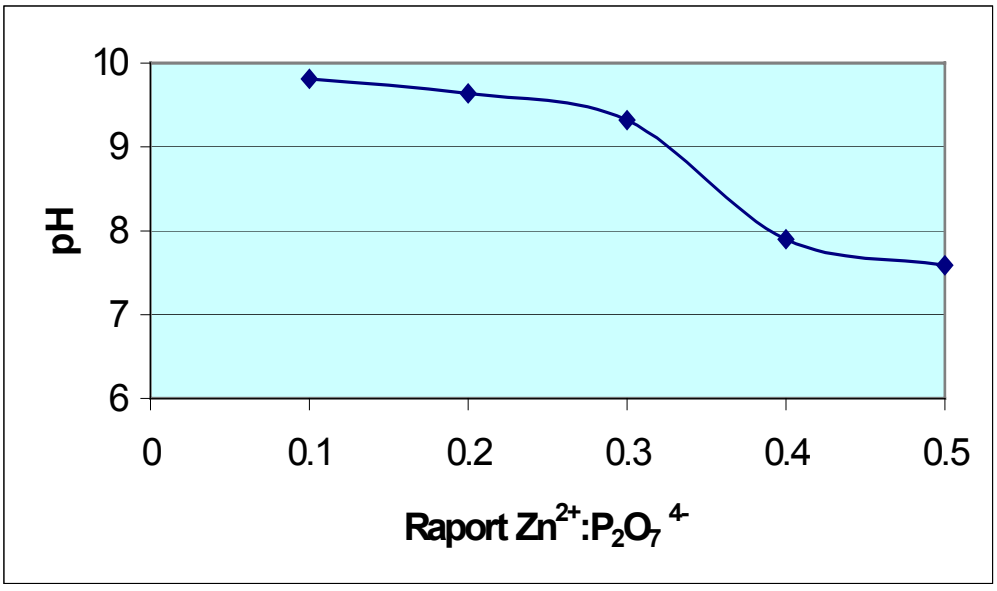

FIGURE 1. THE DEPENDENCE OF THE pH TO THE MOLAR RATIO Zn^{2+}:$P_2O_7^{4-}$, AT 0,1 M CONCENTRATION AND 25°C

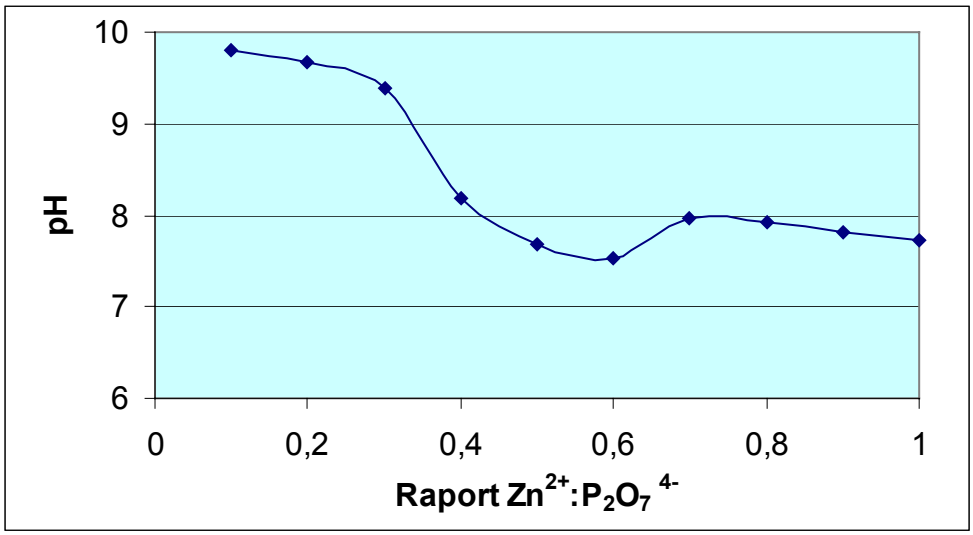

FIGURE 2. THE DEPENDENCE OF THE PH TO THE MOLAR RATIO Zn^{2+}: $P_2O_7^{4-}$, AT 0,1 M CONCENTRATION AND 25°C

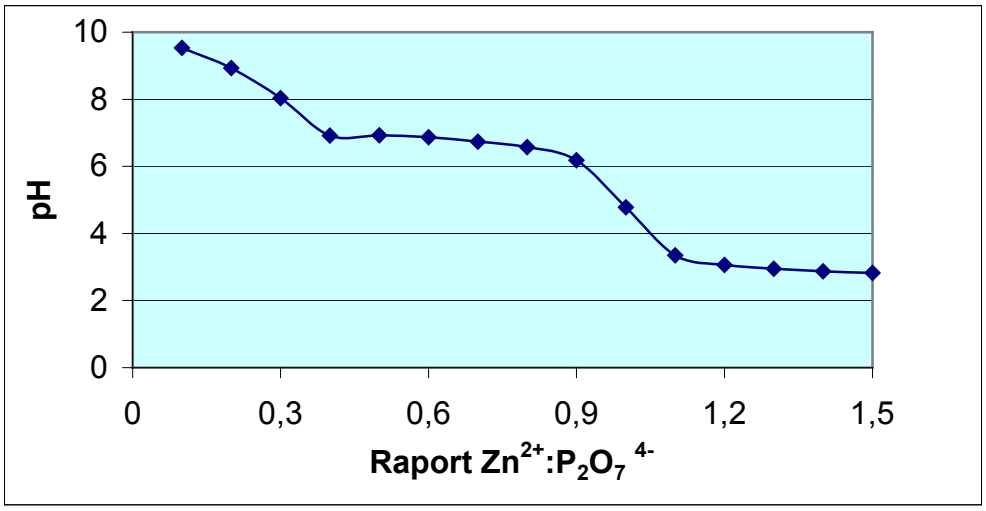

FIGURE 3. THE DEPENDENCE OF THE PH TO THE MOLAR RATIO Zn^{2+}: $P_2O_7^{4-}$, AT 0,1 M CONCENTRATION AND 25°C

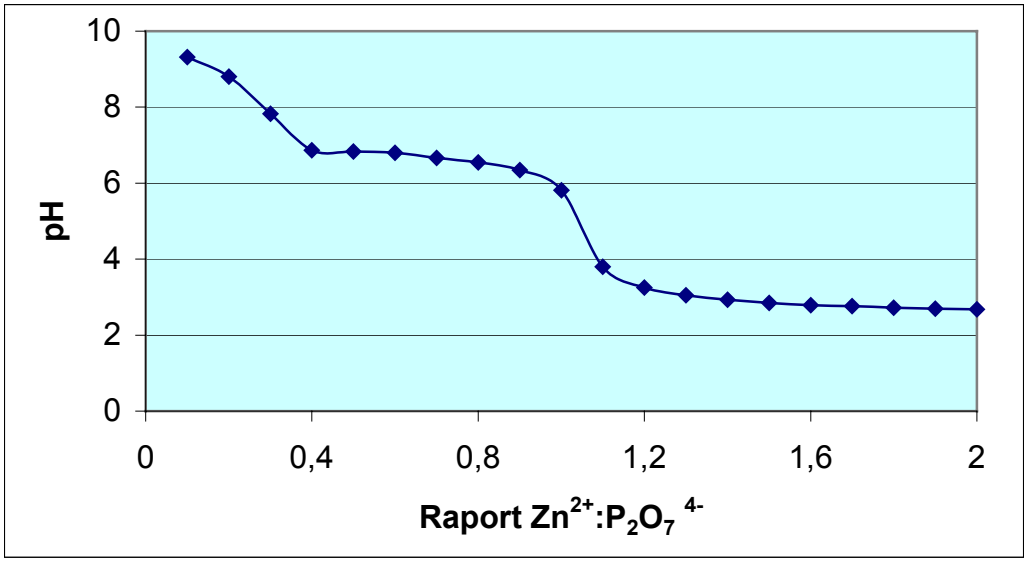

FIGURE 4. THE DEPENDENCE OF THE PH TO THE MOLAR RATIO Zn^{2+}: $P_2O_7^{4-}$, AT 0,1 M CONCENTRATION AND 25°C

These data show us that between the pH of the reaction mass and Zn^{2+}:$P_2O_7^{4-}$ ratio exists a strong interdependence. The pH of the reaction mass depends essentially to the Zn^{2+}:$P_2O_7^{4-}$.

The dependence curve pH=f(Zn^{2+}:$P_2O_7^{4-}$) knows inflexions more pronounced when using the sulphat of zinc solution with a lower $pH_{initial}$. These inflexions appear at ratio Zn^{2+}:$P_2O_7^{4-}$~0,3 and Zn^{2+}:$P_2O_7^{4-}$~1. The pH of the reaction mass diminishes suddenly to 0,3 ratio, remains then constant in the interval Zn^{2+}:$P_2O_7^{4-}$=0,3-0,9 and then diminishes suddenly again in 0,9-1,1 domain and then remains at a constant value.

Thus, we can consider that the pH of the reaction mass is the control parameter of the process of obtaining the pirophosphats containing zinc.

b) The degree of separation (α) of zinc and potassium

The experimental data referring to the dependence of the degree of separation of zinc and potassium depending on the molar ratio Zn^{2+}: $P_2O_7^{4-}$ at 0,1M concentration and 25°C are presented in table 5 and figures 5 and 6.

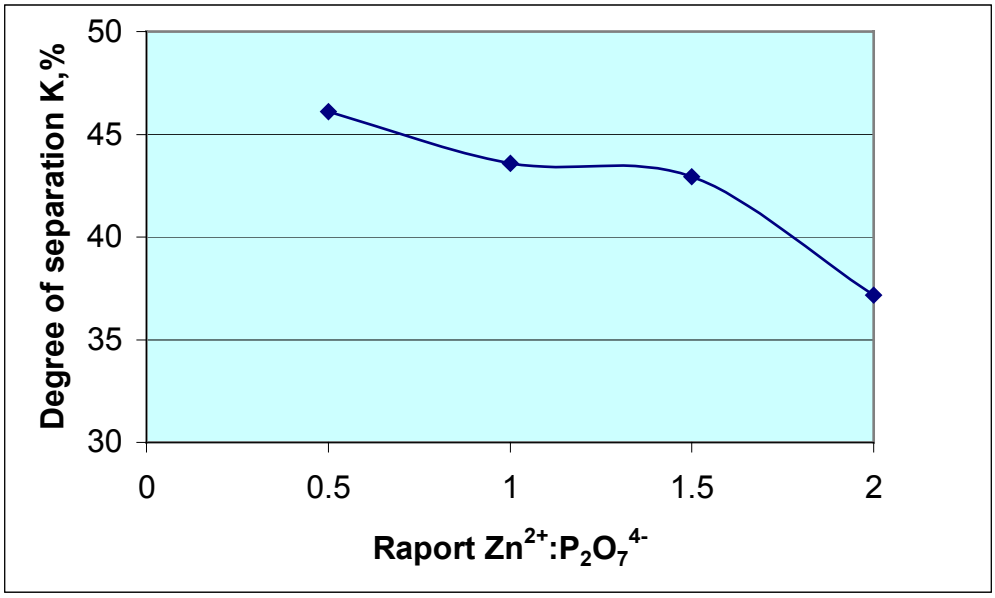

FIGURE 5. THE DEPENDENCE OF THE DEGREE OF SEPARATION POTASSIUM ON THE MOLAR RATIO Zn^{2+}:$P_2O_7^{4-}$ AT 0,1M CONCENTRATION AND 25°C

In figure 5 we can observe that the maximum degree of separation of potassium is at Zn^{2+}: $P_2O_7^{4-}$=0,5:1 ratio, maintains constant in the ratio interval 1-1,5, and then diminishes to ratio 2.

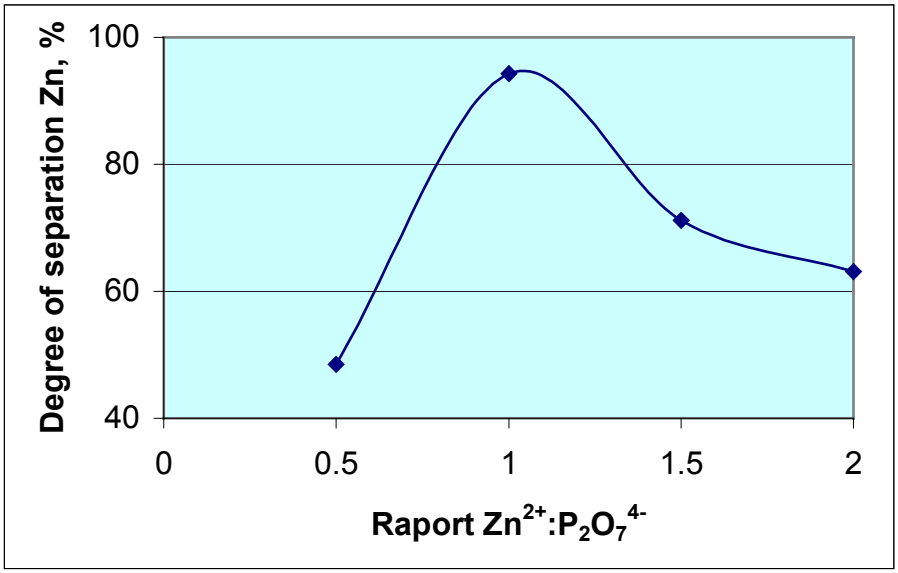

FIGURE 6. THE DEPENDENCE OF THE DEGREE OF SEPARATION ZINC ON THE MOLAR RATIO ZN^{2+}: $P_2O_7^{4-}$ AT 0,1 M CONCENTRATION AND 25°C

In figure 6 we can observe a sudden rise of the degree of separation of zinc until ratio 1, when it reaches the diminishes constantly.

c) STUDY ON THE CHEMICAL COMPOSITION

The chemical composition of the product obtained at the treatment of the pirophosphat of potassium solution 0,1M, with a sulphat of zinc solution 0,1M ($pH_{initial}$=2,25), at molar ratio Zn^{2+}:$P_2O_7^{4-}$=1,5 :1 and 25°C is given in table 6.

On the experimental data, refering to the chemical composition of the separated product, and on data from the litterature (1), we can say that the double pirophosphat solid of zinc of potassium obtained, correspondes to the chemical formula $ZnKHP_2O_7 \cdot 10H_2O$.

Conclusions:

1. For this study were used as reactives $K_4P_2O_7$ and $ZnSO_4 \cdot 7H_2O$, at 0,1 M concentrations ;
2. The temperature of the process is 25°C ;
3. The study was made at the following molar ratios $ZnSO_4$: $K_4P_2O_7$=0,5 :1, 1 :1 ; 1,5 :1 ; 2 :1 ;
4. At molar ratio 0,5 and 1 are forming precipitates with milky aspect, hard to filter and at molar ratio 1,5 and 2, the precipitates formed filter easily ;
5. Between the pH of the reaction mass and the ratio Zn^{2+} : $P_2O_7^{4-}$ there is a well defined interdependence. This is the control parameter of the process of obtaining pirophosphats containing zinc;
6. The maximum degree of separation is obtained at ratio 0,5 for potasium and 1 for zinc;
7. The double pirophosphat solid of zinc and potassium obtained correspondes to the formula $ZnKHP_2O_7 \cdot 10H_2O$, it is white and obtained at ratio Zn^{2+} : $P_2O_7^{4-}$=1,5 :1, 0,1M concentration and 25°C temperature.

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