PHYSICO-CHEMICAL PROPERTIES OF DESULFATED PHOSPHORIC ACID FROM PHOSPHORITES OF CENTRAL KYZLKUM

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Abstract:

There results of laboratory researches on desulfuration of weak wet-process phosphoric acid by calcareous phosphorite powder subsequent it concentration using evaporation were stated. There were determined the composition both the desulfuration and the evaporated solution phosphoric acid. The rate distribution of components on liquid and solid phases was calculated. It was studied that rheological properties (density, viscosity), steam tension and boiling temperature of evaporated and desulfurated wet-process phosphoric acid.

Key words:

Wet-process phosphoric acid, phosphorite powder, evaporation, desulfuration density and viscosity.

Phosphorites of the Central Kyzylkum (CK) is high-carbonated (17% CO_2) types of phosphate raw materials with a high calcium modulus (CaO: P_2O_5 = 2.86). Only after enrichment of this type of raw materials by thermal method on OA "Ammophos-Maxam" is obtained wet-process phosphoric acid (WPA)containing(wt.%): 18.44 P_2O_5; 0.21 CaO; 0.33 MgO; 0.44 Fe_2O_3; 0.79 Al_2O_3; 1.50 SO_3, suitable for the production of ammonia B-grade with 46% P_2O_5 and 11% N. To obtain high-quality ammophos (12% N and $P_2O_5$52%), phosphoric acid from the phosphorites of the Central Kyzylkumis required to be purified and evaporated to a concentration of 40-45 % P_2O_5[1, 2].

The purpose of this study is to investigate the process of desulfuration of the WPA of the phosphorites of the Central Kyzylkum and to determine its physico-chemical properties.

In AO Ammophos-Maxam from Kyzylkum's washed calcined concentrate the following WPA composition (wt.%): P_2O_5 19.88; CaO 0.30; MgO 0.39; $SO_{3common}$. 1.64; SO_{3free} 1.21; Fe_2O_3 0.31; Al_2O_3 0.72 desulfurated and evaporated. The process ofdesulphurisation was carried out using an phosphorite powder composition (wt.%): 17.37 P_2O_5; 47.13 CaO; 1.75 MgO; 0.76 Fe_2O_3; 1.12 Al_2O_3; 1.33 SO_3; 14.89 CO_2. The norm of the phosphorite powder was taken at 80-120% of the stoichiometry to bind free sulfuric acid in $CaSO_4$ at 60-65 ° C for 30 min. Further desulfed WPA was separated from the precipitate by decantation, then weighed. After that, the common content of SO_3 in the clarified part of the desulfed WPA was determined, followed by the calculation of the degree of de-desulphurization. As theWPA is desulfurized, the content of P_2O_5 is increased in it. In all cases in desulfated WPA the P_2O_5 content exceeds 21%, and the content of the remaining components: CaO, MgO, Fe_2O_3 and Al_2O_3 also increases from 0.46 to 0.63; from 0.44 to 0.48; from 0.33 to 0.36 and from 0.74 to 0.78%, respectively. During the precipitation of the latter, the supersaturation of the WPA solution on sulphate ions gradually decreases.

With an increase in the norm of the phosphorite powder from 80 to 120% of the stoichiometry, the SO_3 content is monotonously reduced by the formation of $CaSO_4$ in WPA. from 0.58 to 0.39%, and thus the degree of acid desulphurization is increased from 67.10 to 79.27%.

Optimum for desulfurization of WPA is the norm of phosphorite powder - 100%. The phosphoric acid with the content of 21.35% P_2O_5, desulfurized at this rate, was evaporated to a P_2O_5 content of 35.02-55.16%, followed by clarification of solutions by settling them for 24 hours. Then the precipitates were separated by decantation. Initial evaporated solutions of WPA without precipitation separation, clarified parts thereof, and precipitation were analyzed according to a well-known technique.

The results of the analyzes show that when clarification of WPA solutions separating precipitation for WPA (35.02% P_2O_5), the content of impurity components with the exception of Fe_2O_3 decreases (wt.%): CaO from 0.84 to 0.42; MgO from 0.74 to 0.64; Al_2O_3 from 1.22 to 1.18; SO_3 from 0.81 to 0.32; and for 55.16% P_2O_5WPA the CaO content decreases from 1.33 to 0.19; MgO from 1.17 to 0.97; Al_2O_3 from 1.92 to 1.89; SO_3 from 1.28 to 0.26. In this case, the content of P_2O_5 in the clarified part in relation to its initial part exceeds 1.022; 1.04; 1.051; 1.037 and 1.027 times (WPA concentrations of 35.80, 41.73, 46.76, 52.01 and 56.65% P_2O_5).

The density and viscosity of solutions of evaporated, clarified WPA at different contents of P_2O_5 (21.35-56.65%) and different temperatures (30-100° C) were studied. The density and viscosity of the initial desulphurized but not evaporated WPA at the studied temperatures (30-100° C) are within the limits of 1.1725-1.2101 g / cm³ and 0.54-2,51 cPs, respectively. In increasing of the P_2O_5 content from 35,8 to 56,65%, the density of evaporated acids at 30° C increases from 1,4158 to 1,7601 g / cm³, and at 100° C, from 1,3650 to 1,7037 g / cm³. The density of acids with an increase in their concentration from 35,80 to 41,73% of P_2O_5 increases insignificantly, but with further increase in the content of P2O5 in the acid begins to increase appreciably. For example, at 40°C, the acid density from 35,80 to 41,73% of P_2O_5 differs by 0,059 g / cm³, while the difference between the density values from 41.73 to 56,65% is already 0.285 g / cm³, that is, 4.8 fold more. Increasing of temperature favors to a marked decrease in the density of acids.

As the WPA concentration increases, the viscosity also increases sharply, this is especially noticeable at low temperatures and concentrations above 47% P_2O_5. For example, at 30 ° C, the viscosity of an acid containing 46.76% P_2O_5- 20,57 cPs, an acid with a content of 52.01% P_2O_5- 36.34 cPs and an acid with a content of 56.65% $P_2O_5$is 86.94 cPs. At 60° C, the viscosity of an acid containing 46.76% P_2O_5- 9.06 cPs, an acid with a content of 52.01% P_2O_5- 14.97 cPs and an acid with a content of 56.65% P_2O_5- 35.75 cPs.

The dependence of the saturated vapor pressure on acids belongsto the Arrhenius equation lgP = A-B / T. In the temperature range 293-333°K, the vapor pressure above the WPA as it concentrates to 46.11% P_2O_5decreases sharply (by 2-3 times), then changes insignificantly.
The values of A and B depending the upon WPA concentration range between 12.1167-13.0180 and 3386.11-3814.09, respectively.

The saturated vapor pressure over the evaporated EPA in the range 293-313°K is 0.13-2.65 kPa, which indicates their low volatility in hot climate of the Central Asia.

Thus, the results of the studies performed suggest that the weak extraction phosphoric acid obtained from the washed calcined phosphorus concentrate of the Central Kyzylkum and containing 20% of P_2O_5can be desulfurized with phosphorite powder and it is possible to concentrate the purified WPA by evaporation to a content of 57% P_2O_5, from it highly concentrated phosphorus-containing fertilizers, such as double superphosphate, nitroammophoski or liquid complex fertilizers.

The resulting acid is a liquid-flowing, transportable and does not evaporatein normal conditions.

References

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