Summary

Doctoral thesis

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„Technical and technological conditions for the use of ammonium nitrate in the production of compound fertilizers”

In the doctoral dissertation, tests of thermal stability of multicomponent mixtures containing fertilizer grade ammonium nitrate were carried out in order to assess the possibility of their use in the production of NPK fertilizers. The research was carried out with the use of differential thermal analysis (DTA) coupled with thermogravimetry (TG) and mass spectrometry (MS). Studied systems were assessed on the basis of occurring ammonium nitrate phase transitions and the observed decomposition process.

In the first stage of the work, the thermal stability of the fertilizer grade ammonium nitrate was determined with the use of thermal analysis and appropriate measurement parameters were selected for the tested systems. Thermal analyzes of five selected, commercial fertilizers were performed in order to obtain thermal characteristics of phase transitions and the process of decomposition of products admitted for sale.

In the second stage of the work, two-component systems containing fertilizer grade ammonium nitrate and selected additives, such as sulphate, phosphate, chloride, nitrate and carbonate salts, as well as sodium and potassium silicates, anhydrite, magnesite, dolomite and selected organic compounds - guanidine carbonate, urea, urotropine, were investigated. A total of 35 two-component systems were tested, and each system was tested for three levels of additive content in the ammonium nitrate mixture.

In the third stage of the work, thermal stability tests of multi-component mixtures containing ammonium nitrate, phosphate salt, potassium salt and possible stabilizing additives were tested. Based on the obtained results of thermal analyzes, three mixtures were selected and subjected to further comprehensive tests.

In the fourth stage, thermal stability tests of selected three systems with modified compositions and measurement conditions were carried out:

- Study of the influence of an increased mass of samples on their thermal stability.
- Research verifying the influence of different amounts of added mixtures in order to determine simple mathematical models used to estimate the value of parameters used to assess the thermal stability of tested systems.
- Study of the effect of phosphates added in the form of industrial fertilizer products on the thermal stability of NPK systems in relation to the stability of analogous systems containing the reagent phosphate salts.
- Study of the effect of micronutrient additives in the form of $ZnSO_4 \cdot 7H_2O$, $MnSO_4 \cdot H_2O$ and H_3BO_3.

The last stage of the work was an attempt to find a mixture containing phosphate salt, which, after mixing with ammonium nitrate, would have an inhibitory effect on the negative impact of the presence of potassium chloride in the studied fertilizer system.