

Abstract of doctoral dissertation

„Development of ammonium polyphosphate and liquid fertilizers based on wet process phosphoric acid. ”

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The main goal of this study was to determine the production possibility of ammonium polyphosphate and liquid fertilizers with APP, based on phosphoric acid from GA ZCh Police S.A. Manufacturer use a raw materials of sedimentary origin to produce this acid. Such materials have a certain amount of impurities, which may affect to the dehydration process and final quality of the liquid fertilizers.

The first stage of this study, was to investigate impact of temperature, dehydration time and main impurities content (Mg, Al, Fe(III)) on phosphoric acid condensation process. Research was carried out both in model approach and real-world system. It has been found that in model system, presence of Al and Fe(III) ions from investigated impurities has the most significant impact on condensation of phosphates. In the real-world system, where Mg content was above 1 % by mass MgO, Al and Fe(III) was at average concentration, the influence of Mg on the dehydration process was observed..

Next stage was to obtain ammonium polyphosphate in laboratory scale, using previously obtained polyphosphoric acids. Initially the process was carried out at 40°C analysing the influence of pH to the polyphosphates level. It was found that, with the increase of pH, the polyphosphate rate decreased. Then, more intense cooling (30°C) was applied, which allowed to obtain APP with high content of polyphosphate at higher pH.

In the next part of the research, NP and NPK fertilizers with micronutrients were prepared based on APP obtained from wet process phosphoric acid. In the preparation of these fertilizers, it is necessary to know the chemical composition of the base solutions, in particular Fe(III), Mg and Al content, because some part of polyphosphates could be already used to complex these impurities, and the limiting the possibility of the microelements sequestration.

NPK fertilizers with microelements (NPK 12-4-6 + 0,01 % Cu + Zn + Mn) based on APP with different polyphosphate level, were used in pot tests of lettuce and radishes cultivation. The solutions were used both in soil and foliar fertilization. It was observed that fertilizer

with polyphosphate level at 75%, had a positive effect on the plants weight. It was determined that foliar fertilization was more effective.

The next stage was to investigate stability of the solutions. It was observed that polyphosphate hydrolysis process depended on: storage conditions (temperature and exposure to solar radiation), molar ratio of complexing agent and macronutrient, and APP dilution rate.

The final stage was to calculate mass and heat balance for the production of liquid fertilizers based on APP (NP 10-34). It was assessed that phosphoric acid, ammonia solution and heating steam have a significant impact on production costs. The obtained results will be used by GA ZCh Police S.A. as an implementation guideline for the technology of the ammonium polyphosphate liquid fertilizers production.

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