Technology of obtaining mineral fertilizers with a controlled release rate (CRF) by the coating methods using biodegradable materials.

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Introduction

The project is carried out by a consortium of entrepreneurs - Grupa Azoty Zakłady Azotowe "Puławy" there are. (Leader) and Grupa Azoty Zakłady Chemiczne "Police" S.A. and a research institute - Łukasiewicz Research Network -Of the Institute of New Chemical Syntheses in Puławy. The main goal of the project is to develop a biodegradable polymer coating for nitrogen fertilizers (urea) and compound fertilizers (NPK) in order to ensure a slow release of nutrients into the soil, and thus increase the use of these nutrients by plants. The subject matter of the Project is a response to the challenge of developing coated fertilizers that will degrade in the soil environment within a maximum of 48 months.

Project description

The main objective of the project "Environmentally friendly slow-release fertilizers" is to develop a biodegradable polymer coating for nitrogen fertilizers (urea) and multi-component fertilizers (NPK). It is planned to use large and oligomolecular materials, in particular of natural origin. All materials tested as coating / film forming substances will be tested for effective biodegradability in soil conditions to meet the current and / or planned legal regulations in the field of environmental requirements and the production and use of mineral fertilizers. Coating the fertilizer granules will be aimed at ensuring a slow release of fertilizing nutrients from the fertilizer to the soil, and thus increasing the use of these nutrients by plants, which will positively affect the yield and quality parameters of the fertilized plants.

Research methodology

The research was carried out with the use of two methods, i.e. the application of the material to be coated on the granules in a fluidized bed with the use of a Mini Glatt fluid granulator and by spraying the bed in a plate and granulating drum. The method was the same for urea and for NPK fertilizers. The coating tests were carried out in a batch drum or granulation plate, at ambient temperature. After the disk was covered with fertilizer, the additives forming the coating were applied, each time starting with introducing the oil, and then, after mixing (time approx. 2 minutes), the powdery material was dosed (mixing time 2 minutes), after which the granules were powdered, after such an operation, the fertilizer was poured into trays and dried at the temperature of 80 ° C in order to harden the applied layer. The residence time of the fertilizers in the dryer was 1 - 2 h, depending on the observation of the surface. On all produced samples, a total of 1 to 7 layers were applied: 1 layer: oil - 1 wt.%. % for urea, 1.5 wt.% for NPK; 2-6 layer: 1% w / w oil + then 1% dust component. The first oil layer was to

prepare the surface of the granules, i.e. close the pores (especially for NPK fertilizers). Urea, regardless of the powdering material, during the application of 7 layers, absorbed about 12.5% of the total coating (regardless of the powdering material), NPK fertilizers, due to their surface and shape, were within 10 - 14% by weight. The produced fertilizers with coatings were subjected to tests of macronutrient release over time, after 24 h and 28 days, and to tests for clumping. The tested fertilizers did not show a tendency to caking, and the addition of vegetable oil reduces the tendency to caking. Graphs of the kinetics of macronutrient release from coated fertilizers produced on Polifoski were presented.

Kinetics of the release of macronutrients from of the Polifoska fertilizers.

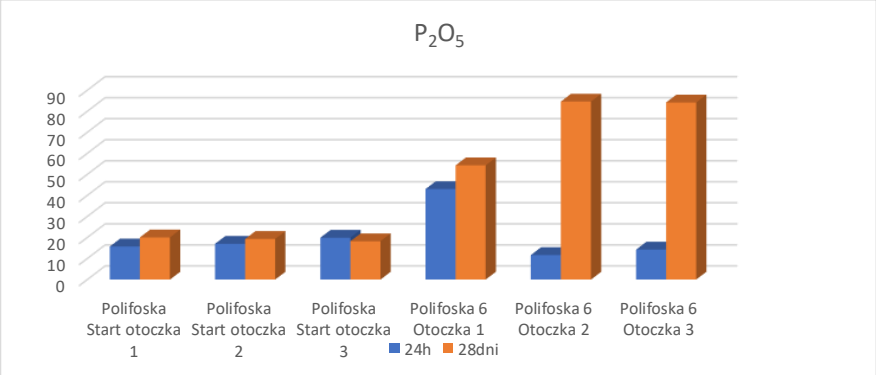

Fig. 1 P_2O_5 release rate from coated fertilizers after 24 hours and 28 days.

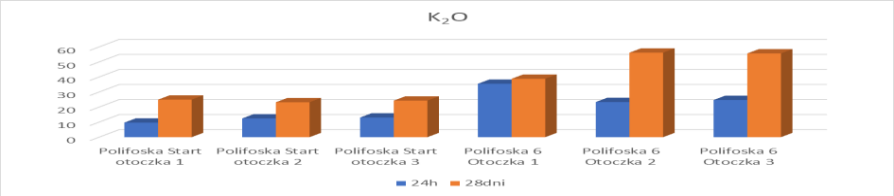

Fig. 2 K_2O release rate from coated fertilizers after 24 hours and 28 days.

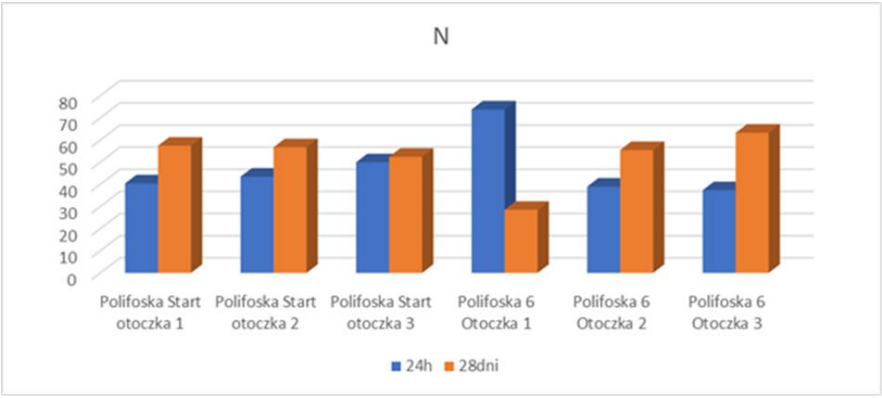

Fig. 3 The rate of N release from coated fertilizers after 24 hours and 28 days.

Conclusions

a) As a result of the tests carried out from among the pre-selected shells, it was found that only the modified oil made it possible to apply the desired layer using the fluidized method with the introduction of a double excess. The remaining preparations pose a number of problems, including of a technical nature during application to fertilizer, which excludes them from the use of the fluidized bed method on a laboratory scale, and therefore also on an industrial scale. In the opinion of SBŁ-

INSCh, the properties of organic substances (flammability, toxicity, explosiveness) used to dissolve selected polymers exclude these preparations for use in the final technological process of applying a coating to fertilizers due to the risk of process safety, as well as the need to design a complex coating system containing a unit for the recovery and purification of the solvents used.

b) The coatings based on vegetable oil with the addition of derivatives meet the criteria for slow-release fertilizers.

c) The number of applied layers in the case of the above systems is too high (7 layers), one should strive to reduce the number of layers and the mass fraction of coatings.

d) The coatings obtained as a result of spraying caprolactone dissolved in chloroform cause the destruction of urea granules due to the penetration of residual solvent into the granules.

e) The assessment of the toxicity and biodegradability will be performed at a later stage, at the moment there is still no new Reg. Fertilizer 2019/1009 of the methodology for testing the degree of biodegradability and toxicity.

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