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

P. Rusek, K. Borowik, S. Schab, Ł. Rusek, U. Ryszko

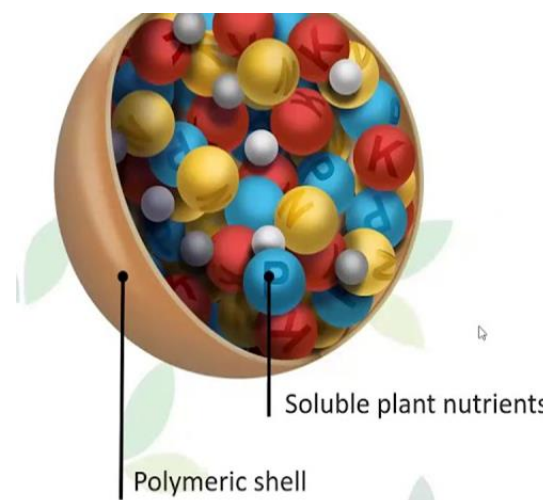
Justification of the research topic.

- 1. The options suggested for the reduction of nitrogen losses include:**
 - ❖ the replacement of urea with ammonium nitrate fertilizers,
 - ❖ **the application of slow- or controlled-nutrient-release fertilizers.**
- 2. 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.**
- 3. The subject matter of the Project is a response to the challenge of the Regulation of the European Parliament and of the Council EU 2019/1009, which imposes requirements for coated fertilisers. The requested materials fall under category 9 of component materials (CMC 9): Polymers other than nutrient polymers.**

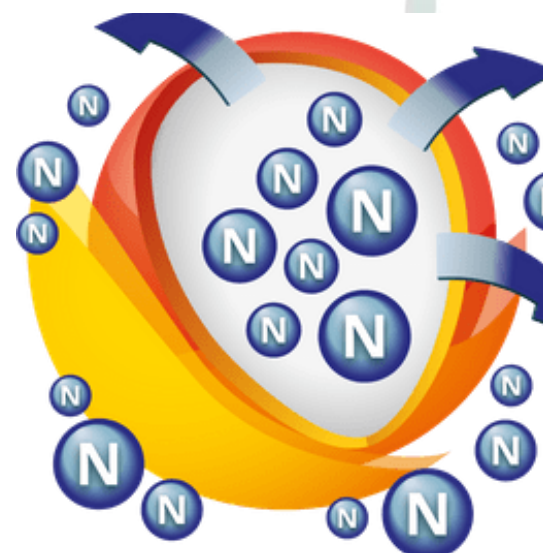
How does coated CRF fertilizers work?



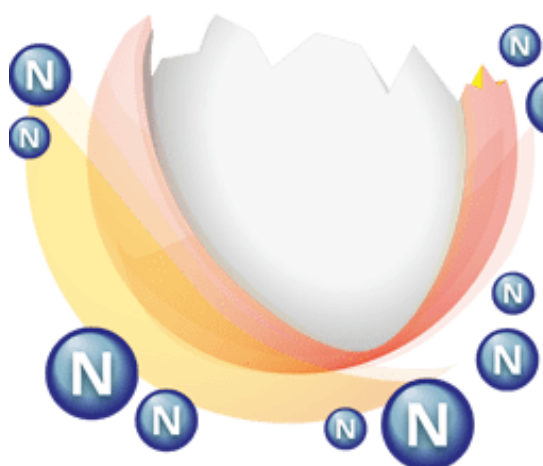
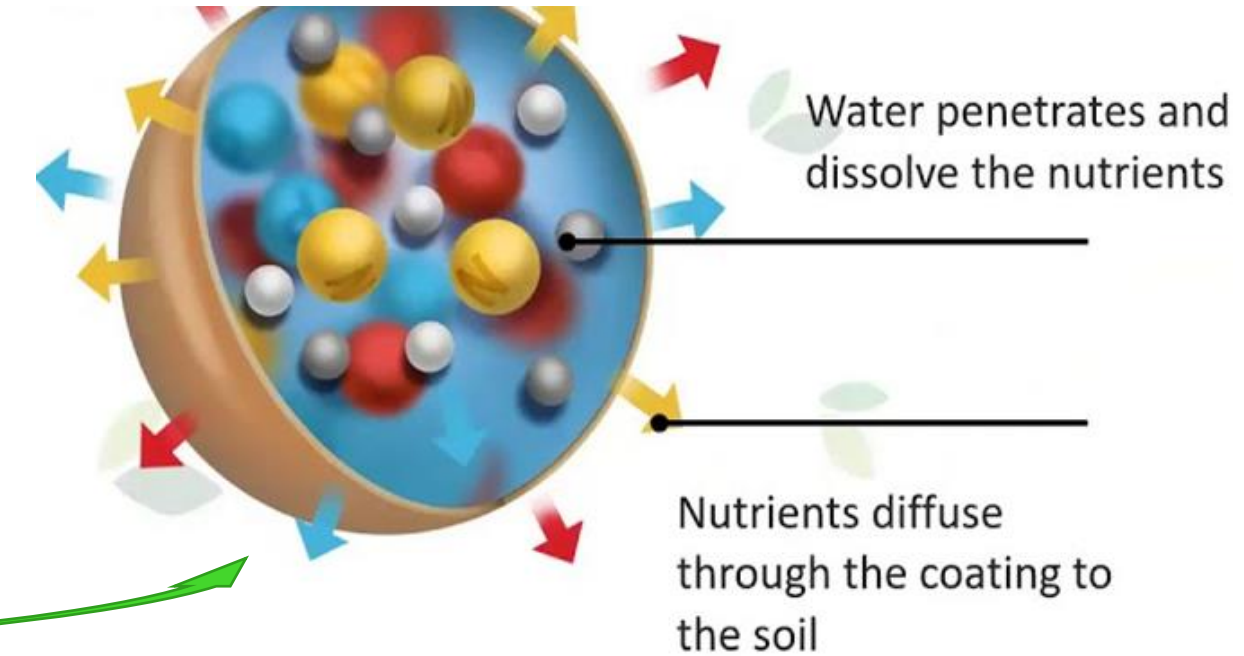
Once applied in the soil, moisture penetrates the biodegradable coating and reaches the nutrient core



Nutrient inside starts to dissolve and begins to release back into the root zone by diffusion



Influenced by soil temperature, nutrient solution is released day-by-day through the biodegradable coating thus reducing nutrient losses to the environment



The coating shell degrades in soil, into CO₂ and water, offering a sustainable solution for future farming

Advantages of CRF



The application of CRF can help to improve NUE and reduce nutrient loss, primarily through nitrate leaching and the volatilization of ammonia and nitrous oxides, which contribute to minimizing environmental pollution.



This can provide economic advantages in terms of saving labor, time, and Energy. Decrease the fertilizer application rate by 20 to 30% of the recommended value to achieve the same yield.



Fertilizer application tends to result in the high local concentration of ions, which induces osmotic stress and causes damage to plants. It contributes to agronomic safety by reducing the toxicity imposed to plants, especially seedlings.

Disadvantages of CRF



There are still no standardized methods to determine the nutrient release rate from CRF in a reliable way.



There is also a lack of correlation between data obtained from laboratory studies and the actual nutrient release rate in practical applications that can be made available to consumers.

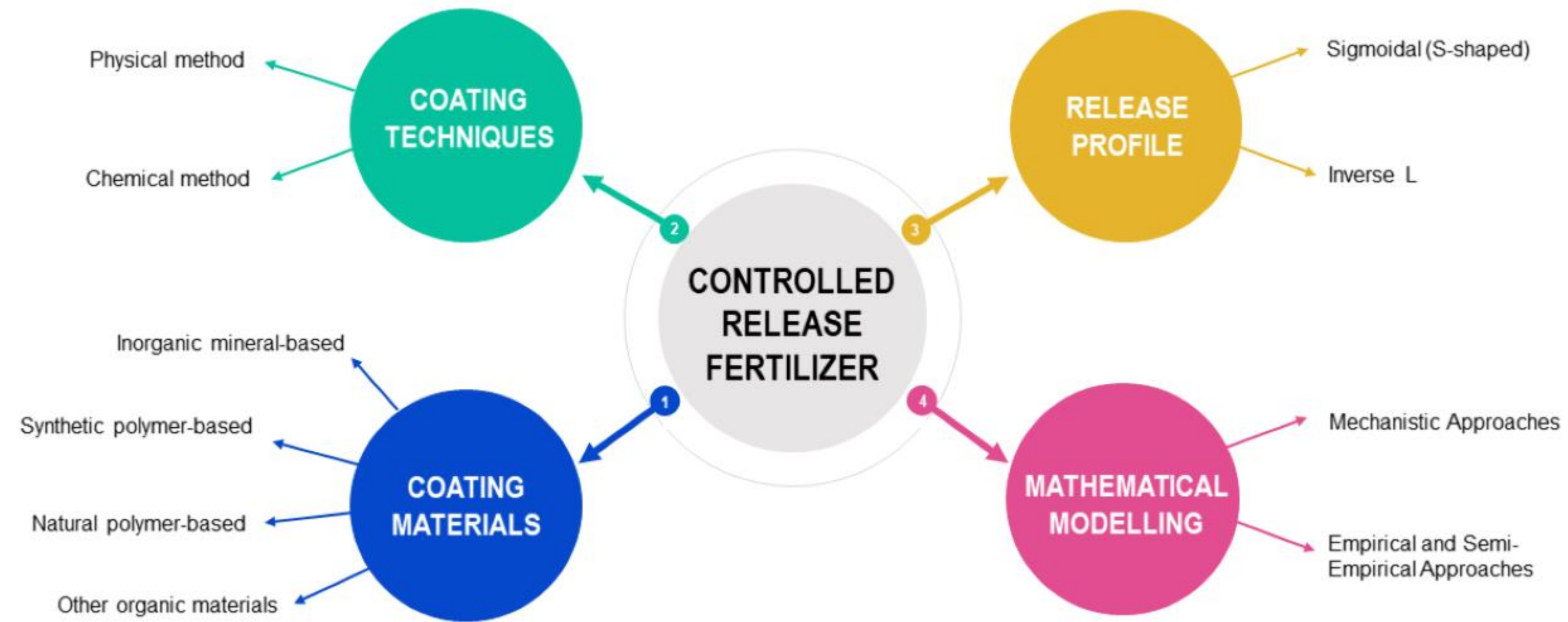


Furthermore, the cost for manufacturing CRF today is still much higher compared to conventional chemical fertilizers, which restricts its widespread use in agriculture.

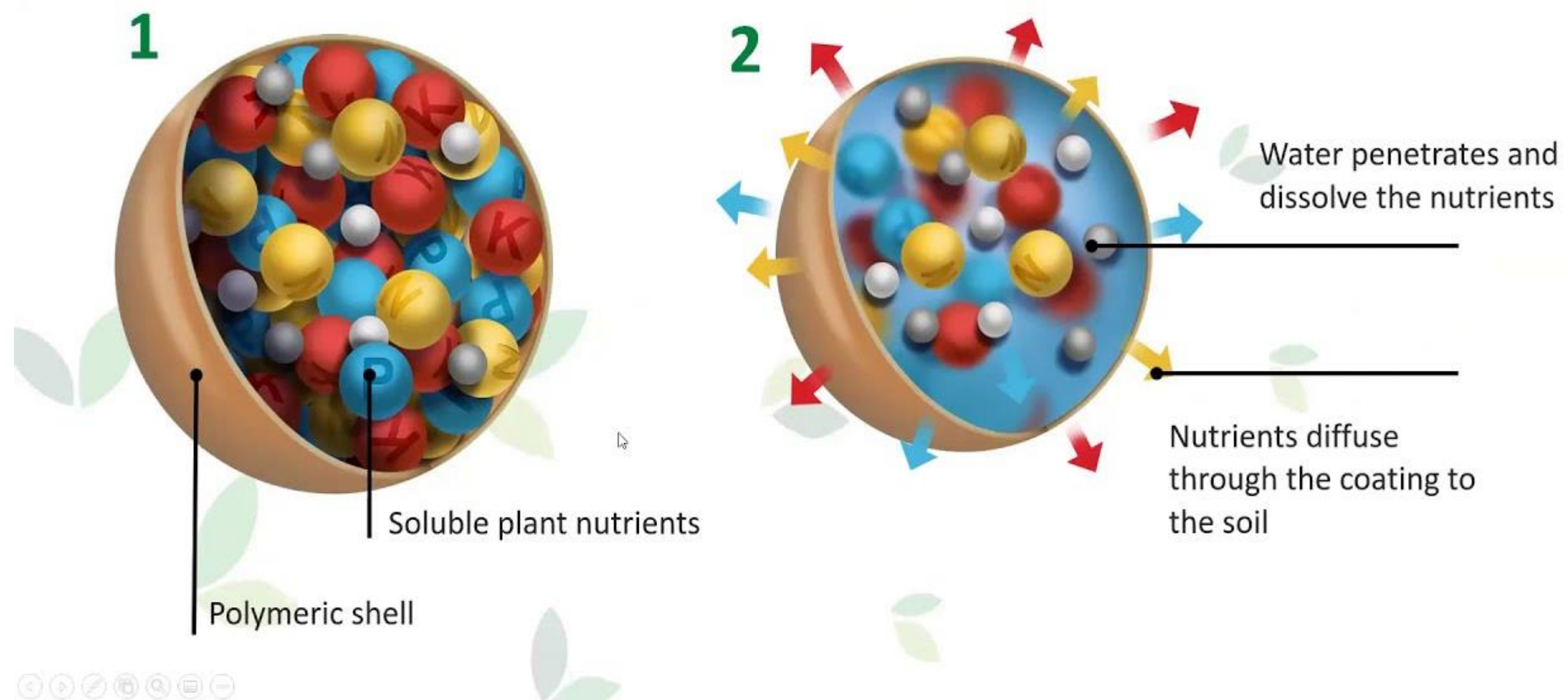
Purpose and research hypothesis



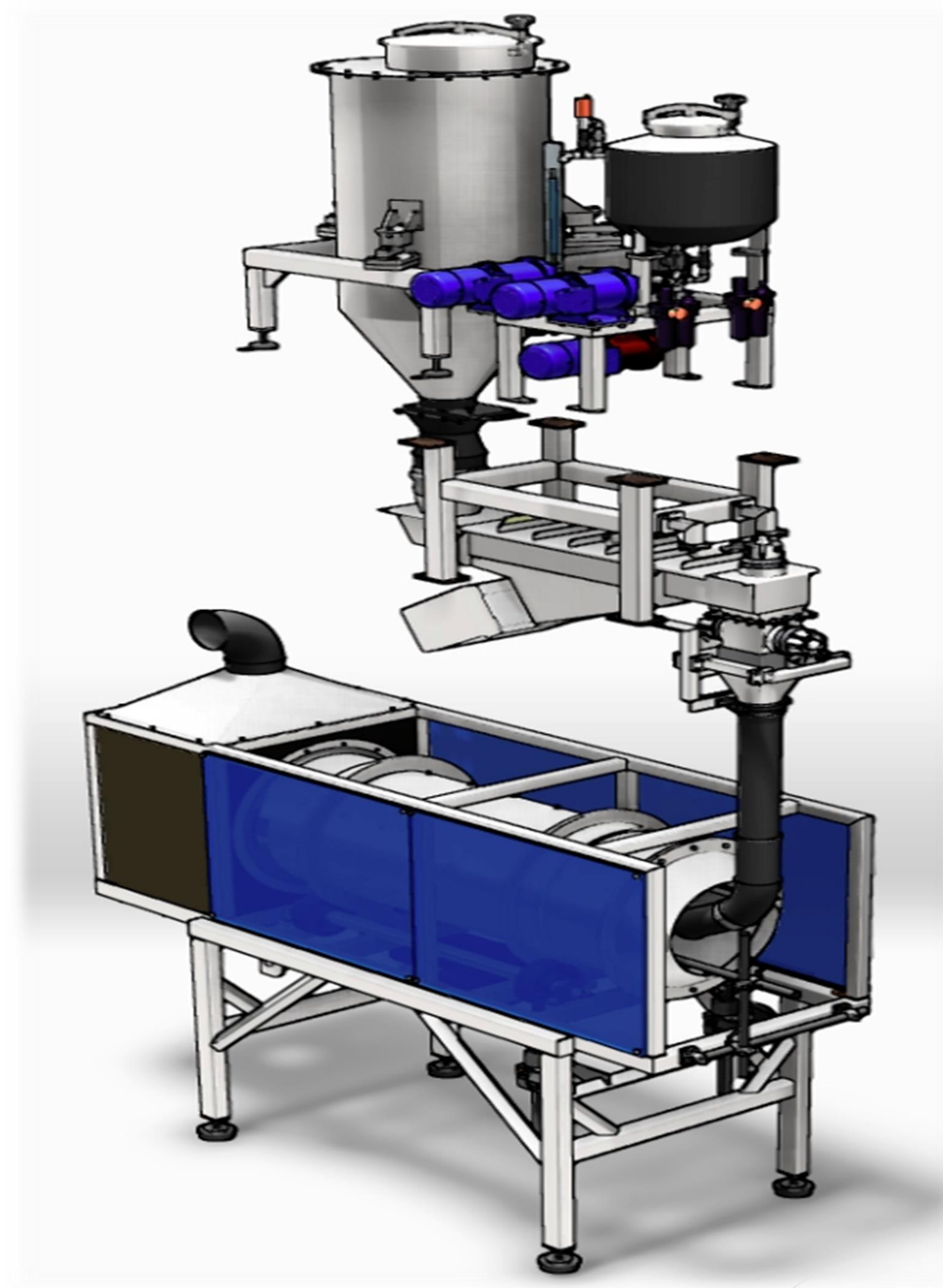
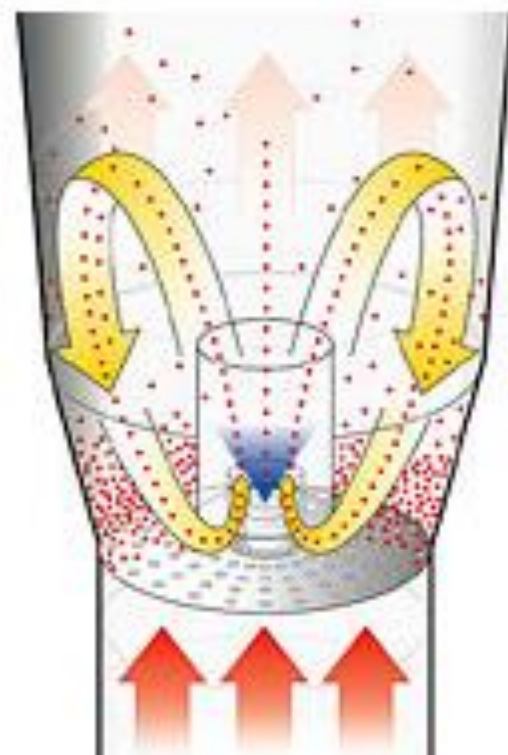
The main objective of the project is to develop a **biodegradable polymer** coating for nitrogen fertilizers compound fertilizers (NPK) in order to ensure a slow release of nutrients into the soil, and thus increase the use of these ingredients by plants, which should affect the maintenance of a high yield-forming effect with reduced fertilizer application rate. The research hypothesis assumes that the coatings will serve to minimize the negative impact of fertilizers on the environment also by reducing ammonia emissions and nitrate leaching.



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Research methods



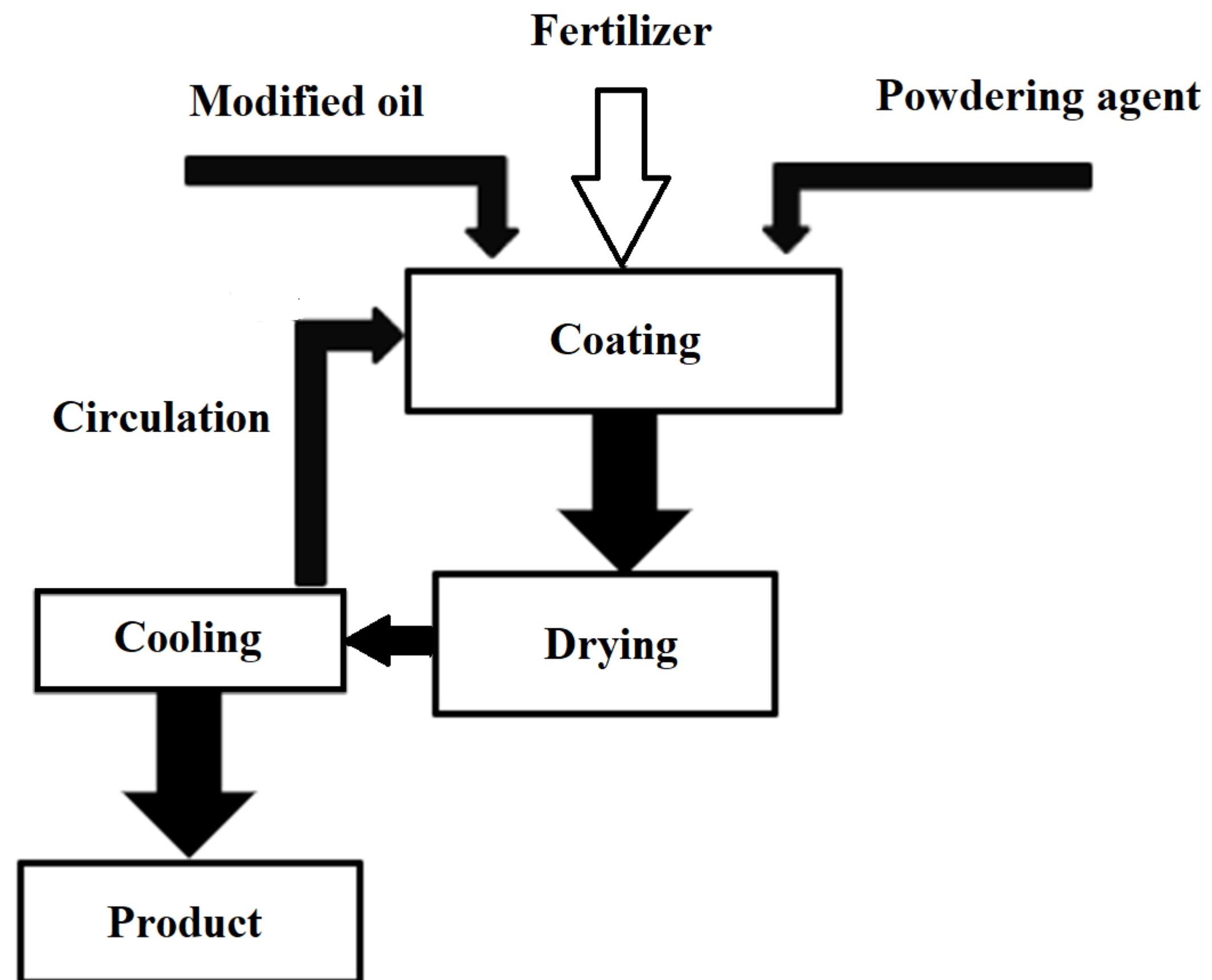
Raw materials used for research

Fertilizer

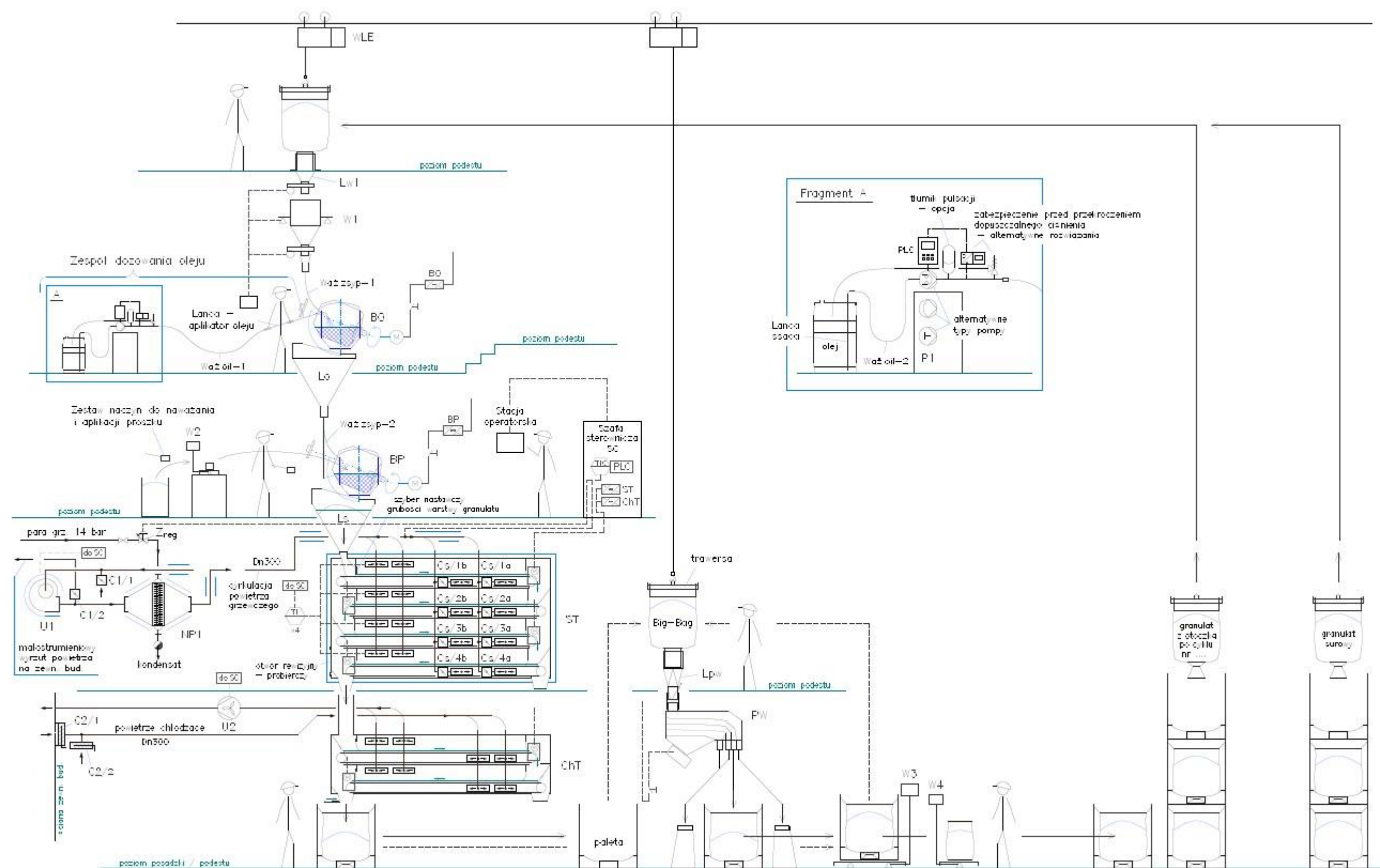
- Polifoska Start
NPK (12-11-18)

Oils

Block diagram of the 1/4 technical scale coating process



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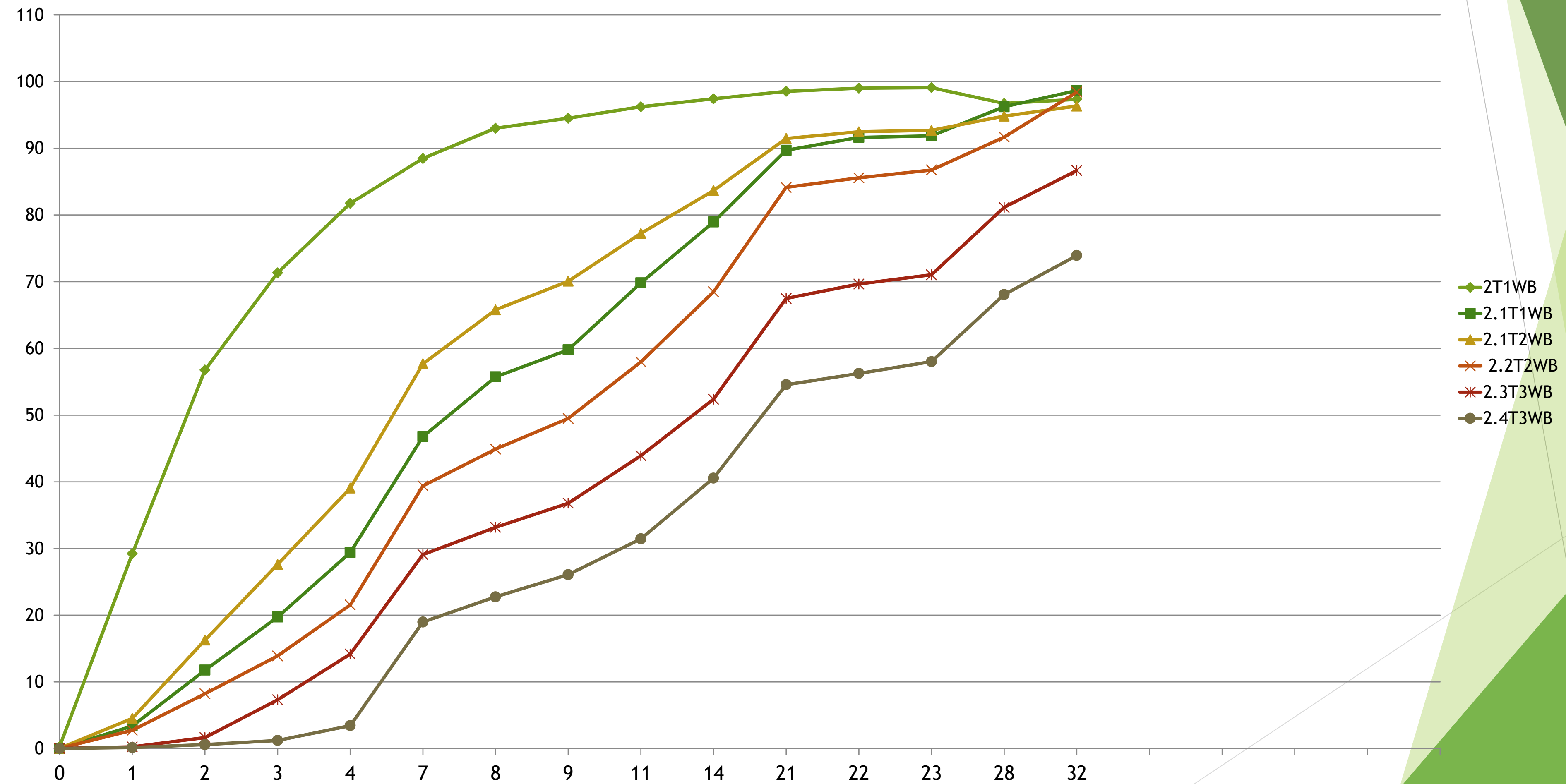


Research methods

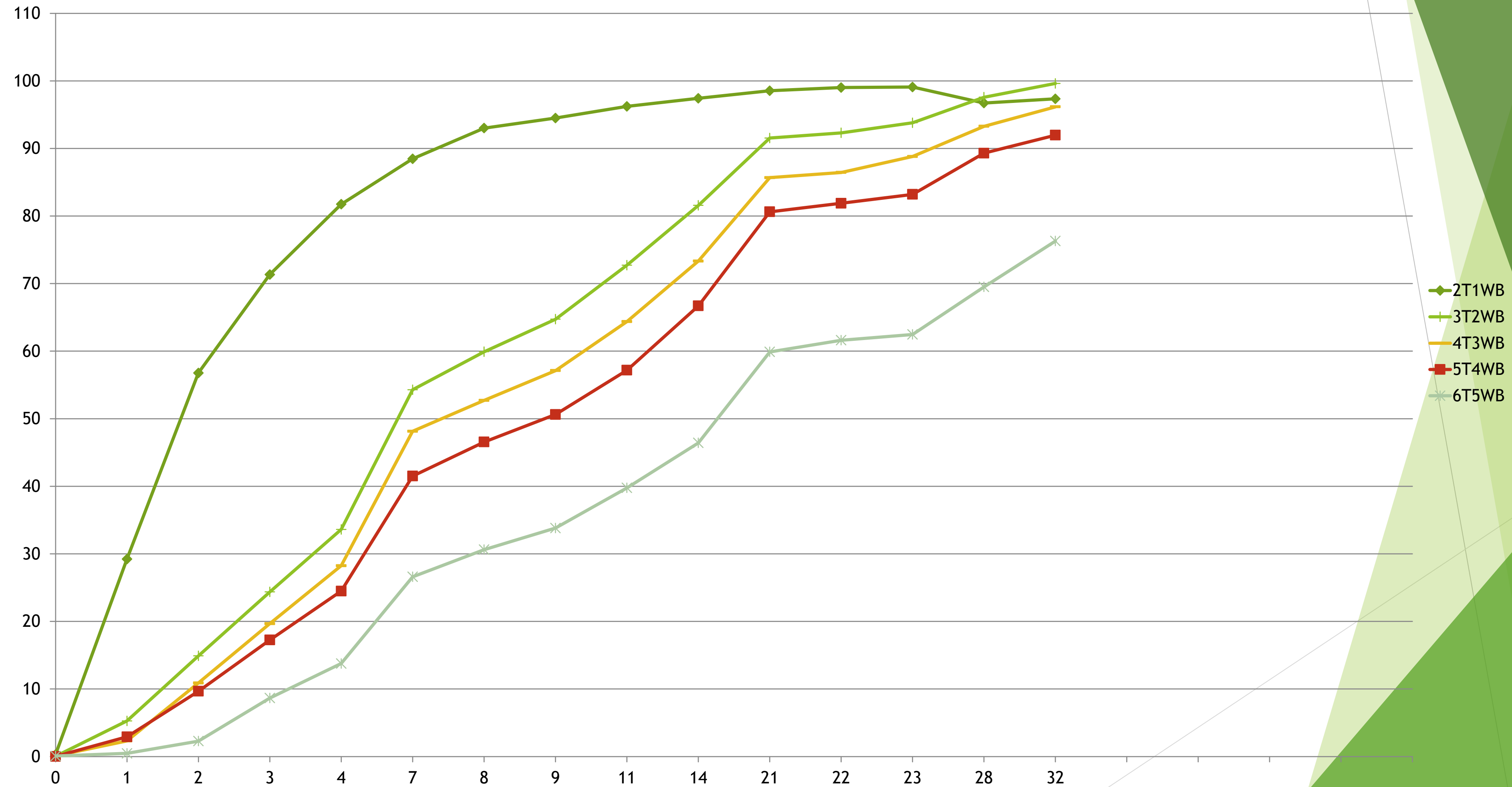


Photographs of samples of coated fertilizers produced at ½ technical scale.

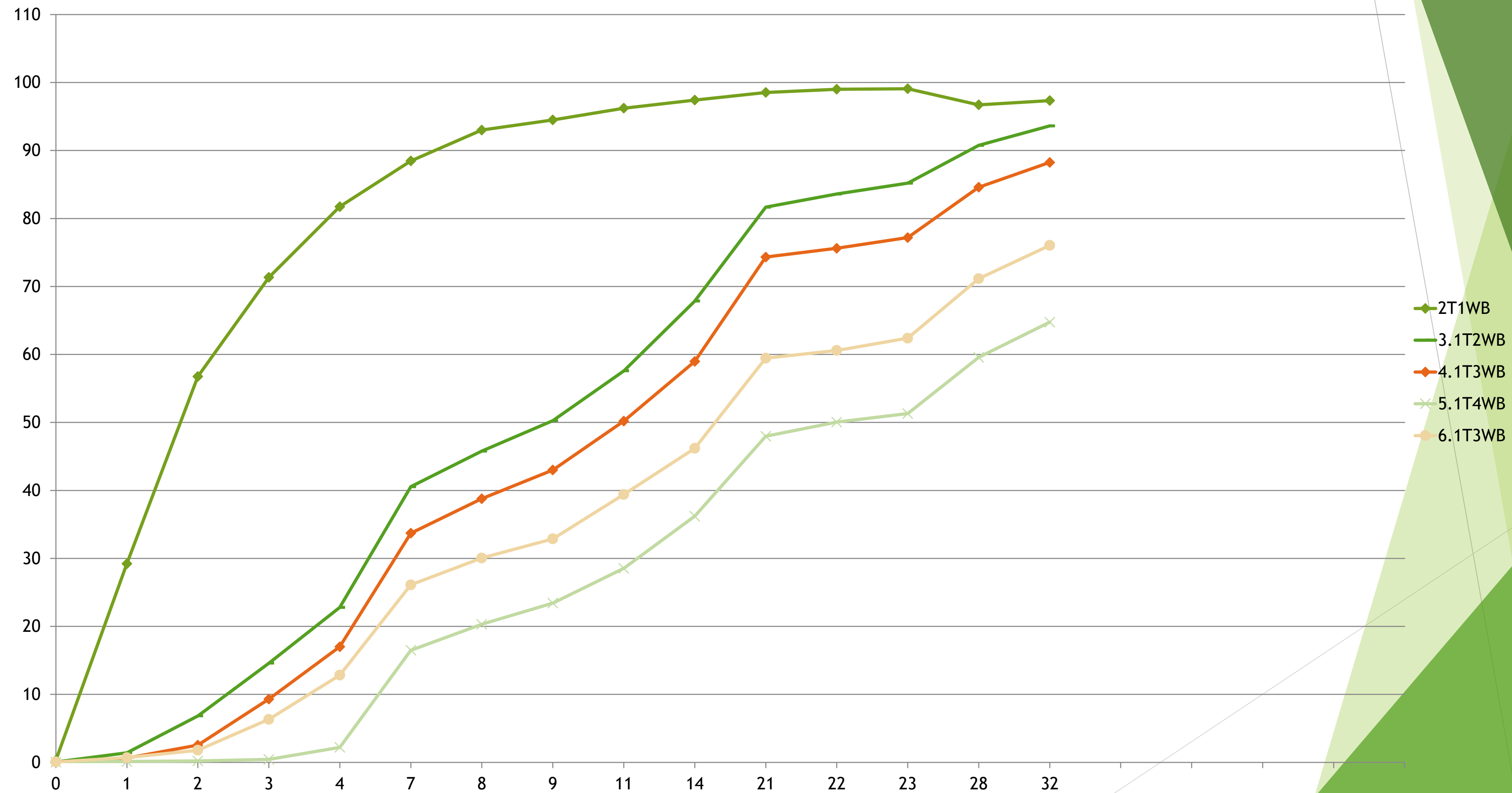
Kinetics of release of macronutrients from coated fertilizers (based on linseed oil)



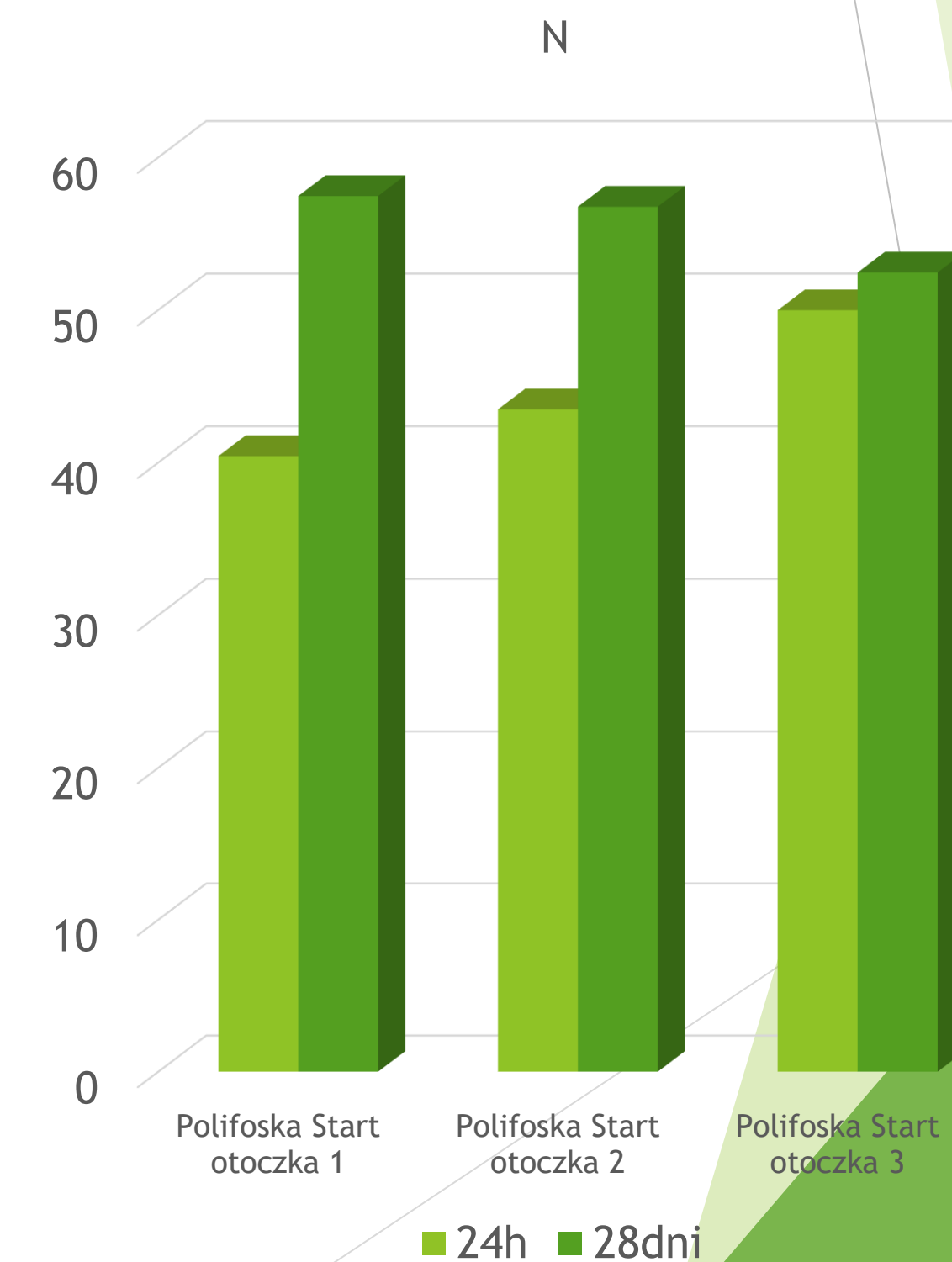
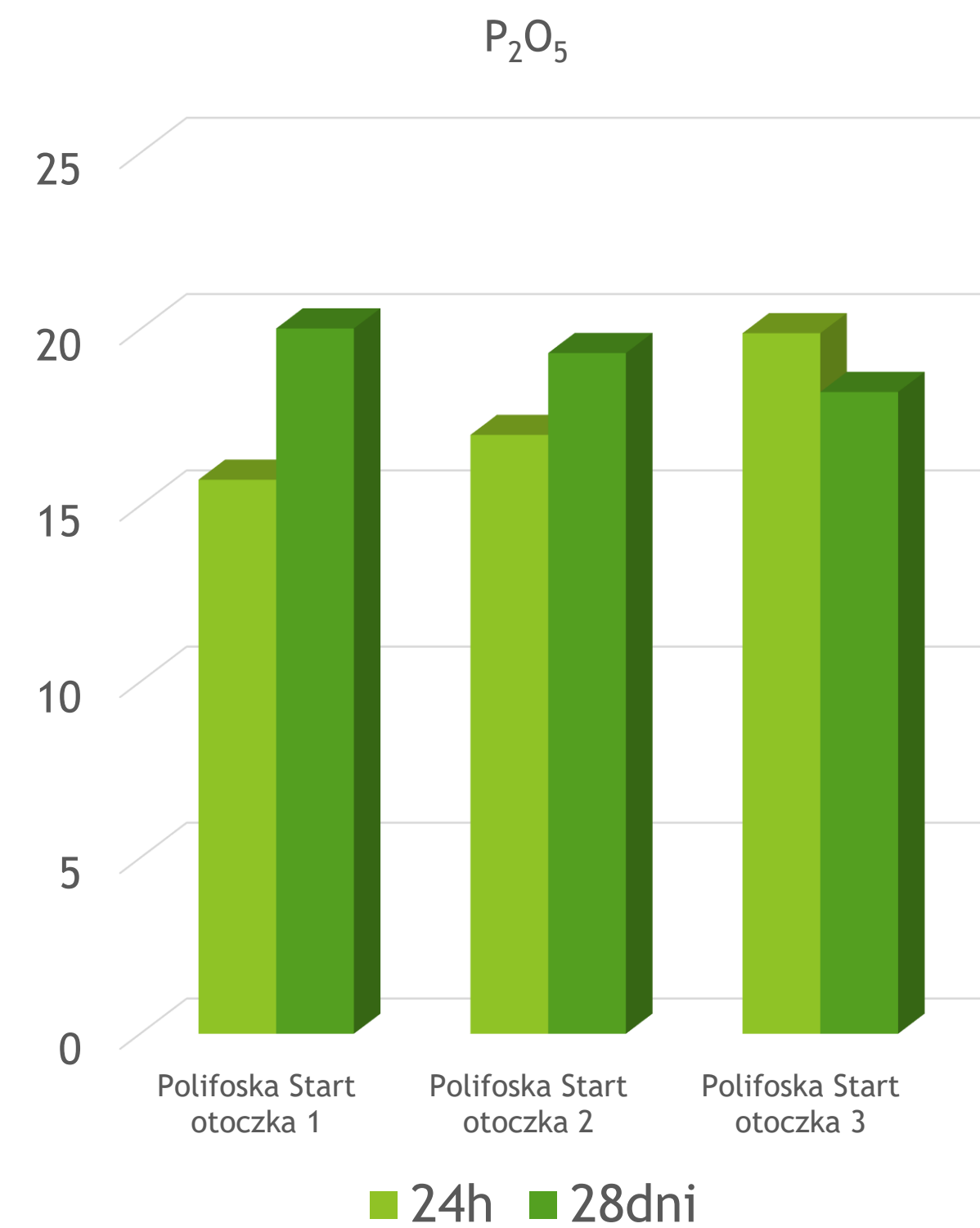
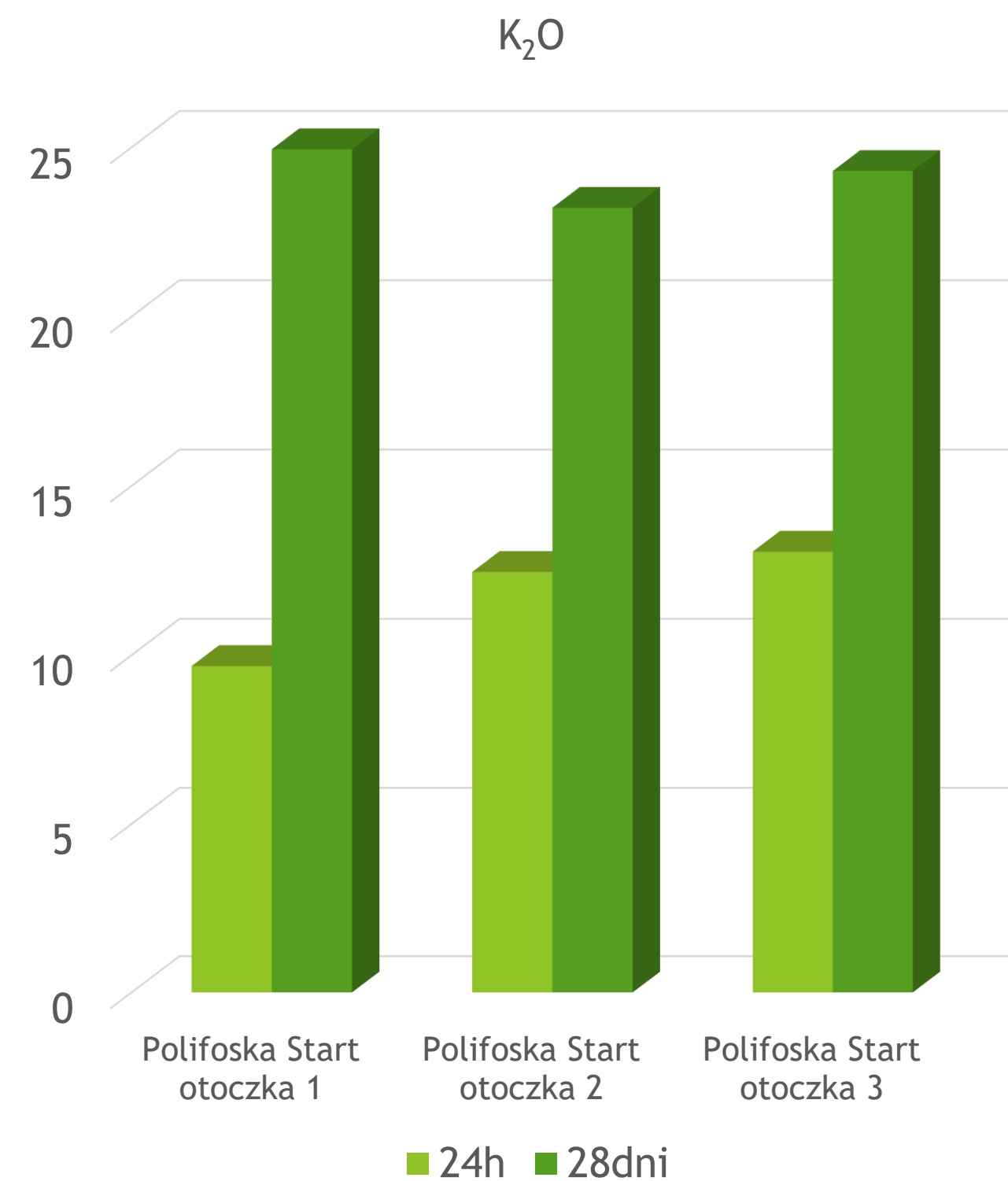
Kinetics of release of macronutrients from coated fertilizers (based on hemp oil)



Kinetics of release of macronutrients from coated fertilizers (based on rapeseed oil)



Kinetics of release of ingredients from NPK fertilizer



Conclusions:

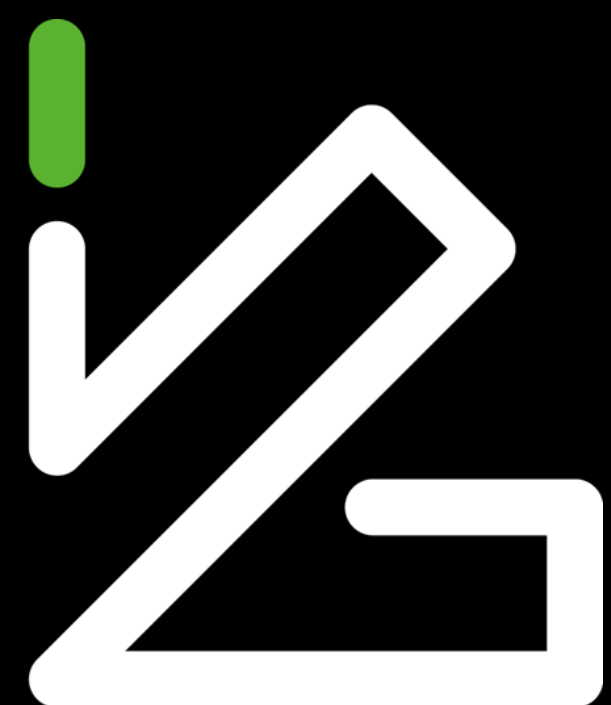
- a) The technology of coating fertilizer granules in a rotating drum or pan granulator gave the best results and high quality CRF.
- b) As a result of the tests carried out from among the preselected shells, it was found that only the modified oils made it possible to apply the desired layer using the fluidized method with the introduction of a double excess.
- c) The coatings based on natural oil with the addition of derivatives meet the criteria for slow-release fertilizers.

d) 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.

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.

Acknowledgments:

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Thank You.