

POLITECHNIKA ŚLĄSKA  
WYDZIAŁ CHEMICZNY  
KATEDRA CHEMII ORGANICZNEJ, BIOORGANICZNEJ  
I BIOTECHNOLOGII

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## ROZPRAWA DOKTORSKA

Synteza, charakterystyka i wykorzystanie  
pochodnych chitozanu do otoczkowania  
nawozów na bazie azotanu(V) amonu

Promotor: dr hab. inż. Ilona Wandzik, prof. Politechniki Śląskiej

Opiekun przemysłowy: inż. Krzysztof Kozioł

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## SUMMARY OF THE DOCTORAL DISSERTATION

„Synthesis, characterization and use of chitosan derivatives for coating fertilizers based on ammonium nitrate”

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Grupa Azoty Zakłady Azotowe Kędzierzyn S.A. is a significant manufacturer of granulated nitrate fertilizers, but further efforts are needed to streamline production processes and improve product quality. The increased demand for food requires the intensification of agricultural products, but excessive use of chemicals in agriculture also contributes to negative phenomena such as eutrophication, the greenhouse effect and soil salting. Overfertilization of soil contributes to the penetration of nutrients into the groundwater of rivers and water reservoirs. To alleviate these problems, controlled and slow release fertilizers (CRF and SRF) are being introduced. One way to produce CRF is to encapsulate fertilizers - spraying a layer or several layers of encapsulating material onto the surface of the fertilizer to create a low permeability coating.

The aim of the doctoral dissertation was to develop a biodegradable shell, made of environmentally friendly materials, which can provide better performance in controlling the rate of release. In such applications, chitosan and its derivatives, which show good biodegradability have aroused interest. In addition, chitosan has antimicrobial properties and can be commercially produced from naturally regenerating resources such as seafood shell waste.

The literature part of the doctoral dissertation includes a review of publications in the field of CRF and SRF and biodegradable polymers used to coat fertilizers. The techniques of coating fertilizers proposed in the literature and the study of the release rate of nutrients from coated fertilizers are discussed. Then, the properties of chitosan and its use in agriculture were characterized. The topic of deep eutectic mixtures that can be used as plasticizers of chitosan films was also discussed.

The experimental part of the doctoral dissertation was divided into two parts: the open part and the confident part. The open part of the doctoral dissertation involved the implementation of three stages: (1) assessment of the physicochemical properties of chitosan, (2) synthesis of chitosan derivatives: 2-hydroxypropyl-3-trimethylammonium chitosan chloride (HACC) and carboxymethyl chitosan (CMC) and their characterization, (3) development of methods obtaining chitosan films with the addition of deep eutectic mixtures.

The confident part of the doctoral dissertation covers the methods of encapsulating fertilizers based on ammonium nitrate(V) - Salmag with the use of synthesized derivatives of chitosan and chitosan solutions with the addition of deep eutectic mixtures, characteristics of encapsulated fertilizers and testing the release rate of nutrients from encapsulated fertilizers.