Summary of the doctoral dissertation

mgr inż. Patryk Dziendzioł

Novel Eco-Friendly Plasticizers for Poly(vinyl chloride)

Based on Dimerized Fatty Acids

PhD thesis Supervisor: dr hab. inż. Katarzyna Jaszcz, prof. PŚ

The doctoral dissertation entitled "*Novel Eco-Friendly Plasticizers for Poly(vinyl chloride) Based on Dimerized Fatty Acids*" consists of a public part and a confidential part, the latter of which, at the request of the Management Board of the industrial partner – Grupa Azoty Kędzierzyn S.A. – has been placed under a confidentiality clause for a period of 20 years.

The public part comprises a literature review on the process of poly(vinyl chloride) (PVC) plasticization and its most relevant aspects, as well as the manufacturing of plasticized PVC from dry blends and plastisols, together with their applications. It also includes a classification of plasticizers, with a discussion of those produced on a large industrial scale, proposals for their synthesis from renewable raw materials, and the characteristics and uses of dimerized fatty acids in chemical technology.

In the experimental part of the dissertation, novel oligoesters based on dimerized fatty acids, along with reference oligoesters serving as control systems, were obtained and characterized. The potential applicability of the synthesized oligoesters as PVC plasticizers was preliminarily assessed using a film casting method from tetrahydrofuran solution. Subsequently, PVC dry blends containing selected oligoesters were prepared and processed into plasticized materials for application-oriented studies. For these materials, thermal and mechanical properties were determined, alongside migration and solvent resistance tests. To enhance compatibility between the polymer and the plasticizer, additional studies were conducted employing mixtures of the newly synthesized oligoesters with a monomeric plasticizer, bis(2-ethylhexyl) terephthalate (DEHT), manufactured by Grupa Azoty Kędzierzyn.

The confidential part of the dissertation presents a method for producing PVC plastisols incorporating the newly synthesized oligoesters and their mixtures with plasticizers currently manufactured by the company. Furthermore, a process flow diagram for an industrial installation and a protocol for synthesizing the novel polymeric plasticizer were proposed. Based on raw material prices obtained from suppliers (as of the second quarter of 2025), an economic analysis of the process was performed, enabling an assessment of its feasibility for industrial implementation at Grupa Azoty Zakłady Azotowe Kędzierzyn S.A.