

Bio-polymers are currently a fast-developing group of materials. The goal of innovative research of many research centres around the world is the synthesis of bio-components derived from renewable resources, which will in the future partially or fully replace components of petrochemical origin in the synthesis of bio-materials, including polyurethanes. Thus, already at the stage of research on bio-polyurethanes, it is crucial to seek possible methods of their recycling in line with the rules of eco-design.

### **Project objective**

The primary objectives of the project aim at gaining new knowledge in the field of recycling of waste polyurethane bio-materials with vegetable raw materials by transforming them into high-quality components for the synthesis of new polyurethane materials. The results of this project will provide valuable data allowing for formulation of a series of relations concerning the influence of the bio-polyol content and chemical structure on the course of the bio-foam chemolysis reaction and subsequently the rheological properties, as well as the chemical structure of the resultant bio-recyclates and the properties of polyurethane bio-materials produced on their basis.

### **Research description**

The studies within this project will be the first comprehensive analyses regarding the influence of the content and chemical structure of bio-polyols on the course of the chemolysis reaction and also the rheological properties, as well as the chemical structure of the bio-recyclates produced and the properties of the polyurethane bio-materials derived from them. The project proposed here will allow us to find the influence of the bio-polyol content and chemical structure on the chemolysis process of polyurethane bio-materials. What is more, the investigation will look into the influence of the bio-recyclates of various chemical structures on the properties of new polyurethane bio-materials. The analysis will cover the properties of both the bio-recyclates and bio-polyurethanes.

### **Justification for undertaking this line of research**

Having reviewed the literature, one may decidedly conclude that there have not yet been studies on the possibility of chemical recycling of bio-polyurethanes. Published works concentrate on the recycling of polyurethanes synthesized from petrochemical raw materials. The introduction of vegetable-based bio-polyols into the synthesis of polyurethanes modifies their chemical structures. Modern chemical synthesis that is consistent with the idea of circular economy and takes into account the life cycle of a product should address the issue of waste management. An innovative line of research taking into consideration the aspect of environmental protection by eco-designing new products and focusing on recycling and analysis of the application potential of the bio-recyclates in new bio-materials offers a possibility to publish the results of the studies in world-renown journals and hence international promotion of Polish science and innovative, environmentally-friendly research.

### **Main expected results**

Within the project, it is expected that an analysis will be carried out of the applicability of eco-designing in the synthesis of bio-polyurethanes. Bio-polyurethanes will be produced with different contents of bio-polyols of various chemical structures that will undergo chemolysis. The resultant bio-recyclates will be reused in the synthesis of porous bio-materials. It is assumed that it should be possible to conduct chemolysis for materials in which 100% of petrochemical polyol will have been replaced by bio-polyols of different chemical structures. Such an approach to composing modern bio-materials takes into account the impact of the product on the environment and society throughout its whole life cycle. A desired result of the project is an assessment of the possibility to deliver a product modeled on the life cycle in nature, which is an ideal example of a closed-loop matter exchange cycle.