POPULAR SCIENTIFIC SUMMARY OF THE RESEARCH PROJECT

Sustainability of production systems in wood processing is an important issue for European industry and society. Proper development of products based on renewable wooden resources gives an opportunity to provide materials with long-term environmental, social, and economic sustainability. For this reason, the problem of wood-like waste generation and associated risks are an increasingly noticeable challenge for modern science. Over the last decades, several manufacturing processes have been developed, but waste management of post-industrial and post-consumer waste is still one of the most essential problems that Polish society is struggling with. Due to the increase in global awareness about environmental protection, growing costs of storage, and disposal of wastes, the utilization of their quantity is an ecologic and economic necessity for many companies. The lack of an effective wood waste management system, especially of post-consumer waste, results in the implementation of solutions which include low-quality incineration or landfilling of full-value products that could be recycled. According to the hierarchy of waste management indicated in EU Directive 2018/851, priority is given to waste reuse and recycling than conducting other recovery methods, i.e., energy recovery or landfilling. It should be emphasized that energy recovery and landfilling of waste are rather a form of material disposal, not forms of recycling. Therefore, there is an urgent need for innovative technologies, which will enable efficient processing of wooden wastes into full-value products.

The main scientific goal of the project is the development of a model process of post-production and post-consumer wood-like waste management in the solvothermal liquefaction. The project includes a number of systematic studies regarding the influence of the liquefaction process parameters and the composition of the reaction mixture on the chemical structure and properties of the obtained polyols. During the project implementation the chemical and physical analysis of wood-like waste structure will be made. In this stage the percentage content of each element in the structure and basic wood components such as cellulose and lignin in wood-like wastes will be determined. Information about the composition and structure of the waste allows to estimate the impact of long-term use and non-wood substances (adhesives and impurities) on the course of the proposed process.

This work assumes an examination of the influence of reaction time, pressure, and temperature on the process and properties of the obtained product. Determining the impact of the basic parameters of this process will allow to fully define the studied process, as well as determine its ability to increase the scale of the project. Moreover, carrying out the reaction at elevated pressure may allow to reduce the reaction time and increase the amount of utilized biomass in one cycle. The impact of the selected waste type, the level of fragmentation, and the amount of waste on process parameters and material properties will also be determined. The research also assumes determining the effect of inert gas flow on the process. Another novelty is the use of a variety of homogeneous catalysts as well as modern heterogeneous catalysts which can be easily separated from polyols. This can eliminate the neutralization process, which is necessary in case of using homogeneous acids. Implementation of more efficient catalysts that can be recycled and used multiple times fits into the trend of “Green Chemistry”. Another key objective is determining the impact of the type and structure of the solvent of solvents on the catalyst activity, process parameters, and properties of polyols. The last research goal is based on life-cycle assessment (LCA) of obtained products. This study will define the environmental aspects and potential impacts throughout a product’s life on environment. There is a lack of research on the LCA of liquefaction process and hence there is a huge need for comprehensive research on this topic.

The results of this research will enable the intensification of technological processes by reducing the costs of bio-polyols production and the amount of waste by optimalization of process parameters. Moreover, climate change and the increase in hazardous substances released into the air has led Europe to the implementation of more restrictive policies. The proposed method of waste disposal can be considered as more ecological due to the reduction of greenhouse gas emissions in comparison to the waste incineration. The interest in the proposed subject will lead to an increase in environmental awareness and educate a new group of scientists who will be interested in implementing pro-ecological solutions in science and industry. This will enable the development of the discipline in a long period of time. The obtained results will allow the creation of a number of scientific publications (JCR list) and enrich the generally available scientific literature.