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POPULAR SCIENTIFIC SUMMARY OF THE RESEARCH PROJECT

In recent decades, due to increased environmental awareness and noticeable environmental degradation, the area of wood waste management has attracted increasing attention. For this reason, the sustainability of production systems in wood processing, the wood industry, and the disposal of wood waste 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. Nowadays, the problem of wood-like waste management and associated risks are an **increasingly noticeable challenge for modern science.** Over the last decades, several methods of wood waste management have been developed, but these methods still cannot be recognized as fully ecological. A large amount of wood waste is still incinerated for the production of electricity and heat. Although this method of waste management allows for partial use of the potential of wood, it is associated with the generation of a certain amount of greenhouse gases. Moreover, a raw material with high production potential is irretrievably lost. Therefore, **there is huge need** for implementation of more sustainable solutions in wood waste management. To optimize the use of valuable waste, the European Union has announced Directive 2018/851 that specifies how solid waste should be managed. This directive presents a hierarchy for the management of all types of waste, which refers to the pyramid of waste management. According to this hierarchy, methods such as **recycling and reuse of waste are preferred than energy recovery.** Sustainable wood waste can reduce the consumption of raw wood raw materials, limit the deforestation process, and preserve biodiversity in forests. Therefore, there is an urgent need for innovative technologies that will enable efficient processing of wooden waste into full-value products.

Moreover, fossil fuel depletion and adverse environmental impacts are two major concerns of rapid industrialization and technology development. Polyols and isocyanates are the two main raw materials for polyurethane production. Currently, both substances are mainly obtained from fossil resources, which consumption does not correspond to the current trend of sustainable development. Therefore, the development of innovative technologies that will help replace petroleum-based products has attracted considerable attention from scientists. An interesting source of such products may be liquefaction of biomass, which relies on turning the whole biomass into liquid by a solvolysis reaction of the biomass with a suitable solvent and catalyst. The main product of this process can be used as a substitute of commercially available petrochemical polyols

The main scientific problem this project tackle is the manufacturing of polyurethane-wood composites (PU-WCs) by utilization of large amount of wood wastes. These composites will be manufactured with an addition of biopolyols obtained via biomass liquefaction. The most critical objective of this research, because of the importance for future studies of the process, is the development of an effective method for the manufacturing of polyurethane-wood composites. The influence of the polyurethane composition and structure on the properties of PU-WC composites. Finally, composites with the addition of biopolyols will be synthesized to determine impact of these substances on structure and properties of the produced composites.

Polyurethane materials and composites will be manufactured in a one-step method using a two-component system. In the described study, it is planned to use petrochemical polyols with different molecular weights and functionality. Moreover, during this research it is planned to replace previously used petrochemical polyols with synthesized bio-polyols. These substances will be synthesized by the biomass liquefaction process. The influence of polyurethane structure and composition will be determined by a wide range of tests which will allow a full determination of variables influence on product properties. The main investigation techniques can be divided into three groups: methods for *physicomechanical properties* (mechanical testing, water absorption properties, rheology, materials structure), methods for determination of *thermal and thermomechanical properties* (dynamic mechanical analysis (DMA) thermogravimetric analysis (TGA)) and *determination of flammability of PU-WCs* (cone calorimetry, UL 94 tests, limiting oxygen index (LOI)).

The results of the proposed project will be significant for **many related scientific fields**: **chemical engineering, polymer chemistry, and material engineering.** The implementation of our solutions can reduce the negative impact of the polyurethane industry on the environment. Moreover, increased interest in the proposed topic will lead to an increase in environmental awareness and to **educate a scientist** who will be interested in implementing pro-ecological solutions in science and industry. The obtained results will contribute to several scientific publications which will enrich the generally available scientific literature, and will **fill gaps in knowledge** about polyurethane-wood composites and use of bio-based polyols.