DESCRIPTION FOR THE GENERAL PUBLIC

In this project it is planned to obtain novel, not previously analyzed, metal oxide–lignin hybrid materials and to investigate their use in the immobilization of selected enzymes from the cellulase and amylase groups. The use of lignin, which is a natural biopolymer and is a by-product of many industrial processes, results in a material with high sorption capacity and a high degree of biocompatibility. It is significant that these materials may help to provide improved environmental protection, broadly interpreted, achieved through the management of waste materials. Magnetite, titania and zirconia will be used as inorganic oxides. These compounds offer high stability and resistance, and so their combination with lignin will result in innovative composite systems, whose properties will be subjected to detailed analysis. Comprehensive descriptions of the resultant M_xO_y–lignin hybrids will be based, among other things, on the results of dispersive-morphological and structural analysis. The systems' sorption properties will be determined, as well as the effect of pH and temperature on their stability – these features are crucial for the further application of these systems in enzyme immobilization. With the use of spectroscopic techniques, the functional groups present in the structure of the obtained materials will be identified.

Enzymes, being natural catalysts characterized by high specificity and selectivity, are widely used in many areas of daily life and industry. The rapid loss of catalytic activity and their limited stability mean that the development of methods to improve these properties is highly desirable. One of the most commonly used techniques to increase the stability and prolong the activity of biocatalysts is immobilization. The use of biocompatible and stable supports means that the range of reactions that can be catalysed by the immobilized enzymes can be expanded even further, and so it is important to determine the optimal process parameters.

Selected cellulases and amylases will be immobilized with the use of two techniques. The first will be immobilization by adsorption, mainly based on the creation of ionic and/or hydrogen interactions between the support and the biocatalyst. The second technique applied will be entrapment, which involves surrounding the enzyme by a layer of the support. Both techniques reduce the impact of the immobilization process on the structure of the enzyme, and consequently maintain good catalytic properties. The use of enzymes from various catalytic groups, and the use of two different immobilization protocols, enable a comparison to be made between the properties of the systems obtained.

The use of advanced analytical techniques will allow to verified proposed experimental methods for enzyme immobilization, and in addition, the results of the spectroscopic and chromatographic analysis will be useful to describe the most important properties of the products. **The results obtained under the project will enable a deeper understanding of the mechanism of enzyme immobilization, as well as providing valuable information on the effect of temperature, pH and storage time on the stability and activity of the immobilized peptides. The project will contribute to better knowledge of many of the processes, and will also have a measurable environmental impact and significant social effects. It will help improve the quality of life by enabling the productive utilization of a waste product, as well as developing the basis of new biotechnological processes.**