DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

Nowadays, environmental protection is becoming more and more important due to the huge amount of pollutants produced. Wastewater, produced in the industry, often enters groundwater, and thus also drinking water. The effect of dyes and other phenolic compounds present in the wastewater on the human body is not neutral, as the toxicity and carcinogenicity of the above-mentioned compounds are a serious problem, which means that hazardous pollutants must be degraded before they enter the water. There are many techniques to remove contaminants from sewage and groundwater, but special attention should be paid to biodegradation, because of its high efficiency and low environmental harm. **An especially interesting method of degradation is remediation using enzymes. Among the wide range of enzymes are oxidoreductases, which, by means of oxidation and reduction reactions, are able to degrade derivatives of phenolic compounds, making them an environmentally friendly alternative to other, often expensive and inefficient methods.**

In order to increase the efficiency of dye removal by enzymes, they are immobilized on a solid support. One possible method to obtain support materials for biocatalysts characterized by a defined structure and chemical composition is electrospinning. It is a method based on the production of polymer nanofibers, having a porous structure and characterized by the presence of many functional groups on their surface facilitating effective enzyme binding via several methods, such as adsorption, covalent binding and entrapment. Inorganic additives, such as magnetite, copper ions and carbon nanotubes, improve the stability of the materials produced and lead to more effective action of enzymes. Moreover, the addition of Fe_3O_4 means that the material with the immobilized enzyme is easy to separate from the reaction mixture using an external magnetic field. The presence of copper ions will increase the catalytic activity of the immobilized enzymes, and addition of carbon nanotubes will facilitate the transfer of electrons, extremely important in reactions catalyzed by oxidoreductases.

One of the topics not widely presented in the literature is the use of electrospun materials for the immobilization of selected enzymes of environmental importance and the use of the biocatalytic systems thus obtained in the degradation processes of dyes, which is the main scientific goal of the submitted project. Electrospun materials, made of cellulose, polyacrylonitrile or poly(L-lactide-co-ε-caprolactone), among others, will be obtained and then thoroughly characterized, which will make it possible to determine their structure and detailed chemical composition. Further, on the obtained materials, enzymes such as laccases, tyrosinases and peroxidases will be immobilized by various methods such as adsorption, covalent binding or entrapment. Results of the analysis will make it possible to determine the stability of the obtained materials as well as the type of the enzyme - support interactions.

During the research, proper selection of the conditions for obtaining electrospun nanofibers and their in-depth physicochemical characterization, based on the results of dispersion and morphological analyses, will be emphasized. In addition, effective enzyme immobilization will be confirmed using spectroscopic measurement, allowing identification of the chemical groups present in the structure of the electrospun materials. Moreover, the activity of the produced biocatalytic systems will be examined based on the degradation reactions of selected dyes from model aqueous solutions according to spectrophotometric measurements (UV-Vis). The UV-Vis measurements will also be useful to evaluate the effect of various process conditions on the efficiency of dye biodegradation.

It should also be emphasized that comparison of the various methods of biocatalyst immobilization will make it possible to select the most suitable technique for immobilizing enzymes, resulting in the formation of biocatalytic systems characterized by high activity in the removal of colored impurities. The use of various oxidoreductases and different immobilization techniques will make it possible to compare the properties of the obtained heterogeneous biocatalyst and to choose the most effective way of immobilizing the biomolecules. Moreover, pathways of enzymatic reactions and final products of biocatalytic conversion will be determined within the framework of the project.

The results that will be obtained as part of the submitted project will make it possible to develop a methodology for the synthesis of hybrid materials using electrospinning, to gain in-depth understanding of the enzyme immobilization process, and to define the mechanisms occurring during biodegradation of selected environmental pollutants using the previously obtained biocatalytic systems. Determination of the influence of process parameters (temperature, pH), as well as the number of successive catalytic cycles and the storage time, on the activity of the produced immobilized enzymes will make it possible to determine optimum conditions for the biodegradation of dyes. The implementation of the project will make it possible to examine the mechanisms of the immobilization and biodegradation processes. **A measurable effect of the study, associated with the environmental aspect of the work, will be the development of technological assumptions for the synthesis of the electrospun materials and for the remediation of dyes from aqueous solutions.**