Due to the discharge of large amounts of metal-contaminated wastewater, industries using toxic metals such as Co, Cd, Cu, Ni, Pb, and Zn pose a significant threat among other industries affecting the environment. Because of their high solubility in aqueous environments, metal ions can be absorbed by living organisms. Once they enter the food chain, high concentrations of metals can accumulate in organisms and cause serious health disorders. Therefore, it is necessary to purify metal-contaminated water and wastewater before it is discharged into the environment. Removal of heavy and toxic metal ions from inorganic wastewater can be achieved by conventional treatment processes, such as chemical precipitation, ion exchange and electrochemical removal. However, these processes have significant drawbacks such as incomplete removal, high energy requirements and generation of toxic sludge. Additionally, commercially available sorbents are increasingly expensive.

Recently, research has been conducted to develop cheaper and more efficient technologies, both to reduce the amount of wastewater produced and to improve the quality of treated wastewater. In addition, the currently popular economical and eco-friendly lifestyle results in more concentrated wastewater due to less water usage. Adsorption has become one of the alternative treatment methods, and the search for low-cost adsorbents with metal-binding capabilities has intensified in last years. An excellent solution, in line with current trends in the circular economy, is the use of waste biomass from the agri-food industry for this purpose and its modification in order to increase the sorption properties of biomass. Modification of a natural sorbent can take place, for example, on its enrichment with natural nanoparticles or the production of biochar.

In many countries, apple pomace is one of the most frequently generated types of agri-food waste. Globally, about 4 million tons are produced annually. If not properly manager, such bioorganic waste can cause serious environmental pollution and public health risks, mainly due to the risk of microbial contamination. In addition, improper management of waste apple pomace results in a huge waste of water, land, energy, capital and labor, which obviously is economically unviable. It is estimated that he amount of apple pomace generated will increase every year due to increased demand for processed products. To avoid the aforementioned problems, it is necessary to implement economically viable pathways for managing apple pomace waste so that it can be further processed and utilized into valuable products. The cost effectiveness of such pathways depends on the amount of waste generated/collected, the need for additional storage space and appropriate equipment. One of the increasingly described options for managing this valuable waste is its use for sorption of water and wastewater pollutants.

The aim of the project is to develop efficient biosorbents based on nanoparticles (MgO, ZnO, Fe_3O_4, hydroxyapatite) and biochar, and to optimize the sorption proces parameters of heavy and toxic metal ions (Cu(II), Zn(II), Ni(II), Co(II), Cd(II) and Pb(II)). The result of the work will be the development of innovative methods for the synthesis of nano-based biosorbents with specific sorption capacity against these metal ions.