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Abstrakt rozprawy: Badanie efektywności usuwania związków fosforu ze ścieków z zastosowaniem wybranych materiałów sorpcyjnych

The eutrophication in surface water bodies is caused by an excessive load of nutrients. This issue has been an aim of scientific studies for many years. The main cause of the abundant algae bloom is phosphorus, which is supplied to the waters with the discharge of wastewater or with surface runoff. This study deals with the effective removal of phosphorus compounds from wastewater in the sorption process using selected reactive materials.

The study aimed to find a sorption material that will effectively reduce the concentration of phosphorus compounds and will not have a negative influence on the basic parameters of wastewater. In the light of the circular economy regulations, the following sorbents were selected as reactive materials: commercially produced material, the material of natural origin, and the material which is a by-product of the technological process.

The studies were performed for a wide range of phosphate phosphorus concentrations, in a synthetic solution and domestic wastewater. Measurements were conducted for different contact times. The influence of the mixing time on the efficiency of the phosphorus compounds removal was investigated, as well as the possibility of multiple uses of the same dose of the adsorbent. During the experiments, the basic parameters of the wastewater solution were determined: physical (temperature, pH, conductivity, total suspended solids, color, turbidity) and chemical (P-PO₄, TP, COD, N-NO₂, N-NO₃, N-NH₄).

Based on the obtained results, the sorption process of the tested reactive materials was determined, due to the verification analysis of the equations of Langmuir, Freundlich, BET, and Temkin isotherms. Also, the adsorption kinetics was determined. It has been shown, that the adsorption of the commercial material is the best described by the BET isotherm, while the adsorption of other materials - by the Freundlich isotherm, which proves the multilayer adsorption behavior. Moreover, the pseudo-second order model might be successfully used to describe adsorption kinetic.

The material of natural origin turned was appear as ineffective for phosphorus removal from the wastewater, while the commercial one and the by-product showed high efficiency in the adsorption process. The best results were obtained for the waste material, however, due to the high pH of the sorbent, it causes a significant pH increase of the wastewater. Commercial adsorbent did not show any significant influence on the other parameters quality of the solution.

The conducted research has shown that phosphorus compounds can be effectively removed from wastewater in the sorption process under appropriate conditions. It was also found that the waste material has an efficiency that exceeds commercial products. However, the wide use of by-products, due to the lack of legal regulations on their production and maintenance, is the subject of many discussions.