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Asystent

Streszczenie rozprawy doktorskiej autorstwa mgr inż. Renaty Stoińskiej pt. „Wpływ form specjacyjnych fosforu na możliwości jego uwalniania z osadów ściekowych"

Abstract of doctoral dissertation written by MSc. Renata Stoińska titled "The influence of the phosphorus speciation on the possibility of the element's release from sewage sludge"

The objective of the research discussed in this dissertation was to:

- investigate the relations between phosphorus speciation in sewage sludge and the possibility of the element's release from the sludge;
- examine phosphorus speciation forms in the sewage sludge formed in a municipal wastewater treatment plant and investigate how they are affected by technological and climatic conditions;
- study the impact of different microorganisms occurring in the sewage sludge on the changes in the number of particular phosphorus speciation forms in the sludge.

This thesis presents a phosphorus speciation analysis of different types of sewage sludge (preliminary, active and excess) from six wastewater treatment plants. The plants differed from each other with regard to capacity and the applied technology. In order to demonstrate the effect of cyclic temperature changes on the shares of phosphorus forms, the sludge samples were examined on an annual basis. The research results provided the basis for the development of the mathematical model describing the relation between the sludge shares of mobile phosphorus forms and the temperature. This relations was described by means of a piecewise regression. The obtained mathematical model permits predicting the number of available phosphorus forms depending on the sludge temperature and the kind of the wastewater treatment plant (mechanical-biological or mechanical-biological-chemical.
Furthermore, the doctoral dissertation discusses the studies concerning the impact of varied oxygen conditions on the occurrence of filamentous bacteria in activated sludge and presents the phosphorus speciation analysis. The research provided the basis for recognizing the relationship between the presence of particular species of filamentous bacteria and the shares of phosphorus. The research results indicate that the simultaneous analysis of phosphorus speciation and filamentous bacteria allows for the evaluation of the process of sewage dephosphatation in the case of the changing oxygenation parameters in the activated sludge reactor.
The paper presents also the effect of the hygenization of excess sludge with lime on the change in the shares of phosphorus speciation forms. In the process of hygienization with lime, the sewage sludge pH has the value of app. 12.The application of such a sludge with alkaline reaction results in the increase in the pH of acid soils and provides significant amounts of calcium to the soil. Due to fertilizing properties of such sludge it was advisable to determine the shares of bioavailable phosphorus forms in the sludge.
Owing to the increasingly widespread agricultural application of biofertilizers (biopreparations) including strains of microorganisms solubilizing phosphorus, the thesis also describes the effect of *Bacillus megaterium* bacteria on phosphorus speciation in the hygienized sludge. The purpose of these studies was to demonstrate the significant differences in the shares of phosphorus speciation forms after the application of *Bacillus megaterium* bacteria on the hygienized sludge. The presence of bacteria caused an increase in the amount of mobile phosphorus fraction in the first days of the experiment. The knowledge on the changes in the shares of phosphorus forms, especially bioavailable (mobile) ones, is important in the case of the application of hygienized sludge vaccinated with biopreparation microorganisms for nature-related purposes.

Moreover, the thesis discusses phosphorus speciations in a stabilized system in which the *Acitnoicmycetes* group microorganisms multiplication resulted in filamentous swelling. The bacteria resulted in the sludge flocs forming a dense network and in the sludge floatation due to hydrophobic properties of this bacterium. This posed a serious problem for the wastewater treatment plant operator, especially the sludge floatation and the migration of large quantities of potentially contaminated matter from the secondary clarifier into the purified effluent. The purpose of the study was to determine the amount of mobile phosphorus forms, which had entered the purified effluent with flocculated sludge and could cause eutrophication of water reservoirs. Hence, the phosphorus speciation analysis allowed a precise determination of the potential amount of mobile phosphorus that could have accounted for the algal bloom.

This thesis discusses different applications of phosphorus speciation analysis in sewage sludge, and thus contributes to extending the knowledge of environmental engineering.

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