Summary

Effective treatment of urban wastewater, and especially the removal of nitrogen compounds from it, is an important issue from the point of view of protecting aquatic ecosystems from eutrophication. Therefore, optimizing the process of biological nitrogen removal in wastewater treatment plants is a necessity today and is becoming a real technological challenge.

Wastewater treatment plants, in which sludge is disposed of in the methane fermentation process, generate digestate as a by-product of dewatering. These leachates are most often returned to the main technological line and although their amount is small in relation to the inflow of raw sewage (1÷2%), they carry very large nitrogen loads. The confirmation of the above theory is the Śródmieście treatment plant, in which the nitrogen load contained in the leachate constitutes an average of 20% of the nitrogen charge contained in the sewage flowing to the main line.

This paper describes various aspects of conducting a technological process in conditions of overloading the system with ammonium nitrogen and presents ways to solve the problem. One of them is the implementation of an innovative deammonification technology based on the action of Anammox bacteria in a side technological sequence. In order to analyse the available systems, a detailed international literature review was carried out and available studies on the work of existing and technically operating deammonification installations were familiarized.

Before conducting the appropriate tests, preliminary tests were carried out on a laboratory model mapping the actual operation of nitrification and denitrification reactors of the Śródmieście sewage treatment plant in Zabrze. The results of the analyses of five series of nitrogen removal test trials for different nitrogen load variants were aimed at establishing the limit percentage of nitrogen load in leachate in relation to the load in raw waste water, which does not yet cause significant nitrogen removal problems in the treatment plant. Observations of the system's operation have shown that 20% of the nitrogen charge contained in the leachate from the dewatering of fermented sludge in the raw sewage stream is the maximum value at which the activated sludge system operating in the given design regime is efficient and effective in terms of nitrogen removal. The obtained results of preliminary tests turned out to be very important to conduct proper research of the deammonification process on the basis of the selected technology.

As part of the relevant research, after market research on the availability of deammonification technology dedicated to the treatment of streams with a high load of ammonium nitrogen, including especially post-fermentation leachate from the sludge dewatering process, Veolia technology - ANITA™ Mox was chosen. As a result of the conducted talks and after reading the reference materials, it was found that this is a technology with the potential to implement to improve the efficiency of nitrogen removal in the Śródmieście sewage treatment plant in Zabrze. It is also an ideal solution for reducing operating costs and improving the energy savings of the treatment plant.

Therefore, in order to carry out the next stage of research, a model bioreactor with a volume of 20 dm3 was made, which was filled with fittings with a cultured biofilm, containing N-NH4 oxidizing bacteria (AOB) and Anammox bacteria. Leachate for research was taken from the nozzle of decanter centrifuges. The concentration of ammonium nitrogen in the leachate ranged from 980 to 1350 mg/dm^3 (on average 1100 mg/dm^3) Thanks to the devices used and the control, measurement and registration equipment, the process was monitored and controlled depending on the results obtained in accordance with the technological guidelines. The range of oxygen concentration in which the process was carried out was 0.8-1.7 mg O_2/dm^3 (optimally

1.4 mg O_2/dm^3), and the temperature in the reactor was maintained at the level of 28-32°C, i.e. it corresponded to the actual temperature of leachate in the Śródmieście treatment plant. The pH value was maintained in the range of 7.1-7.4. The average efficiency of reducing the concentration of ammonium nitrogen after the period of work was over 85%, removing it from an average level of 1100 mg NH_4/dm^3 to the level of 165 mg NH_4/dm^3.

The results of the conducted research clearly confirmed the advisability of the nitrogen removal technology used. The problem of using modern deammonification technology in the side technological line for the treatment of leachate from the dewatering process of fermented sewage sludge in the Śródmieście sewage treatment plant in Zabrze, discussed as part of the implementation doctorate, and the presented results confirm the purposefulness and correctness of the research carried out. The obtained results are part of the program of modern nitrogen removal solutions and have the potential for implementation on a technical scale.