Research subject and the research project objectives

One of the main challenges in environmental protection is to prevent pollution of water resources. This challenge is directly connected with the necessity of the efficient wastewater treatment. Nowadays, there is emphasis on the biological methods, which are the most environmentally friendly One of them is the anammox process. Anammox process is a process of ammonium and nitrite conversion (nitrogen compounds needed to be removed from the water) into dinitrogen gas presented in the air. Process is performed by anammox bacteria. However, application of the anammox process is not without difficulties. Anammox bacteria are characterized by slow growth rate. Moreover, nitrogen gas bubbles produced during anammox process may causing biomass float, which may be the reason of the problems in maintaining this group of microorganisms in the system. Anammox bacteria are also affected by environmental conditions, like temperature. Optimal temperature for anammox bacteria are higher than an average temperature of influent wastewater. Taking this factors into account, performing anammox process at low temperatures and without biomass loss in a systems, would be cost-effective and free of problems connected with slow anammox biomass yield. The promising technique which can help to maintain the biomass in the reactor and effectively prevent loss of anammox bacteria from a system is an immobilization.

The main goal of the presented studies is to analyze and characterize the anammox bacteria community in immobilized biomass during anammox process carried out at low temperatures (similar to an average temperature of wastewater influent to wastewater treatment plant). Studies will investigate if biomass immobilization has an impact on bacterial biocenosis activity and biodiversity after temperature shift in bioreactors. In addition, change of temperature during anammox process, allow to investigate adaptation possibilities of anammox bacteria.

Research methodology

Anammox bacteria are uncultivable in the laboratory. Thus it is necessary to use molecular tools for their research. The aim of the project is to application of methods such as: NGS (Next – Generation Sequencing), FISH (Fluorescence in Situ Hybridization) and RT – Real Time PCR (Reverse Transcription – Real Time Polymerase Chain Reaction). The results obtained on the base of these methods allow for both qualitative and quantitative analysis of anammox bacteria communities due to the temperature of the process. Activity of biocenosis and its structure will be compared in terms of immobilized and non - immobilized biomass. The first stage of the project assumes comparison of different immobilization methods, and select the best one for investigated biomass.

In the presented project anammox process will be conducted in two separate layouts consisting of two bioreactors each. Bioreactors will be inoculated with immobilized and suspended (non-immobilized) biomass. Each of two layouts will be performed firstly at optimal temperature for anammox process (35^{o}C), then temperature will gradually decrease to around 20^{o}C for the first and 13^{o}C for the second layout.

During experiment samples for molecular analysis will be taken regularly from each layout and physicochemical parameters such as: temperature, pH, conductivity and nitrogen forms concentration will be monitored. Results obtained by molecular biology methods will be summarized with physicochemical parameters of the process.