One of the important processes of the nitrogen cycle in nature is biological nitrification. Until recently it was believed that this process was carried out in two steps by independent groups of microorganisms – by ammonia oxidizing bacteria (AOB) and archaea oxidizing bacteria (AOA), and by nitrite oxidizing bacteria (NOB). The recent discovery of comammox bacteria (complete oxidizing bacteria), the first known bacteria carrying out the process of full nitrification (oxidation of ammonium to nitrate), belonging to the *Nitrospira* species, should be considered a breakthrough in the field of the nitrogen cycle in nature. Researchers around the world are now trying to answer the question of whether comammox bacteria can dominate canonical nitrifiers (AOB, AOA and NOB) in natural and engineered environments (e.g. wastewater treatment plants) and are looking for factors that influence the presence of comammox bacteria in various ecosystems.

The proposed project assumes investigation of various wastewater treatment systems for the presence of comammox bacteria, determination of the environmental conditions affecting the presence and activity of these microorganisms (including the concentration of dissolved oxygen, concentration of influent ammonium nitrogen, process temperature) and determination in which environments these bacteria are most abundant. In the 21st century, wastewater treatment technology offers a huge spectrum of possibilities for using different types of biocenosis to remove contaminants. Apart from the "conventional" activated sludge (microorganisms in the form of suspended flocs), we can use biofilm (microorganisms immobilized on a fixed surface of a moving or fixed carrier) or a granular sludge. One of the aims of the project is identification and characterization of comammox bacteria in the systems, which use different forms of biomass, i.e. activated sludge, biofilm immobilized on moving carriers and granular sludge.

An important added value of the project is the combination of technological studies, microbiological studies and mathematical modeling. The technological studies will include the assessment of: i) effectiveness of wastewater treatment with a special focus on nitrogen removal, ii) kinetics of the nitrification process and “anaerobic” oxidation of ammonia (anammox), and iii) N_2O emissions. In parallel, the microbiological studies will be conducted to characterize the microbial communities and their metabolic potential. The latest, most advanced molecular techniques, such as metagenomics and metatranscryptomics, will be used for these studies. In addition, mathematical modeling and computer simulation will help in understanding the relationship between different groups of microorganisms and optimization of the reactor performance in terms of nitrogen removal efficiency.

An innovative and interdisciplinary approach to research on comammox is guided by a deep belief that the project results will help in understanding the role of comammox in the transformation of nitrogen compounds in wastewater treatment systems. The interdisciplinary research in the field of technology, microbiology and mathematical modeling will be an important milestone in finding answers to many questions currently bothering scientists and researchers.