BASIC INFORMATION ON SUB-PROJECT

NAME OF PROGRAMME/FUND	Scholarship Fund - Sciex NMS^{ch}
RESEARCH FIELD AND OTHER RESEARCH FIELDS INVOLVED (if applicable)	Engineering Sciences
TITLE OF THE SUB-PROJECT	Industrial wastewater treatment by membrane bioreactor technology
REGION OF THE CZECH REPUBLIC (according to the location of the home institution)	Prague
GRANT AMOUNT SPENT	80 542 CHF
INTERMEDIATE BODY	Swissuniversities
HOME INSTITUTION	Institute of Chemical Technology Prague Department of Water Technology and Environmental Engineering
HOST INSTITUTION	University of Applied Sciences Northwestern Switzerland (FHNW)
NAME OF THE FELLOW	Lukáš Dvořák

ABSTRACT OF THE SUB-PROJECT	The new member states of European Union are obliged to adopt the legislation concenring the municipal and industrial wastewater treatment within next few years. If the wastewater is treated biologically, nitrification is usually required before the discharge into the receiving waters. Since the nitrifying bacteria are sensitive to various inhibiting effects, biological treatment or co-treatment of industrial wastewater is often a concern due to the presence of potentially inhibiting substances. The objective of the project will be to study the influence of the addition of industrial wastewater on the nitrification process. The work will include the monitoring of the nitrification process in a pilot-scale membrane bioreactor (MBR) fed with a mixture of synthetic and industrial wastewater from an industrial complex in Switzerland. Evaluation will be carried out based on the chemical analyses of influent and effluent from the pilot plant and kinetic tests with activated sludge performed in the laboratory. Since the adaptation of the activated sludge bacteria is expected to play an important role, the composition of the biomass will be monitored in regular intervals using the molecular biology techniques (Denaturing Gradient Gel Electrophoresis - DGGE). Additional tasks will be the monitoring of the filtration properties of the activated sludge. The main benefits for the fellow will be the acquisition of new skills (advanced analytical techniques such as HPLC-MS and DGGE) and gathering a set of experimental data, which will be used for his PhD thesis.

MAIN RESULTS	The maximum inhibition effect of the industrial wastewater on each sample was evaluated by the decrease in the nitrification respiration rate in the test with 100% industrial wastewater compared to the test with 0% industrial wastewater. Before the start-up of the adaptation, the inhibition effect to nitrification rate was about 95%. After 247 days, the inhibition effect was not observed any more. In contrast, the inhibition effect on the samples of reference activated sludge did not change substantially during the whole experimental period and remained in the range 83-92%. An inhibition effect of industrial wastewater to nitrification rate of activated sludge from the MBR was not observed in most cases for tested ratios up to 30%. A relatively strong inhibition effect was observed for the tested ratio of 30% by reference activated sludge. Almost no inhibition effect was found for the reference activated sludge for 5% of industrial wastewater. The results of chemical analyses showed that the increase of the content of industrial wastewater in the MBR influent had almost no influence on the concentration of ammonia nitrogen in the effluent from the MBR until the content of industrial wastewater reached 40%. At 40% IWW load breakthrough of nitrites into the effluent was observed, followed by ammonium breakthrough at 50% IWW load. This reflects the inhibition of the nitrification process; the second step of nitrification (nitratation) is more sensitive to the industrial wastewater than the first step (nitritation). This was also proven by the respiration tests - significant drop of overall nitrification activity was observed after the increase of industrial wastewater content to 40 and 50% respectively. The average concentration of ammonia nitrogen in the effluent during the operation with 0-30% IWW was 0.47 mg/L (corresponding to 98.5% removal), during the operation with 40 and 50% it was 9.3 mg/L (77.8% removal). High concentrations of nitrate nitrogen in the effluent were corresponding to the efficiency of nitrification - transformation of ammonia nitrogen to nitrate nitrogen. Its decrease was observed at 40 and especially 50% content of industrial wastewater in the MBR influent. Elevated concentration of nitrite nitrogen (up to 10 mg/L) was detected in initial period of MBR operation, probably as a consequence of transition conditions after the transfer of the seed into the new conditions in the MBR. After stabilization, nitrite nitrogen decreased to 0.6 mg/L and remained stable until breakdown of nitrification at 40 and 50% IWW. COD concentration in the effluent was influenced by the organic load in the MBR influent. Its slight long-term increase was observed during the whole MBR operation due to limited degradability of the organic load present in the industrial wastewater. However, the COD removal efficiency was relatively stable and high – on average 86%.

DATE OF REALISATION OF THE FELLOWSHIP	1.10.2009 - 31.12.2010
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