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Institute for Sanitary Engineering, Water Quality and Solid Wastemanagement | **ISWA**

BiOS

Planning and operation of resource- and energy- efficient wastewater treatment plants with targeted avoidance of environmentally hazardous emissions (joint project)

The emission of nitrous oxide (N_2O) from sewage treatment plants has recently received more attention since it has been known that this greenhouse gas is also produced under aerobic conditions in the aeration tank. N_2O can therefore occur during both nitrification and denitrification. In particular, the factors oxygen concentration and carbon source are relevant here. As part of the project, a model was developed (by the project partners) to map the processes in the production of nitrous oxide and ultimately to use for process control. For this purpose, the ISWA generated data and batch experiments in the laboratory, as well as semi-technical and large-scale experiments. Conclusions concerning the influence of the carbon source (in denitrification) as well as the influence of the oxygen concentration could be drawn. These results have been applied for the creation of models and the implementation in process control mechanisms by the project partners

Financing Institution:
Bundesministerium für Bildung und Forschung (BMBF)
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Project partner:
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Duration:
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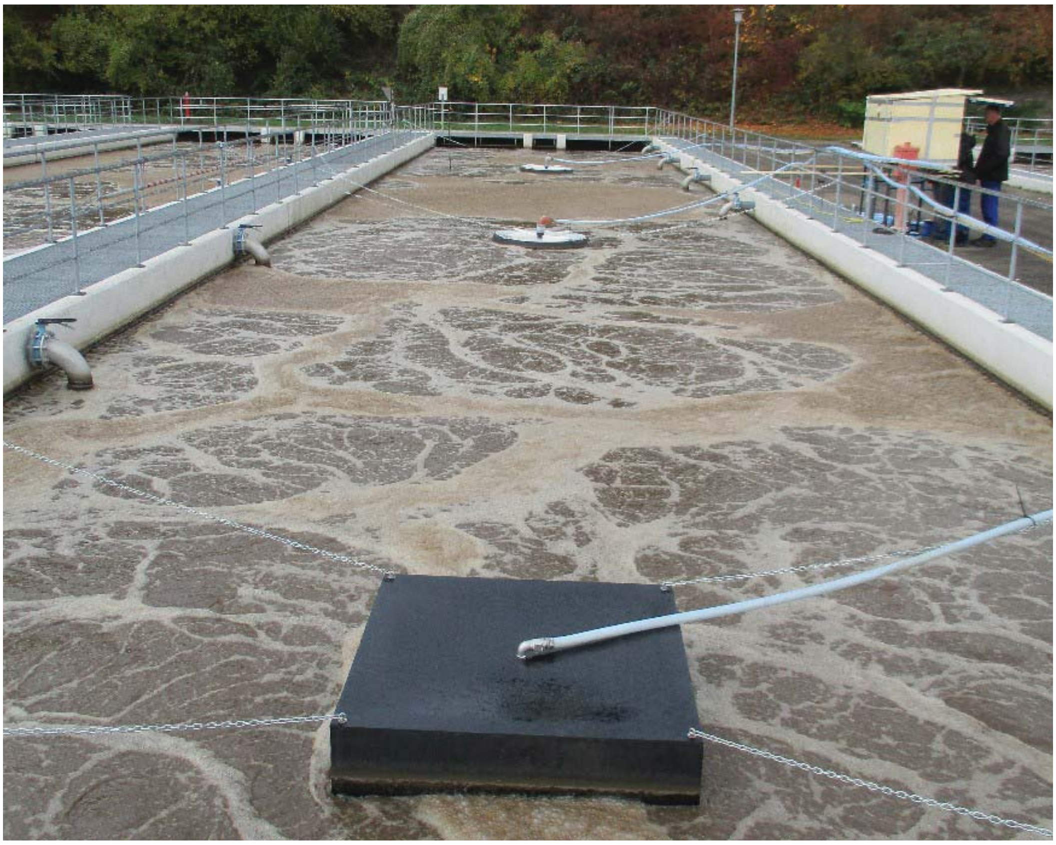

Figure: Pforzheim - NoNitriNox

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BiOS AWT

NoNitriNox - Design and operation of resource and energy efficient wastewater treatment plants with targeted prevention of environmental harmful emissions (joint research project: subproject 2)

The energy demand (power consumption) of wastewater treatment plants has increased steadily over the past 50 years and is already a significant component of the energy requirements of local authorities. The energy consumption of wastewater treatment plants will further rise due to increased demands on the quality of the effluent in order to protect the waters against ammonium, phosphate and total nitrogen, as well as the removal of trace compounds. Therefore efforts are being made since years to minimize the energy require-ment of waste water treatment plants. For example, control strategies are developed to reduce the power consumption for the aeration of the aerobic stage or to improve the efficiency of the denitrification.

In practice it appears that these measures can actually cause an improvement in energy efficiency. However, risks and disadvantages are visible. Besides from increasing the ammonium emissions and negative impacts on sludge stabilization, sedimentation and dewaterability of activated sludge, a risk exists also of increased emissions of nitrite, nitrous oxide (N_2O) and methane. Nitrite emissions are classified as very critical both in terms of water pollution (fish toxicity) and in terms of the risk of microbiological purification processes in wastewater treatment plants (inhibitory effect on microorganisms) and therefore must be avoided. Nitrous oxide, for example, occurs with a decrease of the oxygen transfer and leads to greenhouse gas emissions. Methane emissions play a role, particularly in anaerobic wastewater treatment processes. The discharge of these substances significantly degrades the environmental performance of the wastewater treatment plant.

Therefore the aim of the project is the development of planning tools and control concepts to achieve a cost-, resource- and energy-saving operation of wastewater treatment plants, which include a quantification and evaluation of nitrous oxide, nitrite and methane emissions. It is based on the development of a mathematical simulation model to describe the nitrification and denitrification with the intermediates nitrite, nitrous oxide and CO_2. In parallel, lab-scale batch tests, pilot-scale experiments in a model wastewater treatment plant and large-scale measurements in three different wastewater treatment plants of the project partners are carried out. The basic model is then used to model the experimental plants and sewage treatment plants involved, the measurement data provide verification and calibration of the models. Finally, an integrated optimized operational concept is developed and implemented, using the example of the treatment plants involved. With these experiences, a planning tool is created that integrates the insights acquired.

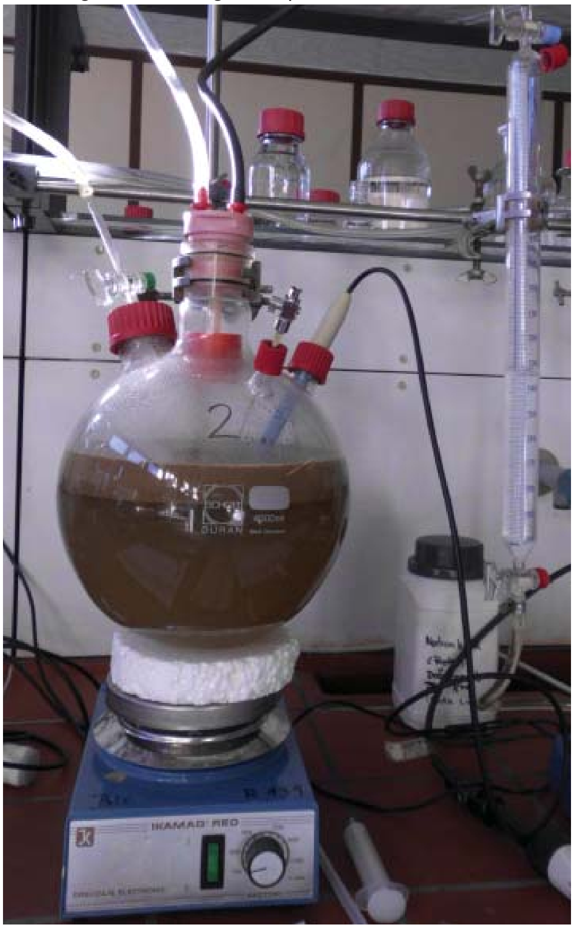

Fig.: Lab-scale Batchtests

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