

Dimensioning of Wastewater Treatment Plants in Hot and Cold Climates

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Deviating wastewater temperatures and salinity levels or specific discharge requirements in other countries regularly challenge export-oriented suppliers of wastewater technology and engineering know-how. The dimensioning of sewage and sludge treatment plants for the special conditions in other countries therefore required the existing DWA regulations to be amended. For this purpose, internationally applicable dimensioning ap-

proaches were developed in the five-year EXPOVAL joint research project funded by the German Ministry for Education and Research (BMBF). These were presented at an event in Essen/Germany. The dimensioning approaches have been added to the new DWA Topic T4/2016, which was presented for the first time at the event.

Without state funding for the 16 German universities and industrial companies involved, the development and validation of the extended dimensioning approaches for world-wide application would not have been possible. As a representative of the Federal Ministry of Education and Research (BMBF), Undersecretary Dr *Ulrich Katenkamp* accordingly highlighted in his welcome address the contribution of the EXPOVAL joint project (Transfer-Oriented Research and Development in the Field of Wastewater – Validation to Technical Installations) which apart from supporting the know-how transfer to foreign regions also should help German companies to achieve success in the face of international competition.

Constraints and conditions for international projects

The particular constraints and conditions for foreign projects were emphatically addressed by several speakers. Dr *Fritz Holzwarth* (formerly in the Federal Ministry of the Environment and still active for internationally oriented organizations) and *Volker Karl* (formerly KfW Development Bank) set out the range of challenges for the use of German wastewater technology and design approaches abroad. These were illustrated by Prof. *Holger Scheer* of Emscher Wassertechnik GmbH who co-ordinated and led the EXPOVAL project, based on the example of discharge requirements and monitoring regulations in the international market which differ from those in Germany. He pointed out that the monitoring practice with daily composite samples, which is not common outside Germany, has a major impact on dimensioning.

Accounts of experiences from export companies were provided for lively discussion. Dr *Uwe Moshage*, representative of an international consulting firm (Dahlem Beratende Ingenieure GmbH & Co. Wasserwirtschaft KG), *Christian Schulmerich*, plant engineer, (Passavant Energy & Environment GmbH) and Dr *Ralf Schröder*, managing director of a planning and operating company (WTE Wassertechnik GmbH), described the challenges of insufficient basic data and emphasised the need for internationally applicable, more competitive dimensioning

approaches. The advantages of the new dimensioning approaches will be ultimately evident in better adapted designs.

The contribution of research projects such as the EXPOVAL project for the export of wastewater management knowledge and technology was presented by Dr. Ing. *Gerd Sagawe* (EnviroChemie GmbH and board member of German Water Partnership) with further project examples.

The speakers as well as the participants expressed the wish for a better availability of the new dimensioning approaches in the new DWA Topic T4/2016 and favoured its translation at least into English, without which international acceptance would not be achievable.

Modification of DWA dimensioning rules

The DWA dimensioning rules used for wastewater plants so far are aimed at the conditions prevailing in Germany. Application in different climates, for example, is possible only with appropriate adjustment. Correspondingly modified dimensioning approaches were presented for municipal wastewater treatment methods such as activated sludge systems, trickling filter, anaerobic and wastewater ponds.

Besides extending to, in particular, lower and higher wastewater temperatures (5–30°C), the dimensioning approaches presented were throughout adapted to the internationally widespread monitoring practice using daily average values. For carbon decomposition, COD is used as a design parameter throughout. In addition, it was investigated and shown that, with appropriate adaptation of the biomass, permanently increased salt contents of up to 10 g/l have no negative influence on the rating of the C and N treatment performance.

New approaches to wastewater treatment

The extended and new design approaches were briefly explained by the project participants. The start was the activated sludge process, for which Prof. *Marc Wichern* (Ruhr-University Bochum) presented the recommendations in addition to the dimensioning rules

described in the standard DWA-A 131. This relates, for example, to the aerobic sludge age which is adjusted based on temperature and which has a major influence on the dimensioning of the basin but also on the adjustment of the process factor to the monitoring practice. In addition, Prof. *Martin Wagner* (Technical University of Darmstadt) spoke about the required pressure or surface aeration systems, the consideration of increased temperatures and salinity and altitude in dimensioning among others according to DWA-M 229-1.

As the DWA standards for the increasingly less-used trickling filter and wastewater pond methods in Germany did not yet provide adaptations to wastewater temperature changes, new empirical dimensioning algorithms were developed for this purpose: Dr. *Christian-D. Henrich* (Enexio Water Technologies GmbH) presented the algorithms for carbon decomposing and nitrifying trickling filters based on modified approaches according to Velz respectively Gujer and Boller. *Sebastian Weil* (IEEM gGmbH – Institute of Environmental Engineering and Management at the University of Witten/Herdecke) explained the dimensioning algorithms for anaerobic and non-aerated ponds, further developed on the basis of internationally accepted approaches by Mara, as well as specifications for aerated ponds. Prof. *Uwe Neis* (Ultrawaves Wasser- und Umwelttechnologien GmbH) presented large scale studies into the use of pond-like systems with symbiotic algae-bacterial biomass, which were carried out for the first time in the course of the EXPOVAL project.

Anaerobic reactors are not used in Central Europe because of too low wastewater temperatures in the municipal applications. They can be practical in hot climates however, assuming the climate-friendly collection of the biogas produced. The corresponding dimensioning was presented by Prof. *Karl-Heinz Rosenwinkel* (Leibniz University of Hannover) and *Klaus Nelt-ing* (DiMeR GmbH) using the example of UASB reactors.

In the field of wastewater disinfection, which has become increasingly important on an international scale, the elimination of helminth eggs had so far lacked both uniform analysis methods and reliable dimensioning principles for micro-screening. As presented by Prof. *Peter Cornel* (Technical University of Darmstadt), this gap was closed as a result of the EXPOVAL research.

New approaches for sludge treatment

Prof. *Norbert Dichtl* (Technical University of Braunschweig) presented add-ons for anaerobic sludge treatment under special climatic conditions: The design temperature range for digesters according to DWA-M 368 has been expanded to include the low-mesophilic interval of 20–34 °C. It has also been verified that, under certain conditions, digesters can be economically dimensioned at average daily air temperatures from 20 °C without thermal insulation.

A new, manufacturer-independent dimensioning method was presented for solar sludge drying based on a modification of Wendling's modified hydrometeorological model according to Penman. Operating recommendations were also offered which make solar drying of sewage sludge conceivable even in moderate climates.

At the end, Prof. *Norbert Dichtl* presented the results of a conveyor screw for thermal sewage sludge disinfection developed in collaboration with Huber SE.

New DWA Topic T4/2016

All of the above dimensioning approaches have been included in an application-orientated form into the new DWA Topic T4/2016 "Design of wastewater treatment plants in hot and cold climates". This was presented by Prof. *Holger Scheer* and Dr. *Tim Fuhrmann*. The report complements the DWA Set of Rules with globally applicable dimensioning approaches for activated sludge, trickling filter and wastewater pond systems, UASB reactors, systems for anaerobic sludge stabilization and solar sewage sludge drying as well as for aeration systems and the elimination of helminth eggs. The dimensioning approaches are supplemented in each case by practical calculation examples. An English translation will be published in May 2018.

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