

Wastewater treatment modelling: *Quo vadis?*

● The 1st IWA / WEF wastewater treatment modelling seminar (WWTmod2008) took place earlier this year in Mont-Sainte-Anne, Québec, Canada, organised in order to allow for debate and the presentation of ideas on this subject. **LEIV RIEGER, PETER A VANROLLEGHEM, IMRE TAKÁCS** and **BRUCE R JOHNSON** discuss the areas covered at the event.

After introducing the first Activated Sludge Model (ASM1) by an International Association on Water Pollution Research and Control (IAWPRC) (now IWA) task group in 1985 (at the Kollokollo seminar in Denmark), wastewater treatment (WWT) modelling can now – 20 years later – be seen as a standard engineering tool. Used in research, development and consulting projects, it has developed from a pure research instrument into a commercially valuable (and widely used) tool.

With the end of the well-known Kollokollo seminars, a platform was missing to discuss questions related to WWT modelling, and the idea of WWTmod2008 was conceived to close this gap. The main objective of the seminar was to bring together different 'schools of thought' with the aim of consensus, building on topics where discussion has matured and clarification of differences on topics for which further research is required. Another goal was to discuss the use of models in practice and particularly for whole plant modelling.

To allow in-depth discussions, the seminar was limited to 120 invited people. In contrast to normal conferences where research results or practical case studies are presented, the goal was to develop new ideas during the event. The seminar's set-up reflected this special goal: during the three-day event only 12 presentations were given, and ten workshops and eight break-out sessions held. All sessions and workshops were prepared before the seminar, involving no less than 85% of the attendees (as committee member, author, or workshop contributor). We achieved a mix of 40% academics, 40% consultants, plus software/equipment suppliers

and plant operators and worldwide coverage.

Inviting leaders in the field did not block out young water professionals (YWPs). The organizers developed a special approach in which one YWP was linked to every senior expert of the scientific committee, having a combined voice. In this way we involved 30 YWPs in the programme development procedure including abstract reviews, topic and final presentation selections.

The topics discussed at the seminar can be split into two major groups:

- New model extensions and modelling concepts
- Use of existing models for different objectives and good modelling practice

Submissions for the first topic showed that a number of extensions and new model concepts have been developed in the past decades. For instance, a new, metabolic approach to modelling has surfaced, based on insights from microbiological research (e.g. the TUDelft Enhanced biological phosphorus removal model). Two presentations discussed the two main lines in this research field: using purely thermodynamic and bioenergetic calculations and a kinetic approach based on rRNA levels. From the discussions it became clear that kinetics are seen to be essential for practical applications of these models but that a combination of both lines could be a possible future of WWT modelling.

Another hot topic of the seminar was the session on modelling nitrification and denitrification. Whereas these processes are currently modelled as single step processes in most models, the development of new treatment processes (e.g. Sharon, Anammox) together with new, very strict limits for effluent total nitrogen (see e.g. Chesapeake Bay in the US) triggered the need for

model extensions including nitrite as an intermediate compound. The intense discussion highlighted that modelling nitrification and denitrification as two-step processes seems to be sufficient for most of the practical applications but it was also mentioned that the modelling of the greenhouse gases nitric oxide and nitrogen dioxide would be of special interest in the near future (the climate impact of nitrous oxide is 320 times stronger than that of carbon dioxide).

With stricter effluent limits, classic process units also have to be looked at in more detail. New modelling approaches were discussed for primary and secondary clarifiers (introducing more detailed models and combining biological processes with computational fluid dynamics (CFD) models) or anaerobic digesters (application and extension of the ADM1 to describe, for example, the fate of phosphorus). The workshops on membranes and secondary clarifiers both reported on the need to characterize particles more closely. The failure of some tertiary membrane filtration plants underlined the importance of modelling the colloidal solids, which is a fraction ignored by most models. The group also looked at approaches to include fouling into wastewater treatment models. The Biofilm group identified that although the models were good at describing the biofilm and boundary layer, they still had difficulty in explaining how reactor configuration and operations affected the treatment performance.

The second group of topics looked at use of models in consultancy, particularly for WWTP design and models in teaching and training. A future WWT modelling field, which is not fully developed yet, was discussed in a workshop on the use of models at the plants and by operators. One workshop opened

up a discussion on the work of the IWA Task Group on Good modelling practice – guidelines for use of activated sludge models. Wastewater characterization is one of the topics where standardization is still required. A workshop compared different approaches and identified several typical pitfalls and research needs.

Eight break-out sessions were organized to allow smaller groups to discuss topics raised during the seminar. This rather informal set-up was excellent to discuss areas a bit outside of the conference focus or deepen the discussion on certain hot topics. The following break-out sessions took place: micro-pollutants, endogenous processes, greenhouse gas generation, particle size modelling in clarifiers and membrane systems, updating model nomenclature, chemical and biological phosphorus removal, and the use of on-line data for model calibration.

The most popular topic was modelling accuracy and uncertainties. The importance of model transparency, the existence of safety factors and the importance of communicating the limitations of the models to the client were discussed in a workshop. ●

Next event

The next WWTmod is planned for March 2010. We hope it will be a similar success to WWTmod 2008.

About the authors

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