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Discussion

Reply to: Comment on "A critical comparison of systematic calibration protocols for activated sludge models: A SWOT analysis" Water Research (39) (2005) 2460–2474 by Denny Parker and Henryk Melcer

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We want to thank Parker and Melcer (2006) for their constructive comments on our SWOT analysis of four recent attempts to make activated sludge model calibration less of an art, and more of a stepwise, procedural methodology that can be carried out by a wider group of modellers.

We are convinced that the Water Research readership will have appreciated the clarifications made by the commenters, i.e. Parker and Melcer (2006), regarding the rationale for the WERF sponsored research that led to their protocol definition, as there was insufficient place in the paper to extensively bring such elements forward. Indeed, each of the four protocols subjected to our SWOT analysis, i.e. the BIOMATH, STOWA, HSG and WERF protocols, was developed from a different objective and therefore had different foci. For example, the BIOMATH protocol comes from a modelling methodology perspective, the STOWA and WERF protocols reflect a (European resp. North American) model calibration practice point of view and finally the HSG protocol aims for support beyond model calibration to maximize overall model usage quality. More protocols have certainly been developed, but have not become as visible in the literature as these four, and must probably be extracted from calibration exercise reports. More efforts have in the mean time developed as well, e.g. in Japan, where a committee conducts

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an "Evaluation of the Method of Practical Application of the Activated Sludge Model" (Hiroki Itokawa, Japanese Sewage Works Agency, personal communication), in Europe, where the HarmoniQuA project has delivered a comprehensive guideline for water systems modelling and, connected to it, the MoST Modelling Support Tool (Scholten et al., 2006) and in North- and South-America, where the Modelling Expert Group of the Americas was established. Given this multitude of worldwide activities, it is very fortunate that last year a truly international activity has been initiated, the IWA Task Group on Good Modelling Practice (http://www.iwahq.org/templates/ld_templates/layout_633184.aspx?ObjectId=634908), to synthesize the results of these different activities dealing with activated sludge modelling. Among others, it aims to identify why differences in practice exist, are warranted and must be explicitly accommodated for in a use(r)-focused guidance. Examples are differences in design and operation of secondary clarifiers (minimum sludge blankets or sludge buffering), applied sludge ages, and use of on-line nutrient sensors for process monitoring and control. It is the confrontation of this variety of practices, starting points and objectives, which is the wealth of ideas that the Task Group can tap into to come up with a Scientific and Technical Report that pursues good modelling practice in wastewater treatment.

In relation to the comments of Parker and Melcer (2006) to our SWOT analysis, we would like to point out that the commenters have only focused on specific elements of the BIOMATH protocol, and missed to take into consideration views adopted by the developers of the two other protocols. These protocols also dealt with specific experiments for model calibration (e.g. STOWA), or with the importance of settler and hydraulic model selection (e.g. HSG).

The WERF work focused on the (development of) experimental methods for calibration of the biodegradation submodel (especially related to nitrifier growth) whereas the other protocols also focused, in more or less detail, on among others, hydraulic characterization and settler modelling, in view of whole plant model development (whole plant being defined in the comment by Parker and Melcer (2006) as the water line—reactors and settlers—and not including the sludge line). The WERF report also aimed at giving quite some technical details regarding these methods, whereas the other protocols refrained from this (for reasons of space limitation) and only refer to literature and already available reviews of experimental methods (e.g. Vanrolleghem et al., 1999; Petersen et al., 2003).

Our SWOT analysis focused on a comparison of modelling protocols and could therefore not include the work on performance testing of settlers as described in the other WERF reports Parker and Melcer (2006) refer to, as these reports do not provide a direct help for modellers to select settler submodels or estimate their parameters. Selection among currently available models is indeed needed, as differences in operating or design schemes (e.g. minimum sludge blanket operation in NA or clarifier sludge buffering elsewhere) may lead to differences in requirements for the settler submodel to be included in the whole plant model.

We agree with Parker and Melcer (2006) that the settler submodels among which one can currently choose as part of a whole plant model cannot describe all phenomena occurring in a secondary clarifier. As our own research line over the last 5 years has shown (De Clercq, 2003; De Clercq et al., 2004), we too believe that CFD modelling is one of the new approaches to tackle problems in activated sludge treatment plants, e.g. related to aeration systems, mixing devices and clarifiers. However, in terms of whole plant modelling, the focus of the protocols discussed in the SWOT analysis, we do not foresee a direct role of CFD in near future. We also agree (and have experienced) that setting up and calibrating CFD models is at least on a par with activated sludge calibration, and we do not think that we have implied in the paper that this is a simple matter, on the contrary, we commented that at this stage CFD is still a time-consuming task.

Regarding the use of SBR pilots or short-term batch experiments, we want to emphasize again that one of the most important requirements for an adequate experimental method for model calibration is that it must deliver information that is relevant for the plant to be modelled. This means that the sludge subjected to the experiment must provide a response representative of the sludge from the parent plant. Bringing sludge for a prolonged period of time in different conditions, albeit close to the conditions of the parent plant, will affect its biological composition and properties (as the three key references provided in the paper support). This is exactly what Parker and Melcer (2006) bring forward too, when they discuss the results of Chudoba et al. (1985) regarding plug flow and completely mixed reactors: Sludge adapts to the conditions it is exposed to. We have therefore advocated for many years (e.g. Spanjers and Vanrolleghem, 1995) that short-term, low initial substrate to biomass ratio (S/X), experiments must be conducted so that sludge does not have the time (nor the substrate) to adapt. In this way, the collected data set can provide relevant information regarding the sludge properties in the parent plant. Given the fact that new experimental protocols are being proposed, it is certainly worthwhile to compare the available methods in terms of the information they provide regarding the full-scale behaviour.

To conclude, we fully support the proposal to work towards more international consensus on modelling approaches and we hope that our SWOT analysis has contributed towards such consensus. We feel that the IWA Task Group on Good Modelling Practice provides a valuable platform for such consensus search and wish it to receive the support from all professionals active in the field.

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