UP- AND DOWNSTREAM OF THE WASTEWATER TREATMENT PLANT: MODELLING ISSUES FROM AN INTEGRATED PERSPECTIVE

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EXTENDED ABSTRACT
Today, models are available that can reasonably simulate the behaviour of the individual sub-systems of the urban (waste)water management system, although they may be fairly complex and their parameters hardly identifiable despite extensive measuring campaigns (Vanrolleghem *et al.*, 1998). Future urban wastewater management was clearly identified to be in need for a problem oriented selection and integration of adequate models of the three sub-systems (Rauch *et al.*, 1998). Such integrated modelling is even more complex not only due to the shear increase in model size, but also due to the different modelling approaches that reflect the history of these models and of the purpose they were built for. Obviously, these purposes are now changing (Schilling *et al.*, 1997). For instance, a lot of attention was drawn in the past to model the sewer's hydraulics in great detail (as flood prevention was its main purposes), while the quality of the conveyed sewage was hardly considered. Biological processes in the sewer may not be considered important when a CSO load is to be determined, but they can be significant for reliable prediction of the input load to a WWTP.

The considerable differences in modelling approaches confront us now with compatibility problems when an integrated model is to be built. To illustrate some of the main "connection" problems, Table 1 gives an overview of the most commonly used state variables in the models of the different subsystems. For integrated simulation, it is probably possible to use existing models of sub-systems, but translating the state variables at the interfaces turns out to be a major problem.

Table 1 also shows that different levels of detail are used in the different models, e.g., the fractionation of organic matter and nitrogen compounds. Moreover, sometimes different descriptors are used for the same quality aspects, e.g. BOD as a measure of organic pollution in sewer and river models and COD in WWTP models. Finally, some state variables are not felt to be significant at all in certain subsystems, such as heterotrophic biomass in sewer and river models.

Currently, the considerable compatibility issues are typically solved either by assuming values for variables that were not modelled in an upstream subsystem, or by creating *ad hoc* conversion factors based on empirical evidence (e.g. Vanrolleghem *et al.*, 1996). Recently, some work was initiated to create compatible models with a common set of state variables (Fronteau *et al.*, 1997; Maryns & Bauwens, 1997). Also, a task group was created within the International Association on Water Quality (IAWQ) to build a modelling suite for receiving waters compatible with the *de facto* standard IAWQ Activated Sludge Models (Somlyody *et al.*, 1998).

Table 1. Comparison of state variables used in sub-models of an urban catchment (Rauch *et al.*, 1998).

Sewer System		Wastewater Treatment Plant		River	
Flow Rate		Flow Rate		Flow Rate	
Total Suspended Solids		Total Suspended Solids		Total Suspended Solids	
BOD	-> particulate -> soluble	COD	inert soluble (S_I) soluble readily biodegradable (S_S) inert particulate (X_I) slowly biodegradable (X_S) heterotrophic biomass (X_{BH}) autotrophic biomass (X_{BA})	BOD	slowly biodegradable readily biodegradable sediment oxygen demand
Total (Kjeldahl) Nitrogen		N	ammonium (S_{NH}) nitrate (S_{NO}) soluble biodegradable (S_{ND}) inert soluble (S_{NI}) soluble biodegradable (S_{NH}) slowly biodegradable (X_{ND})	N	ammonium nitrite nitrate Kjeldahl
		Dissolved oxygen		Dissolved oxygen	
Total Phosphate				Phosphate	inorganic organic
Fecal coliforms				Fecal coliforms	
				Chlorophyl a	
				pH	

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