

Seminar dates and abstracts in 2002

- **Author: Prof. Dr. Lic. Hans Vangheluwe**

Institution: Biomath

Country: Belgium

Title: Computer Automated Multi-Paradigm Modelling

Date: 17-06-2002

Abstract:

Computer Automated Multi-Paradigm Modelling is an emerging field which addresses and integrates three orthogonal directions of research: (i) multi-formalism modeling, concerned with the coupling of and transformation between models described in different formalisms, (ii) model abstraction, concerned with the relationship between models at different levels of abstraction, and (iii) meta-modeling, concerned with the description (models of models) of classes of models and as such allows formalism specification. Multi-paradigm modeling explores the possible combinations of these notions. It combines and relates formalisms, generates maximally constrained domain- and problem-specific formalisms, methods, and tools, and verifies consistency between multiple views. The above three issues will be introduced briefly and demonstrated by means of AToM3 (A Tool for Multi-formalism, Meta-Modelling). The focus will be on meta-modelling and the ease with which customized modelling and simulation systems can be constructed within the framework of Computer Automated Multi-Paradigm Modelling.

- **Author: ir. Eveline Volcke**

Institution: Biomath

Country: Belgium

Title: Modelling the SHARON process in view of coupling with Anammox

Date: 11-06-2002

Abstract:

The combined SHARON-Anammox process for treating wastewater streams with high ammonia load, is discussed. Partial nitrification at high temperatures in a continuously aerated SHARON reactor, should yield an optimal ammonia-nitrite ratio, that is subsequently sent to the Anammox process to form nitrogen gas. A mathematical model of the SHARON process is presented. %consisting of mass balances for both the liquid and the gas phase, a The stoichiometric matrix is formulated in terms of yield coefficients and biomass composition. Special attention is given to the calculation of pH. Preliminary simulations of the behaviour of the SHARON reactor are discussed.

- **Author: ir. Frederik Verdonck**

Institution: Biomath

Country: Belgium

Title: Added value of a (hierarchical) bootstrap model in environmental standard setting

Date: 11-06-2002

Abstract:

Data sets can be hierarchical in structure. But how can we account for this hierarchical structure in a quantitative way? Should we use a hierarchical model or is a non-hierarchical model sufficient? This will be illustrated for the application of environmental quality standard setting.

- **Author: ir. Usama El-Sayed Zaher**

Institution: Biomath

Country: Belgium

Title: Comparison of Two Titrimetric Sensors for On-line Monitoring of Anaerobic Digestion

Date: 27-05-2002

Abstract:

The anaerobic process appears to be the most efficient and economic to treat the wastewater of small and medium enterprises focused upon by the TELEMAT EC project. In view of its stability and a better control of the process, the Volatile Fatty Acids (VFA) concentration, alkalinity and gas composition should be measured. For the first two measurements, titration methods show a great potential. Lately, much research work has focused on the development of these methods to accurately achieve these measurements in appropriate time for anaerobic process control. Among these efforts, two titration setups have been developed by two TELEMAT members and are potentially suitable for on line application. Chronologically, the first has been tested for on-line monitoring of effluent quality of wastewater plants (Van Vooren, 1996) and was considerably developed at the BIOMATH department with the PhD work of (Van Vooren, 2000). Therefore it was originally decided to study the lab bench titrimetric sensor available at Biomath to know its limitations and capabilities, to analyse the technical requirements of the measuring set-up and to evaluate experience so far. However, a second set-up was introduced by INRA. This sensor is already used for monitoring an anaerobic pilot scale reactor treating winery waste and has shown good results (Bouvier et al, 2002). More over, the INRA titrimetric sensor is implemented on line since 1997. Thus, it is decided through this work to compare both titrators in measuring and monitoring the anaerobic wastewater treatment process. The objective of this comparison is to assess the further development for online application to be carried out in co-operation with a third TELEMAT member, APPLITEK.

• **Author: ir. Bob De Clercq**

Institution: Biomath

Country: Belgium

Title: Hydraulic characterization of a wastewater treatment clarifier by an acoustic doppler current profiler

Date: 13-05-2002

Abstract:

Optimization of the solids removal performance of a clarifier requires, in part, a complete

understanding of the tank hydraulics. This paper presents velocity measurements obtained by utilizing an acoustic doppler current profiler (ADCP). The latter provides the necessary temporal and spatial scale to understand and analyze in a detailed way density-driven flows in wastewater clarifiers. Velocity profiles and Reynolds shear stresses of a full-scale installation were investigated. Two different clarifiers were investigated that differ in floor slopes and solids removal mechanisms. The ADCP revealed that sloped clarifiers provide significant solids transport towards the central removal sump. Implications in the design of clarifiers are discussed and new insight is provided into the transport of solids and purpose of the solids removal system. The velocity measurements suggest that the analysis of the removal mechanism should be considered from a fluid mechanical perspective. It was also seen that a scraper-equipped, central solids removal design creates non-ideal flow fields compared with a suction, radial removal design. Shear stress corresponded well with simulation results from literature. The paper has to be seen as a first attempt to apply this proven measurement technology in wastewater treatment.

- **Author: Karel Vandegehuchte**

Institution: Biomath

Country: Belgium

Title: Activated Sludge Flocculation: On-line Determination of Floc Size and

Distribution

Date: 13-05-2002

Abstract:

- **Author: Sammy Van Den Broeck**

Institution: Biomath

Country: Belgium

Title: Modelling and analysis of the SHARON process for nitrogen removal over nitrite

Date: 29-04-2002

Abstract:

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- **Author: Frederik De Grove**

Institution: Biomath

Country: Belgium

Title: Immission based control of the dissolved oxygen concentration in the integrated urban wastewater system

Date: 29-04-2002

Abstract:

The urban wastewater system has a major impact on the river water quality of urban streams. In urban water management, mathematical models are often used to describe the behaviour of the urban wastewater system. One way to improve the performance of the system is to apply real time control (RTC). Real time control aims at the optimisation of the urban wastewater system performance under dynamic loading conditions, e.g. originating from rain. This thesis presents a novel approach to control the whole system: sewer system, treatment plant and receiving water with the aim to achieve minimum effects of pollution in the river. The application of model based predictive control results are illustrated with hypothetical problem sets. The methodology makes it possible to optimise the system performance directly with respect to water quality parameters and to avoid the traditional artificial performance criteria, such as to minimise the overflow volume. In this research, real time control is applied to the Tielt catchment. A minimum oxygen predictor in the river has been implemented to control the amount of water treated biologically in the treatment plant. A minimum oxygen predictor is modelled, based on the Streeter-Phelps equations. The control element considers the water level of the storm tank, the sludge blanket depth of the clarifier in the treatment plant and the predicted minimum oxygen concentration in the river. This investigation gives an indication on the possibility of using the Streeter-Phelps equation in model based predictive control, in order to improve river water quality. It was shown that the proposed integrated control could improve the oxygen concentration in the river downstream the treatment plant. Hence, a proof of principle has been given that the use of measurements in the river to perform control actions in the treatment plant

is a promising option, especially during storm situations. However, during dry weather conditions the possibility exists that the water quality deteriorates with this kind of integrated control.

- **Author: ir. Matthew Brannock**

Institution: University of Queensland

Country: Australia

Title: Computational Fluid Dynamic Modelling of an Anoxic Wastewater Treatment Channel

Date: 22-04-2002

Abstract:

The background and results of modelling work that was performed during a work visit will be presented, along with a comparison to validation experiments undertaken at Luggage Point Wastewater Treatment Plant, Brisbane, Australia. The modelling work performed here involved the development of a three-dimensional hydrodynamic model (involving sludge transport) with the inclusion of a simplified version of the Activated Sludge Model No. 1.

- **Author: Koen Mahieu**

Institution: Biomath

Country: Belgium

Title: Modelling AS flocculation using a population balance model

Date: 08-04-2002

Abstract:

The use of a population balance model (PBM) to model the activated sludge flocculation process was investigated. Experimental datasets of Biggs (2000) were used. An alternative error calculation method is presented. A sensitivity analysis was performed to check the identifiability of the parameters and the model performance was investigated.

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- **Author: ir. An De Moor**

Institution: Ghent University

Country: Belgium

Title: Monitoring and modelling of subsurface flow constructed wetlands

Date: 08-04-2002

Abstract:

In Flanders, an estimated 15 % of the population will never be connected to a central wastewater treatment plant (WWTP). Small WWTP can be a valuable option, e.g. constructed wetlands are commonly used. The objective of my thesis is to enhance the insight in the operation of the different removal processes and mechanisms in horizontal subsurface flow constructed wetlands. As the title says, there was a monitoring and a modelling part in my research. A pilot scale constructed two-stage reed bed and a subsurface flow constructed wetland have been monitored. Using the dataset obtained during the monitoring campaign, simulations were done with an adjusted model in WEST++. Also a sensitivity and an identifiability analysis of the model have been carried out.

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- **Author: ir. Ruxandra Govoreanu**

Institution: Biomath

Country: Belgium

Title: Linking Floc Structure and Settling Properties to Activated Sludge Population Dynamics in an SBR

Date: 18-03-2002

Abstract:

Over a period of 227 days properties of activated sludge grown in a Sequencing Batch Reactor (SBR) operated under stable conditions were analyzed. Settling properties (Sludge Volume Index - SVI) of the activated sludge were compared with on-line measurements of floc size and size distribution obtained by using a laser light scattering technique (Malvern Mastersizer/S, Malvern,

UK), and with measurements of microbial community dynamics analyzed by denaturing gradient gel electrophoresis (DGGE) patterns of 16S rRNA genes. In addition, microscopical observations were used to confirm the results. Three distinct stages in the SBR evolution were observed. In the first stage the structural floc properties showed predominant presence of floc-forming bacteria in the activated sludge. A good correlation between floc size, settling properties and microbial community evolution was observed. The second stage showed a good balance between floc-forming and filamentous bacteria, with good settling properties and a highly dynamic community in the SBR. In the third stage, an increase in the filamentous bacteria, which became predominant in the system was observed. Again, a good correlation between settling properties and floc size distribution was obtained and a new dominant species (ribotype) was observed in the DGGE patterns, which can be assumed to be a filamentous organism. Further, the floc break-up and flocculation studies showed that filaments reinforce the floc structure.

• **Author: ir. Klaas Malisse**

Institution: Biomath

Country: Belgium

Title: Monitoring of the denitrification in activated sludge processes using combined nitrate- and titrimetric data

Date: 04-03-2002

Abstract:

My thesis objective is the development of a biosensor for the monitoring of biological nitrogen removal processes in wastewater treatment with special focus on the denitrification under anoxic conditions. In aerobic regions, monitoring of the processes is mostly based on respirometry that measures oxygen uptake rate of biomass. However this method fails under anoxic conditions. Nitrate measurements are instead used for monitoring anoxic activity of the biomass. Online, fast and reliable methods for measurement of nitrate becomes significant for process monitoring. In this study, ion-selective nitrate probe is chosen for nitrate measurements and the proposed biosensor is based on this nitrate-electrode and on titrimetric measurements. Experimental results show that the two independent measured variables of the biomass activity are well in agreement

with each other, which offers the opportunity to cross-validate the quality of the experiments and therefore the monitoring. Overall this methodology provides information-rich data that can be used not only for monitoring but also for model-based estimation of biokinetic parameters of biomass activity.

- **Author: Dieter Dubois**

Institution: Biomath

Country: Belgium

Title: Model verification and parameter estimation of one-dimensional secondary clarifier models

Date: 04-03-2002

Abstract:

The secondary clarifier can be modelled with several mathematical models. To predict the sludgeblanketheight and bottomconcentration in the clarifier an approach in one dimension is quite sufficient. For this, the approach of Krebs et al. (2000) has been studied to figure out how this model can give a good representation of reality. The model was implemented in the softwareprogram WEST to perform test on optimisation and sensitivity analysis to figure out in which conditions the model was applicable, future research on optimal experimental design will be performd.

- **Author: ir. Bob De Clercq**

Institution: Biomath

Country: Belgium

Title: On-line particle characterization on a secondary clarifier

Date: 18-02-2002

Abstract:

The seminar will concern an on-line particle size characterization method, i.e. the focussed beam

reflectance method. Besides presenting the technique, it will also be evaluated towards possible applications in wastewater treatment, with a special focus on the secondary clarification where particle growth is of major importance. This research was conducted at the Advanced Wastewater Management Centre at the University of Queensland (Australia). Experiments were performed at an installation of Brisbane Water.

- **Author: ir. Veronique Vandenberghe**

Institution: Biomath

Country: Belgium

Title: Uncertainty and Sensitivity Analysis in River Water Quality Modeling

Date: 28-01-2002

Abstract:

This presentation will give an overview of the work i've done for my Phd project on Uncertainty and Sensitivity Analysis in River Water Quality Modeling and also some planned research work will be discussed. For this research, a modified QUAL2E model is used implemented in ESWAT. It is an extended version of SWAT, a simulator developed for the integral modeling of the water quantity and quality processes in river basins. The sensitivity analysis uses Latin Hypercube Sampling and criteria related to the duration of low concentrations of dissolved oxygen and the occurrence of high algae concentrations. Next to the sensitivity analysis and subsequent calibration of the model with resulting uncertainty on the model output, the aim of the project is to make the final uncertainty smaller. Therefore an optimal design technique was performed on the river Dender. Starting with an extensive set of measurements, it is the aim to reduce those data to obtain just as much data as necessary for a calibration with an acceptable uncertainty on the parameters.

- **Author: Dr. ir. Olga Georgieva**

Institution: Biomath

Country: Belgium

Title: Fuzzy modelling and control design of biotechnological processes

Date: 21-01-2002

Abstract:

Modelling and control design of complex nonlinear processes by both used fuzzy process description techniques is considered. First, the benefit of fuzzy linguistic approach through Mamdani rule of inference is discussed. Second, knowledge-based fuzzy approach defined through Takagi-Sugeno fuzzy model is presented. It will be placed a special emphasis upon data driven techniques based on fuzzy clustering techniques for structure identification and learning techniques for parameter identification. Case studies of fuzzy modelling and control design of xanthan gum fermentation process, WWTP and SO₂ absorption process will be considered as a matter of illustration.

*) 본 자료는 BIOMATH 홈페이지에서 발췌하였음.