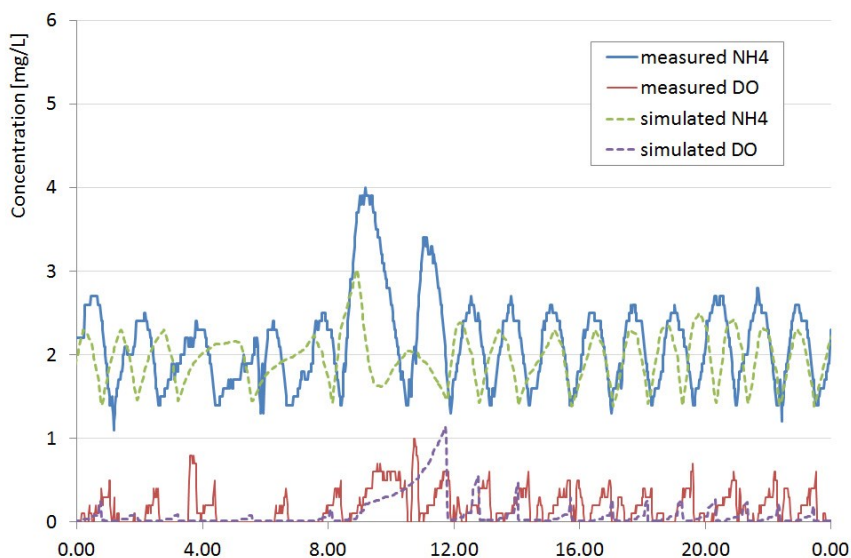# OPTIMISING MUNICIPAL WASTEWATER PROCESSES

Achieving significant energy savings with a model-aided design approach

ETC Sustainable Solutions needed to optimise treatment processes in existing municipal wastewater treatment plants (WWTPs). In order to find the optimal solution for revamping the WWTPs, they initiated two studies to examine the potential benefits of a model-based design approach for the installation of their OSCAR® controller. For these studies, they used our MIKE Powered by DHI WEST modelling software under dynamic conditions. By using a model-based design approach, they were able to successfully develop and evaluate control strategies and achieve energy savings in bioprocesses of up to 60%.

IMPROVING NITROGEN REMOVAL AND SAVING ENERGY

OSCAR® (Optimal Solutions for Cost Abatement in nutrients Removal) is a real-time wastewater treatment process controller that operates the single-tank intermittent denitrification/nitrification process based on:

- data collection
- processing of ammonia and dissolved oxygen

Comparative evaluation of measured and evaluated ammonia and DO over a typical day. ©DHI

CLIENT

ETC Sustainable Solutions

CHALLENGE

- Need for sufficient information in order to optimise existing municipal wastewater treatment plants (WWTPs)
- Need to assess the optimal configuration for alternate anoxic-aerobic processes using the OSCAR® controller under dynamic conditions

SOLUTION

Using MIKE Powered by DHI's WEST software to aid in the installation of ETC Sustainable Solutions' OSCAR® controller

VALUE

- Enabled up to 60% energy saving in bioprocess
- Aided in the successful development and evaluation of model-based control strategies
- Provided dependable model results to support and validate potential benefits of implementing the OSCAR® controller
- Enabled ETC to improve WWTP by increasing nitrogen removal efficiency

LOCATION / COUNTRY

Trento, Italy

SOFTWARE USED

WEST

This project was carried out by the client using MIKE Powered by DHI software.

© DHI

The expert in **WATER ENVIRONMENTS**

DHI

ETC Sustainable Solutions wanted to properly assess the potential for using OSCAR® to optimise wastewater treatment and aeration processes. To do this, they decided to model and evaluate controller scenarios in two existing plants.

In the first study, they modelled a 10,000 Population Equivalent (PE) WWTP to investigate the predicting capability of the Activated Sludge Model No. 1 (ASM1) for an extended aeration process, which was converted into an OSCAR® installation.
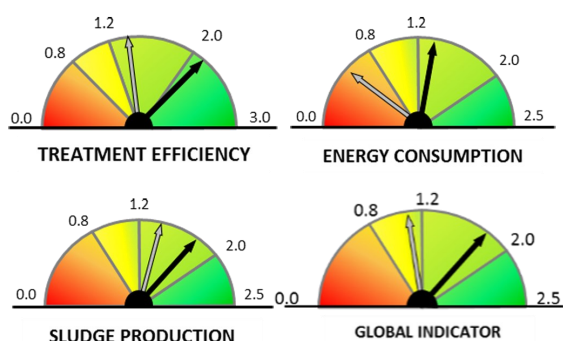
ETC set up the bioprocess layout in WEST by taking two important factors into account:

- the hydrodynamic behaviour of the tank
- the oxygen transfer efficiency of the installed aeration device

Once the setup was completed, they performed short-term calibration to determine the chemical oxygen demand (COD) fractions in the influent, the autotrophs and heterotrophs biokinetics, and the ammonification rate. The calibrated model was then successfully verified over a 30-day validation period.

Next, the outputs of the WEST model were used as a support tool in the definition of optimal thresholds and set-points of the OSCAR® controller. ETC confirmed a large improvement in performance of the controller with regard to nitrogen removal, energy savings in blowers, and reduced sludge production.

The carrousel tank was mimicked in WEST by 12 ideally mixed activated sludge tanks in series. The oxygen transfer parameters of actual Mammuth rotors and the influent wastewater characterisation based on operational data were put into the model.

INCREASED DENITRIFICATION EFFICIENCY

In the second study, ETC examined the possibility of installing the OSCAR® controller for a carrousel process in one of three treatment lanes of a 60,000 PE municipal WWTP.

The layout – defined according to the real tank – consisted of 12 tanks in series with inlet and outlet points to and from the settling tank. ETC set the oxygen transfer parameters of the existing Mammuth rotors and the influent wastewater characterisation according to the operational data provided by the end user.

Once this was completed, they compared current performances and the on-off aeration control achievable with the OSCAR® controller by using a typical pattern of influent flow rate, COD, and nitrogen concentration. Introducing properly set anoxic phases increased denitrification efficiency and resulted in a substantial improvement in nitrogen removal.

BENEFITS OF A MODEL-BASED CONTROLLER DESIGN

According to ETC Sustainable Solutions, the optimisation of process parameters for the intermittent aeration process in an existing plant is the most significant benefit of using WEST for their studies. In addition, our software is a strong tool for validating the potential benefits of the OSCAR® controller in a plant suffering from poor nitrogen removal efficiency.

In this specific instance, WEST helped ETC Sustainable Solutions achieve a 60% reduction in energy consumption and a 35% reduction is excess sludge production.

Performance index comparison between pre-OSCAR (grey arrows) and post-OSCAR (black arrows) operation. Index is relative to a properly operated WWTP (1.0) according to national and local regulations. ©DHI

BENEFITS OF WEST

WEST is a powerful and user-friendly software application for dynamic modelling and simulation of WWTPs and other types of water quality related systems. Designed for operators, engineers, and researchers interested in studying physical, biological or chemical processes in WWTPs, sewer systems, and rivers, typical applications include:

- evaluation of design options
- process optimisation
- model calibration
- development of advanced control strategies
- monitoring of plant operation and troubleshooting
- research and development
- integrated urban water systems modelling

CLIENT TESTIMONIAL

We chose WEST for its extensive and transparent model library and its high flexibility for developing customised models. These features allowed us to simulate complex control strategies and reproduce the real behaviour of our controller, and thus to optimise thresholds and set-points and to validate the benefits of different operating strategies. Marco Vian, PhD—Environmental Engineer—ETC Sustainable Solutions

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