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Let's Solve Water

Case study

# Smart biomass control saves energy while maintaining treatment objectives

## Results from Hammarby Sjöstadsverk, Sweden

In the biological treatment step of a wastewater treatment plant (WWTP), the biomass solids retention time (SRT) and the dissolved oxygen (DO) concentration are the two most important parameters affecting treatment performance and energy consumption. While most WWTP today use aeration control to regulate the amount of oxygen added, automated control of the biomass inventory is still seldom used. Typically, the biomass is only controlled manually by an operator adjusting wasting time and targeting a desired mixed liquor suspended solids (MLSS) concentration.

A smart biomass control system was implementated at a pilot plant in Hammarby Sjöstadsverk, Sweden. It was shown to automatically maintain the biomass required to reach treatment objectives with a significant potential to reduce energy consumption.

### Plant data

The study was conducted at a pilot plant with a continuous feed ICEAS advanced Sequencing Batch Reactor (SBR) situated at Hammarby Sjöstadsverk (Nacka, Sweden). During the study, the influent and effluent streams to the ICEAS system were monitored with 24-hour composite samplers and analyzed for organic material, nutrients and suspended solids. The SRT and MLSS of the SBR reactor was continuously monitored both online and through reference lab samples. The energy consumed by the blowers was monitored online.

### Smart biomass control system

During a stable period of five weeks, the plant was controlled with the OSCAR process performance optimizer control system with SIMS biomass controller. This biomass controller automatically calculates the SRT required for the current process conditions and maintains it stabally by automatically adjusting the amount of sludge wasted. The controller was set to reach an effluent ammonia concentration of 1 mg/L.

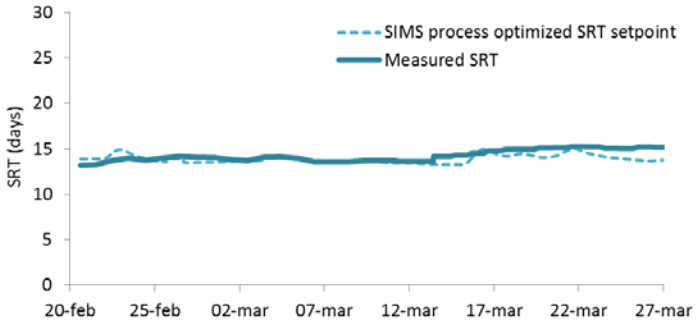

**TEST PLANT:** Hammarby Sjöstadsverk, Sweden
**PROCESS:** Sanitaire ICEAS advanced SBR
**DESIGN FLOW:** 4500 GPD
**TEST DATES:** Feb 2014 – May 2014

**TEST PERIODS**

| Period | Biomass control |
|---|---|
| Period 1 | **Process optimized SRT:** Controlled with the OSCAR system with SIMS controller |
| Period 2 | **High SRT:** Controlled to constant value of approximately double the process optimized SRT |

The process optimized SRT setpoint and the measured SRT of the reactor during the five weeks of operation is illustrated below. The SRT setpoint varies since it is calculated continuously based on real-time process parameters. The actual sludge age was controlled within on average 0.5 days of the required SRT.

Lab samples of the effluent water showed that the SIMS controller managed to maintain a biomass as required to reach the treatment objectives, with an average effluent ammonia and total-N concentration of 1.0 and 6.6 mg/L respectivly.




## Energy savings potential

After operating with the SIMS controller, the SRT was increased twofold during an acclimation period of three weeks and was then maintained for an additional stable period of three weeks. The second period represents a scenario when the sludge age is not optimized for the process but set excessively high for safety, which is the case in many plants today.

Similar treatment performance was measured for the second period both in terms of BOD and nitrogen removed, despite the significantly higher SRT. This shows that running at a higher SRT than the process optimized SRT setpoint made no additional improvements to the process performance.

A significant difference between the two periods was however found in the energy consumption. During period 2, the energy consumed was increased by 12 %. The higher SRT induces endogenous respiration, which increases the oxygen demand and therefore the energy required.

## Conclusions

This study shows that it is possible to automatically adjust and control the required SRT for a process with the SIMS controller to reach a desired treatment performance. A smart biomass controller like the SIMS controller provides a stable and well-functioning process while minimizing energy consumption. It also provides greater autonomy for operations staff with growing demands and limited resources.

PROCESS PARAMETERS

| | | Period 1 *Optimized SRT* | Period 2 *High SRT* |
|---|---|---|---|
| SRT | Days | 14.2 | 24.8 |
| MLSS | mg/L | 2700 | 3600 |
| SVI | mg/L | 160 | 170 |
| DO average | mg/L | 1.9 | 1.9 |
| Water temp | °C | 15 | 18 |

TREATMENT PERFORMANCE

| | | Period 1 *Optimized SRT* | Period 2 *High SRT* |
|---|---|---|---|
| Infuent flow | GPD | 5300 | 4500 |
| Nitrogen treated | lb/day | 1.9 | 1.9 |
| BOD treated | lb/day | 14 | 14 |
| Ave effluent TN | mg/L | 6.6 | 8.0 |
| Ave effluent NH4 | mg/L | 1.0 | 1.2 |
| Ave effluent BOD | mg/L | 5.3 | 9.0 |

ENERGY CONSUMPTION

| | Period 1 *Optimized SRT* | Period 2 *High SRT* | Saving |
|---|---|---|---|
| Energy (kWh/day) | 16 | 18 | **12 %** |
| AE* (lb/kWh) | 1.68 | 1.54 | **9 %** |

**AE = Aeration Efficiency*