Case study

Solids Inventory Management System (SIMS) Controls SRT to Meet Treatment Objectives

Results from Black River Falls, Wisconsin, USA

Solids retention time (SRT) is a critical design and operating parameter, and defined as the average amount of time (usually in days) that bacteria stay within the biological reactor. Since the growth rate of nitrifiers are slow compared to heterotrophic BOD-removing organisms, most wasterwater treatment plants (WWTP) are designed and built based on SRT required for reliable nitrification. Beside process conditions (dissolved oxygen, pH, toxicity, etc.), nitrification is a very temperature sensitive process that can be affected by seasonal temperature variations and seasonal SRT adjustments are often required. The selection of an SRT has many consequences related to process performance, sludge production, and oxygen requirements. For example, lower SRT results in inadequate nitrification that leads to ammonia or total nitrogen permit violation. On the other hand, higher SRT results in adequate ammonia treatment but offers higher energy costs due to endogenous respiration of the old sludge. Therefore, an optimum SRT is always desired to get sufficient treatment at the lowest possible energy costs. The traditional method to maintain optimal SRT is to manually adjust the waste activated sludge (WAS) wasting rate based on mainly judgment or by removing a calculated amount of biomass that is not based on real time calculation. A reliable and smart OSCAR™ process performance optimizer Solids Inventory Management System (SIMS) can automatically control optimal SRT based on an operator's preference or based on nitrification kinetics (i.e., smart SRT) to control WWTP operation and meet desired treatment objectives. Additionally, this control system offers two control modes (MLSS, Time) to optimize process operation.

Implementation of the OSCAR SIMS control system at a conventional activated sludge plant in Black River Falls, Wisconsin automatically maintained operator desired SRT and smart SRT to meet treatment objectives.

Plant data

During the study, the aerobic basin MLSS concentration, WAS concentration, and WAS flow rate (Q) were recorded continuously using the OSCAR SIMS control system (Figure 1).

TEST PLANT: Black River Falls, Wisconsin
DESIGN FLOW: 0.86 MGD
TEST DATES: March-June 2015

PROCESS CONTROL SYSTEM

Before upgrade	• Manual wasting to control SRT (approximate volume/day)
After upgrade	• Smart SIMS controlled wasting to maintain operator-desired SRT, Auto SRT or MLSS

TEST PERIODS

Reference period	• Manual control of SRT
OSCAR control	• SRT control: smart SIMS controlled wasting to maintain operator-desired SRT • Smart SRT control: smart SIMS calculated SRT required for complete nitrification and controlled wasting to maintain that SRT

Laboratory analysis of MLSS and WAS concentration was also carried out five days per week to verify sensor readings.

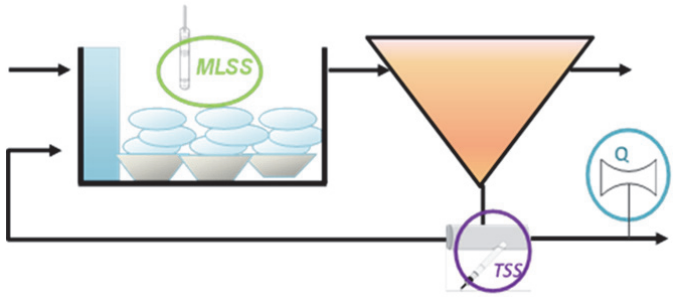

Figure 1: Location of sensors and flow meters.

OSCAR SIMS control system

During the reference period, the biomass was controlled manually by plant operators targeting an MLSS concentration by wasting an approximate volume of WAS per day. OSCAR SIMS control system was implemented on March 26th, 2015 in order to provide stable operation and meet treatment objectives. From March 26th through May 11th, the operator-selected SRT mode was implemented. From May 12th through May 31st, the smart SRT (automatically calculated based on nitrifiers growth rate or complete nitrification) mode was implemented.

Operator desired SRT control

During the reference period, the daily calculated SRT varied from 8 to 21 days (Figure 2). Results illustrated in Figure 2 show that the OSCAR SIMS control system maintained the operator desired SRT setpoint of either 14 or 12 days. This smart control system automatically adjusted WAS mass wasting rate to keep stable operator-desired SRT to meet treatment objectives.

Smart SRT Control

During this operation period, the OSCAR SIMS control system calculated SRT based on nitrifiers maximum specific growth rate which is a function of basin dissolved oxygen (DO) and temperature.

Conclusions

This study showed that the OSCAR SIMS control system expertly adjusts WAS mass wasting rate to maintain operator-desired SRT and smart SRT, providing stable operation and maintaining desired treatment performance. Routine operator decisions are less critical but effective, routine maintenance is needed for successful, smart-process-control system operation.

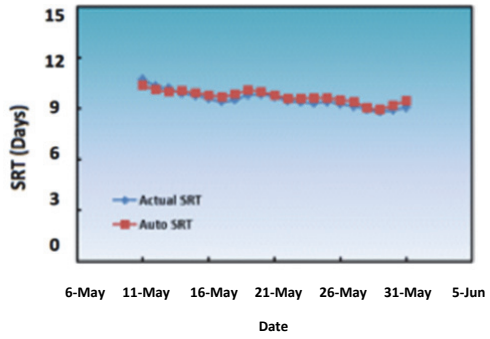

Figure 2: Auto SRT control over time. Results show that the OSCAR SIMS control system maintained SRT within ±5% of the calculated smart SRT set point while maintaining complete nitrification.

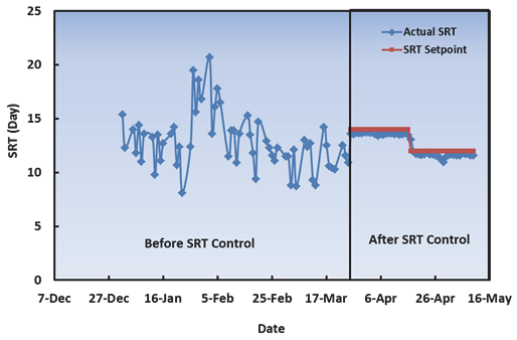

Figure 3: Operator desired SRT control over time.

Table 1: Treatment Performance

		Operator-desired SRT period	Smart SRT period
Avg. effluent NH4	mg/L	0.7	0.02

Effluent ammonia (NH_4) analysis (Table 1) showed that the average concentration was always less than the treatment goal of 1.0 mg/L.

"Historically, we ran our waste activated sludge pump manually for a certain period of time per day. We love the way the OSCAR SIMS control system is automatically controlling wasting based on our need, maintaining stable operation and providing superior effluent quality. Furthermore, we do not need to worry about WAS pump run time during work days, weekends or long weekends."

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