



SRTmaster™ White Paper

Real-time sludge age control: twenty years of full-scale results

Summary

The food-to-microorganism (F/M) ratio is the most important condition for an efficient activated sludge process, and sludge age, or solids retention time (SRT), is the practical way to hold it constant. Conventional wasting, calculated once or twice a day from laboratory samples, cannot hold sludge age precisely. SRTmaster calculates the waste flow in real time from on-line measurements. Since the first installation in 1996, plants using it have held sludge age within 5% of the setpoint, and within 2.5% most of the time, and have recorded higher secondary treatment capacity, better foam control, lower chemical use and lower laboratory workload.

1. Why sludge age matters

The waste flow is a small fraction of the influent flow, but small variations in it have a large effect on the process:

- **Too little wasting** can overload clarifiers, cause low F/M bulking and foaming, and raise air demand for endogenous respiration.
- **Too much wasting** can cause poor removal of soluble pollutants, low-DO bulking and, where the plant nitrifies, higher chlorine demand because nitrite is not fully removed.
- **Variation in wasting** changes the load on sludge thickeners, which increases polymer use and reduces thickening efficiency.

2. Why conventional wasting falls short

Conventional waste flow calculations rely on gravimetric suspended solids tests:

- a grab sample can differ significantly from the daily average because influent and return sludge flows vary;
- sampling is usually limited to once or twice a day, while the solids inventory changes continuously;
- the test takes two to four hours, so every adjustment is delayed;
- the average error of an individual test is about 5%;
- manual calculations are tedious, and errors in them affect the process.

3. The SRTmaster approach

A basic installation consists of two suspended solids analyzers, a waste flow meter, a flow control element (a valve or a variable-speed pump) and the SRTmaster controller, which runs on a Windows-based computer and communicates with the plant SCADA system using the standard OPC protocol. The control system has three parts:

1. **Data verification.** A pattern-recognition filter based on non-parametric statistics and machine-learning techniques removes erroneous readings. An activated sludge model detects suspended solids meter drift and alerts operators when recalibration is needed. Problems with flow meters, pumps or valves, and unusual changes in sludge inventory or wasted mass, are reported to operators.
2. **Calculation.** The waste flow is calculated continuously. The controller for each plant is designed with a calibrated activated sludge process model rather than by trial and error.
3. **Safeguard.** Before a waste flow is sent, the safeguard checks that it will not overload the clarifiers or sludge processing, underload sludge processing, vary excessively, or move the biomass inventory outside the range set by operators. A dedicated control function keeps the daily mass of wasted sludge nearly constant for the thickening facilities.

4. Instruments

Suspended solids analyzers perform well in open channels, wet wells or sampling sinks; in-pipe installations need full pipes, correct velocity and positioning, and effective self-cleaning. Electromagnetic waste flow meters must be installed with the straight runs their manufacturers specify. These instruments can be bought from any supplier. Ekster & Associates sells no hardware, but provides recommended performance specifications.

5. Field results

Control accuracy.

Sludge age has been held within 5% of the setpoint, and within 2.5% most of the time. At the Pomona Water Reclamation Plant of the Los Angeles County Sanitation Districts, the average SRT control error was 0.13 days, less than 2% (U.S. DOE final report).

Treatment capacity.

At Bellingham, Washington (14 MGD), precise SRT control reduced the 92nd percentile sludge volume index from 148 to 115 mL/g and increased secondary treatment capacity by 25%; the SRT control error fell from 0.5 days (15%) to 0.1 days (3%). At the Victor Valley Wastewater Reclamation Authority (18 MGD), the 95th percentile SVI fell from 225 to 138 mL/g and treatment capacity increased by 30%; the control error fell from 0.9 days (15%) to 0.15 days (2.5%).

Foam control.

Nocardia foaming was significantly reduced at Sacramento Regional (181 MGD), with similar results at San Jose/Santa Clara, Oxnard, San Francisco's Oceanside plant and East Bay Municipal

Utility District.

Effluent quality.

At Chico (12 MGD design), pin floc and intermittent nitrification problems were reduced, and chlorine dosage was reduced.

Chemicals and energy.

Polymer for sludge thickening was reduced by 25% at Oxnard. Combined with dissolved oxygen optimization, aeration energy savings of up to 25% have been reported.

Reliability and workload.

In the twenty years to 2016 there was no recorded incident of the controller acting on an erroneous input signal. Daily variability of wasted sludge mass fell from 23% to 3% of the daily average. Suspended solids meter calibration was reduced to one to three times per month, and laboratory suspended solids tests for process control by as much as 90%.

6. Operator authority

SRTmaster acts automatically, but operators keep authority. They set the sludge age target and operating limits, and can override the system at any time. Faulty readings are detected and not acted on, and operators are alerted with troubleshooting information. Every reading is checked before it is used.

7. SRTmaster and DO/Nmaster together

Low dissolved oxygen operation depends on a stable biomass. SRTmaster and DO/Nmaster share one architecture and operate together; at Pomona, sludge age was held within 0.13 days of the target as dissolved oxygen was lowered.

8. Next step

A free plant assessment estimates the benefits for a specific plant. Send one year of operating data and energy bills. You will receive a written estimate of savings in kWh and dollars, the assumptions behind it, any changes required before installation, and a fixed price. If your plant is already operating efficiently, the estimate will say so.

References

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5. Moise, M. and Norris, M. (2005). Process Optimization and Automation Improves Reliability and Cost Efficiency of Oxnard WWTP. *WEFTEC 2005*.
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