WATER TREATMENT PLANT SOLIDS BALANCE MODEL

Surface Water Treatment Plant Solids Mass Balance and Process Optimization Model



Benefits of a Solids Mass Balance Tool

This key dashboard tool of the Blue Plan-it[®] Decision Support System is designed for solids mass balance for surface water treatment plants. This tool supports several types of analysis, including but not limited to:

- Tracking the whole plant water and solids mass balance, including all recirculation streams.
- Calculating the Unit Solids Production Rate (USPR), based on raw water quality (turbidity, suspended solids and TOC), and chemical doses (coagulants, polymers, PAC), using built in equations.
- Sizing the solids handling facilities (e.g., clarifiers, EQ basin, thickeners, dewatering facilities, storage, etc.) based on default and adjustable parameters (e.g., hydraulic loading rates, solids loading rates, standard equipment sizing, etc.).
- Guiding users to perform virtual experimentation of their systems with friendly animated warning messages.
- Evaluating alternative dewatering technologies (e.g., mechanical dewatering versus drying beds or lagoons).

- Determining the required number of centrifuges or belt filter presses required and the anticipated operation hours to optimize solids handling facility design and operation.
- Determining the sizes of raw water impoundment, and thickened and dewatered solids storage.
- Performing dynamic capital and O&M costs estimates that vary with inputs on flow, water quality, design and operational parameters, etc.
- Simulating and optimizing complex continuous operation and operations with discrete event nature (see back side for more details).
- Empowering the users to perform what-if analysis, sensitivity analysis, Monte Carlo simulation, and multi objective optimization in one platform.
- Expanding to include a liquid stream operation simulation and optimization for DBP mitigation (see other fact sheets for more details).

"Carollo introduced us to Blue Plan-it[®] when we were discussing solids handling for our 320-mgd WTP expansion projects. The Blue Plan-it[®] model combined easy-tounderstand visual graphics with a computational engine running real-time in the background. This allowed the City to quickly understand all of Carollo's assumptions and instantly showed us the impacts of changing a variety of inputs and operational constraints. The result was an incredibly powerful tool that helped us better understand cause and effect relationships throughout the WTP, which resulted in one of the most productive meetings that we had on the project. I highly recommend the use of Blue Planit® and have requested this tool to be incorporated not only into the expansion, but retrofitted for the existing 80-mgd plant."

> — Drew Molly, P.E., Assistant Director, Drinking Water Operations, City of Houston



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Extended Time Simulation

The ability to perform extended time simulation with or without Monte Carlo simulation is especially critical to determine the optimal quantity and size of solids handling and storage facilities (e.g., raw water impoundment, pre-sed basins, sedimentation, thickeners and dewatering units, solids storage, etc.) The facility sizing depends on not only how high each raw water turbidity spike is, but also how long it could last. For example, the number of mechanical dewatering units could be reduced if the facility has an optimal volume of thickened sludge to store excessive amount of solids for a short period of time during a high turbidity event.



Our advanced solids balance model assesses the level and duration of turbidity spikes to optimize solids handling and storage facilities.

Complex Operation Simulation

A unique prioritization module was developed in the Blue Plan-it® Decision Support System to simulate complex operation process. It was originally designed to simulate how to operate a number of washwater recovery lagoons. In this example, each lagoon is fed until the maximum solids loading rate of 4 lbs/sf is reached. After the first layer is dried to 40% or higher, the washwater recovery lagoons can receive another 4 lbs/sf solids on top of previously dried layer without rehydration. This procedure can be repeated multiple times until the percolation through the dried layers decreases significantly. Due to the complexity associated with the multi-layer operation sequence, in conjunction with seasonal variations in solids drying and the discrete nature of various operation events, this type of operation is extremely difficult to evaluate using the conventional steadystate analysis in an EXCEL spreadsheet.

However, as shown in the figures below, the prioritization module easily simulates the washwater recovery lagoon operational cycles on a weekly basis over multiple years. The model utilized a series of drying curves obtained from field testing to project the solids concentrations over time. It also conducts a net present value (NPV) analysis based on solids concentrations, radioactivity classification, and associated landfill disposal costs.

The prioritization module can be applied to simulate the operation of drying beds and evaporation ponds. It can be used to track filter backwash or clarifier blowdown schedule and optimize the operation of multiple mechanical dewatering units. This tool could also be applied to simulate and optimize operations of multiple tanks and reactors (e.g., fill, settle, draw and decanting cycles) as well as solid storage and hauling.



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