The objective

In 1975, the Green Bay Metropolitan Sewerage District (GBMSD) wastewater treatment facility became the first plant in the nation to simultaneously treat municipal and pulp mill wastewater. A major upgrade and expansion, in the early 1990s, brought improved ammonia removal efficiency to the activated sludge facility as well as dechlorination of effluent. Covering nearly 60 acres of land, the treatment processes include primary treatment, aeration, activated sludge, secondary clarification, nitrification/denitrification and disinfection.

In addition to serving the city of Green Bay, the GBMSD facility serves 12 other communities and the Oneida Tribe of Indians of Wisconsin. Two paper mills, Fort James Cooperation and Proctor & Gamble Products Company, are also important contract customers of GBMSD. Current plant flow averages approximately 32 mgd, comprised of about 2/3 domestic flows and 1/3 paper mill wastewater.

Oxidative disinfection is the final stage of treatment (seasonal chlorination, May 1 to September 30) before effluent is discharged into the Fox River at the Bay of Green Bay. Formerly gaseous chlorine and now sodium hypochlorite is used to disinfect treated wastewater to meet a stringent effluent limit for fecal coliform of 400 MPN per 100 ml. Following disinfection, the water is dechlorinated using sodium bisulfite, and previously sulfur dioxide, to meet the plant’s chlorine residual discharge limit to zero.

The task

After power costs, chemical disinfection typically represents the single largest consumable expenditure at a municipal wastewater treatment facility, especially if dechlorination is performed. A reduction in chemical usage of just a few percentage points can add up to tens of thousands of dollars in annual savings at a large plant.

By 1997, the plant’s former chlorine system was approaching its 24th year of operation and becoming a problem prone. This, coupled with a desire to further improve safety for the facility’s employees and the surrounding community, prompted GBMSD management to switch to alternative disinfection chemicals in 1998.

Three key benefits of the Water Champ installation

- Reduction of chemical usage by 50 percent; significant cost savings
- Switch to safer chemicals; same technology for liquid or gas feed
- Efficient oxidative disinfection of wastewater
At the 32 mgd Green Bay Metropolitan Sewerage District (GBMSD) Plant in Green Bay, chemical use has been effectively reduced by 50 percent, representing substantial cost savings for the district. The major reduction in chemical usage is attributed primarily to the installation of a new submersible chemical induction system as part of a recent disinfection upgrade at the plant.

The old chlorine disbursement system was of conventional design, incorporating the use of injectors, diffusers, and mechanical paddle mixers to feed gaseous chlorine to flows entering the plant’s two contact chambers. Only one major component is used in the new system, however, and is the key to the system’s effectiveness – the submersible Water Champ chemical induction system that blasts chemicals directly into the process stream at velocities up to 60 ft/sec. Two Water Champs have been installed at the plant, one serving each chlorine contact chamber.

The chemical induction/mixing units operate on the simple principle of applying all available energy directly to the chemical being activated. The unit design includes a 15-hp submersible motor in a vacuum body with an airfoil design propeller at one end. Chemical solution is injected into the body of the unit and is dispersed into the channel and mixed simultaneously through this open propeller.

At the GBMSD facility, each unit has been installed just after the first turn of flow enters the contact chamber. The units are mounted to the bottom of each contact chamber and positioned horizontally in the center of the 12.5 ft wide channel. From the sodium hypochlorite day tanks, two ½ hp (80 ghp max.) pumps feed to chemical lines leading to the mixing units. Because chlorination is a seasonal procedure, the units are easily removed for annual maintenance using a stainless steel guide rail and hoist.

Positioned in the center of the flow regime, the mixer provides for countercurrent mixing at a high velocity gradient across the entire width of the channel. The submerged mixer generates high zone diffusion and a high turbulence region extending across the entire channel as sodium hypochlorite is simultaneously dispersed. Flows passing the mixing area make contact with turbulence and distributed chemical, providing for a high rapid mixing rate.