Improving The Economics Of Wastewater Treatment

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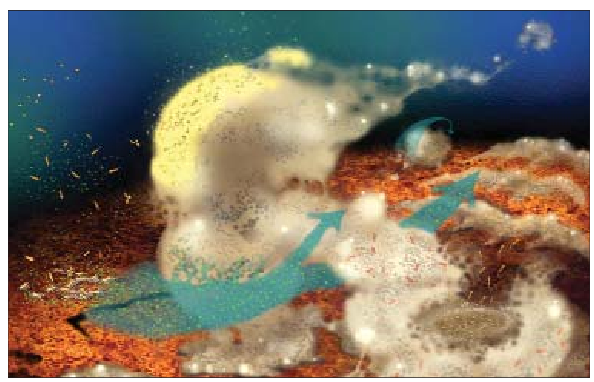
Municipalities around the world face similar challenges as they work to diligently serve the public. They collectively face the task of treating growing volumes and organically loaded wastewater produced by increasing population and industrial growth. This is often coupled with environmental pressures to improve plant performance and improve water quality either for direct discharge or beneficial water reuse applications. These growing demands must be met with an aging infrastructure and a tightened or reduced budget. User-fee increases are viewed as political suicide. However, public expectations for improved performance and services continue to escalate despite the universal push towards reducing taxes and, therefore, municipal budgets. Capital investments in new infrastructure are particularly difficult to fund, and cities often find themselves unable to borrow the money required to build or repair the required facilities. These economic dynamics are particularly manifested in the public utilities department and are especially acute in the area of wastewater treatment.

Most wastewater managers believe that treatment starts at the headworks. The collection system is viewed as simply a means to transport the wastewater to the treatment facility. The capital and operation and maintenance (O&M) costs associated with the collection system can be a very large portion of the utilities department budget. There are many hours, if not days, of residence time in the collection system that, up until now, have been nonbeneficial to the treatment process. In fact, the indigenous biological growth within the collection system is generally detrimental to the treatment objectives at the WWTP. In an effort to combat this residence time, one company has developed a technology and service that converts the existing passive collection system into a meaningful treatment step prior to the water arriving at the wastewater treatment facility.

The technology involves the introduction of a proprietary formulation of naturally occurring, facultative, planktonic bacteria into the outermost reaches of a municipality's collection system. With continuous dosing, the beneficial bacteria become the dominant organisms. Within a period of time, the added bacteria convert the biofilm on the walls of the system piping into a controlled, beneficial biological population, creating a pretreatment reactor that selectively inhibits the growth of the sulfate reducing bacteria (SRB) that are odor causing. They also metabolize fats, oil, and grease (FOG) in the collection system and at the treatment plant. This collection system biofilm reactor provides beneficial treatment in the collection system by accelerating metabolic conversions and thereby reduces organic, nitrogen, and solids loads entering the WWTP.

The microbiological treatment for a system is carefully engineered and driven by such factors as organic and solid loads, time of year, distribution, hydraulic flow in sections, and weather, among others. Simple, battery-powered, dosing panels are installed at numerous strategic locations in the collection system and precisely administer bacterial dosing. Each panel contains a replaceable liter bottle of the bacterial consortium that can provide time-controlled treatment for as long as 90 days.



Schematic of biofilm growing on pipe surface courtesy of CBE

By using the collection system as a biofilm reactor, considerable WWTP efficiencies are realized. Solids are broken down in the collection system into more readily biodegradable food sources for the bacteria. BOD and COD are reduced in the sewer by as much as 40% and the fraction of BOD/COD that is readily biodegradable is increased. Decreases in the organic loading and the fact that there is more bioavailable carbon can be directly correlated to reductions in aeration energy input required in the activated sludge process. Further, facultative organisms by nature use oxygen more efficiently than nontreated influent biomass, resulting in more aeration reductions. The overall result is substantial energy reductions in the activated sludge system.

The city of Lakeland, FL has been using this technology in the collection system since early 2001. The original goal of the project was to control odor in trouble spots within the collection system. As a result of this treatment, Lakeland reduced the influent BOD loading by 30% and influent TSS loading by more than 38% after taking into consideration documented growth of both the domestic and industrial inputs to the collection system during the past six years. To further make the case for bioaugmentation in the sewer, the city of Lakeland was able to reduce its sludge age by nearly 50% and still achieve superior effluent performance. Through reductions in the influent load and reduction of the SRT, this plant was able to decommission one of three activated sludge trains, effectively reducing their energy usage by 33%.

Lakeland has an industrial surcharge program that charges industrial customers $0.27 per pound of BOD and $0.17 per pound of solids. This results in a cost-effective method to treat the industrial load.

The city of Jackson, MS has been using this technology since 2002 and had complete system coverage since 2006. The sludge yield out of the Savannah WWTP has decreased from 0.66 # waste activated sludge (WAS) produced/# chemical oxygen demand (COD) removed to 0.41 # WAS produced/# COD removed. When adjusted for a 5% flow increase, this is a 40% reduction in WAS. With a reduction of WAS going to the digesters, the plant gains more retention time in the digesters thereby reducing the overall sludge generated for ultimate disposal. This will also reduce polymer usage for drying and sludge handling equipment. With all this in consideration, it is easy to see how this significantly reduces the cost of wastewater treatment and sludge disposal and increases the capacity of the existing infrastructure, potentially deferring capital expenditures.

Slidell, LA is a project sponsored by the Louisiana Department of Environmental Quality for sludge reduction and energy savings. After only six months of operation, the aeration time (kW-h) in the activated sludge process has been reduced by 28% as a result of influent loading reductions of 24% BOD and 37% TSS. Sludge production has been reduced by 19%

G2 Panel (closed)

G2 Panel (installed in pump station)

G2 Panel (installed in ground)

although this value will increase considerably as the project gains age and the bioaugmentation gains dominance throughout the collection system and digesters.

As a final example, the city of Greenville, MS has been using this technology to reduce energy consumption and sludge production in its aerobic digesters. The facility is rated at 6.0 mgd. Because the treatment utilizes facultative organisms, the air in the digester has been turned off, except for about 5% per day for mixing. This facility has a 500 hp blower that has been shut down, resulting in a savings to the city of more than $276,000 per year. This does not include savings from the reductions in sludge production, drying, or ultimate disposal.

Through the use of bioaugmentation in the collection systems, cities around the world can improve the efficiency of their WWTPs. Reductions of loading, reductions of aeration requirements, and reductions of sludge production and quantities for disposal all combine to reduce the cost of treatment. They also reduce the overall environmental impact, minimizing the 'green footprint' of these facilities. As an additional benefit, odor and FOG deposits are controlled throughout the collection system.

It has been estimated that wastewater treatment consumes approximately 3% of the United States' electrical consumption. This technology can make a 20% to 30% reduction in energy consumption and will have a significant and favorable impact on the overall 'green footprint.'

About The Author

Dan Williamson has been employed with In-Pipe Technology Company since he cofounded the company in 1999. Williamson studied biochemistry, cellular biology, and molecular genetics. Williamson has been involved in the purification and wastewater treatment industries since 1980. In-Pipe Technology Company is generating technical data confirming biochemical impacts on the wastewater process, specifically regarding nutrient removal, energy savings, and increased plant capacity. As president of In-Pipe, Williamson is responsible for global brand building, as In-Pipe has continued expansion from its home base in Illinois.