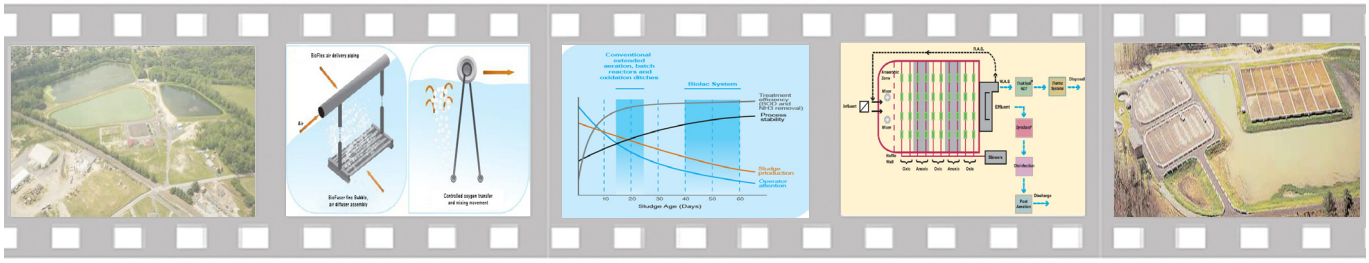
Extended Aeration Treatment System



This article discusses an innovative activated sludge process using extended retention of biological solids to create an extremely stable, easily operated system.

By Parkson Corporation

Extended Sludge Age Biological Technology

The Biolac® system is an innovative activated sludge process using extended retention of biological solids to create an extremely stable, easily operated system. The capabilities of this unique technology far exceed ordinary extended aeration treatment. The process maximizes the stability of the operating environment and provides high efficiency treatment. The design ensures the lowest cost construction and guarantees operational simplicity.

The system utilizes a longer sludge age than other aerobic systems. Sludge age, also known as SRT (Solids Retention Time) or MCRT (Mean Cell Residence Time), defines the operating characteristics of any aerobic biological treatment system. A longer sludge age dramatically lowers effluent BOD and ammonia levels, especially in colder climates. The systems long sludge age process produces BOD levels of less than 10 mg/L and complete nitrification (less than 1 mg/L ammonia). Minor modifications to the system will extend its capabilities to denitrification and biological phosphorus removal.

While most extended aeration systems reach their maximum mixing capability at sludge ages of approximately 15 to 25 days, the Biolac® system efficiently and uniformly mixes the aeration volumes associated with a 30 to 70 day sludge age.

The large quantity of biomass treats widely fluctuating loads with very few operational changes. Extreme sludge stability allows sludge wasting to non aerated sludge ponds or basins and long storage times.

Aeration Components

Simple Process Control & Operation

The control and operation of the process is similar to that of conventional extended aeration. Parkson provides a very easy to use system to control both the process and aeration. Additional controls required for denitrification, phosphorus removal, dissolved oxygen control and SCADA communications are also easily implemented.

Aeration System Components

The ability to mix large basin volumes using minimal energy is a function of the unique BioFlex moving aeration chains and the attached BioFuser® fine bubble diffuser assemblies. The gentle, controlled, back and forth motion of the chains and diffusers distributes the oxygen transfer and mixing energy evenly throughout the basin area. No additional airflow is required to maintain mixing.

Stationary fine-bubble aeration systems require 8-10 CFM of air per 1000 cu. ft. of aeration basin volume. This system maintains the required mixing of the activated sludge and suspension of the solids at only 4 CFM per 1000 cu. ft. of aeration basin volume. Mixing of a Biolac® basin typically requires 35 to 50 percent of the energy of the design oxygen

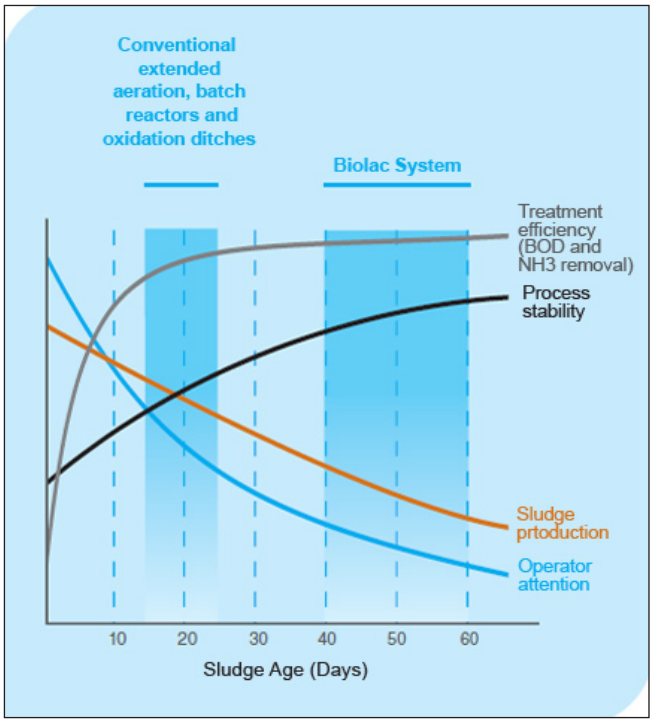


Figure 1: Sludge Age

requirement. Therefore, air delivery to the basin can be reduced during periods of low loading while maintaining effective food to biomass contact and without the risk of solids settling out of the wastewater.

System Construction

A major advantage of this system is its low installed cost. Most systems require costly in-ground concrete basins for the activated sludge portion of the process. This system can be installed in earthen basins, either lined or unlined. The fine bubble diffusers require no mounting to basin floors or associated anchors and leveling. These diffusers are suspended from the BioFlex floating aeration chains. The only concrete structural work required is for the simple internal clarifier(s) and blower/control buildings.

Biological Nutrient Removal

Simple control of the air distribution to the BioFlex® chains creates moving waves of oxic and anoxic zones within the basin. This repeated cycling of environments nitrifies and denitrifies the wastewater without recycled pumping of mixed liquor or additional external basins. This mode of Biolac® operation is known as the Wave Oxidation process. No additional in-basin equipment is required and simple timer-operated actuator valves regulate manipulation of the air distribution. Biological phosphorus removal can also be accomplished by incorporating an anaerobic zone.

Type "R" Clarifier

Land space and hydraulic efficiencies are maximized using the type "R" clarifier. The clarifier design incorporates a common wall between the clarifier and aeration basin. The inlet ports at the bottom of the wall create negligible hydraulic headloss and promote efficient solids removal by filtering the flow through the upper layer of the sludge blanket. The hopper-style bottom simplifies sludge concentration and removal, and minimizes clarifier HRT. The sludge return airlift pump provides important flexibility in RAS flows with no moving parts. All maintenance is performed from the surface without dewatering the clarifier.

Case Study I

The Town of Laurel is located in Sussex County in southwest Delaware. The town of approximately 4,000 people is mostly residential and situated between Seaford, DE and Salisbury, MD. Prior to the upgrade, the town utilized a 0.5 MGD lagoon treatment system for their wastewater. Effluent from the treatment facility discharges into Broad Creek, which is a tributary of the Nanticoke River and then to the Chesapeake Bay.

Challenge

In order to reduce nutrient discharges into the Chesapeake Bay, wastewater treatment plants of significant size surrounding it have been charged with upgrading their facilities with established Enhanced Nutrient Removal (ENR) systems. The Chesapeake Bay is the largest estuary in the US and has a significant problem with nitrogen and phosphorous. There has been an ongoing and increasing effort to reduce nutrient discharge into the Bay since the 1980's.

The Chesapeake 2000 Agreement established ENR limits of 5 mg/L of Total Suspended Solids (TSS), 3 mg/L Total Nitrogen (TN) and 0.3 mg/L Total Phosphorus (TP), for wastewater plants discharging into Bay tributaries.

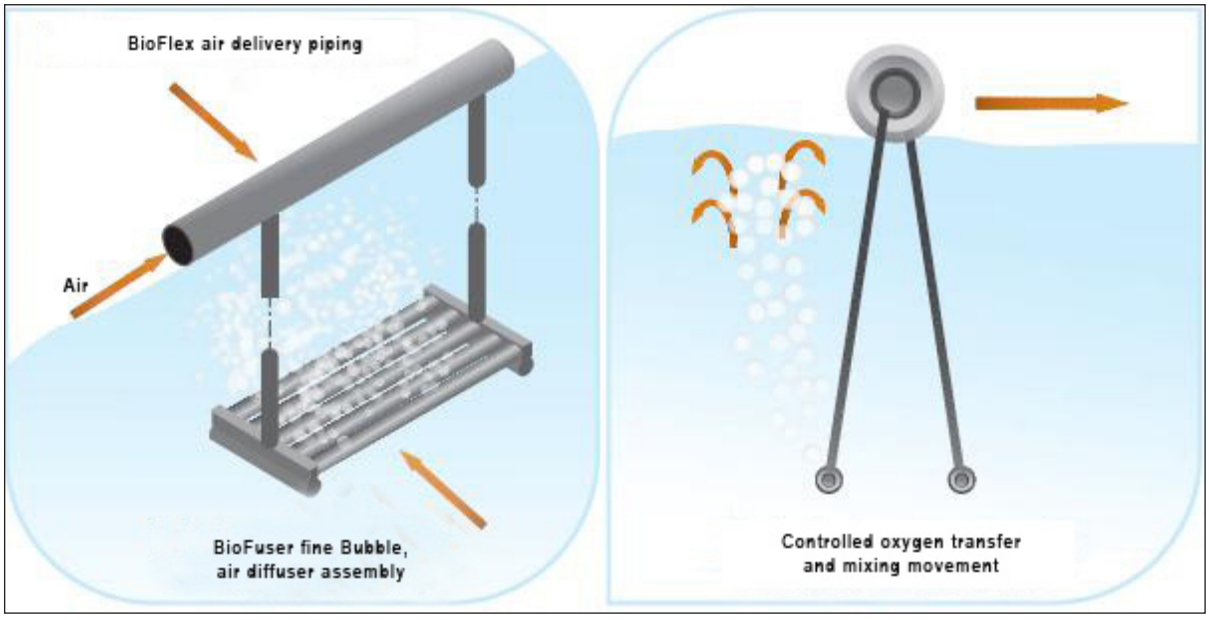


Figure 2: Fine Bubble Diffuser Mechanism

Solution

In order to improve effluent quality to protect the Bay and add capacity for growth, the town planned an upgrade to a 0.7 MGD ENR compliant plant with capacity to process 21,000 gpd of screened septage (partially treated waste stored in a septic tank). George, Miles & Buhr Engineers in Salisbury, MD were tasked with designing the upgrade of the wastewater treatment facility.

The project was funded by the Delaware Water Pollution Control Revolving Fund, which is supported by the Delaware Department of Natural Resources and Delaware Division of Water Resources. After consideration of the best solutions, including extended aeration and oxidation ditches, the project was designed and bid based around Parkson Corporation's Biolac® Wastewater Treatment System and DynaSand® Filter technology.

The design ensures the lowest cost construction and guarantees operational simplicity. The DynaSand® Filter, on the other hand, is an upflow, deep bed, granular media filter with continuous backwash. Its internal washing system makes maintenance simple and demands low energy consumption.

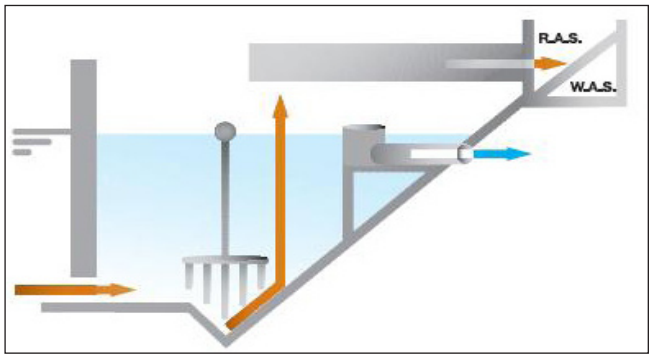


Figure 3: Type "R" Clarifier

Figure 4: Aerial view of the Laurel, DE Wastewater Treatment Plant

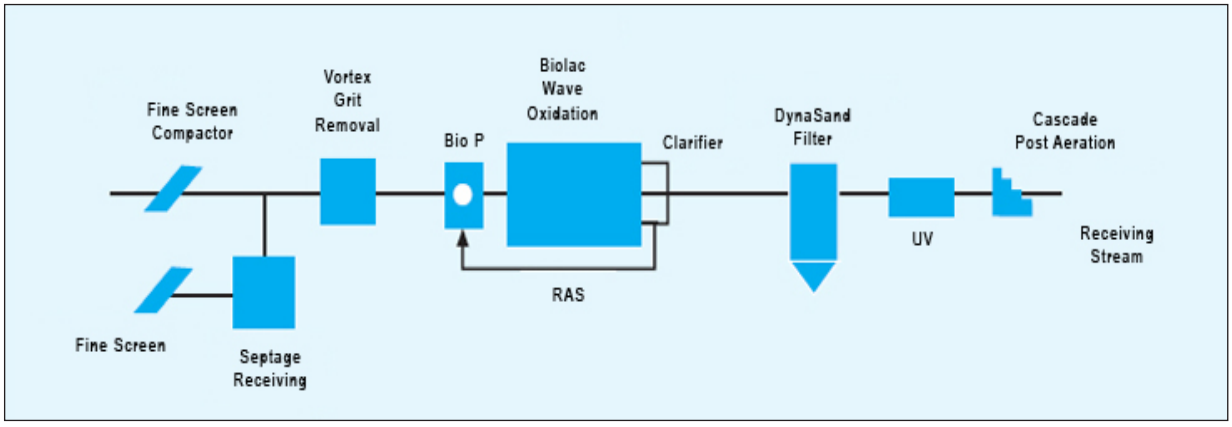


Figure 5: Laurel Wastewater Treatment Process

Similar performing biological ENR systems in the area have been awarded based on other technologies for over $16.40 per influent gallon while the system designed around Parkson cost the town only approximately $11.43 per gallon.

Biological Nutrient Removal

The secondary process at Laurel is the Biolac® System Wave Oxidation with Nutrient Removal Process. This extended aeration process (SRT>50 days) includes an anaerobic selector for initial biological phosphorous removal. Raw influent and return activated sludge are combined in this zone under anaerobic conditions prior to discharge into a single extended aeration basin.

The extended aeration basin construction is compacted earth with sloped walls and a synthetic liner. The aeration system consists of floating aeration headers (chains) with automated valves. The aeration chains are controlled to create moving zones of oxic and anoxic conditions within the single basin to facilitate nitrification and denitrification. The movement of the aeration chains also maintains complete mixing of the basin contents at lower airflow rates allowing greater turndown during periods of low loadings. Integral to the extended aeration process are two parallel secondary clarifiers. Excess biological solids are wasted out of the process and can be pumped to one of the former treatment lagoons due to the high degree of biological stability.

Enhanced Nutrient Removal (ENR)

The tertiary treatment step at Laurel encompasses final filtration, denitrification and phosphorous polishing. The treatment system utilizes the Parkson DynaSand® Continuous, Upflow, Granular Media Filter along with Parkson's patented ENR control and instrumentation system.

The ENR control system consists of a multi-parameter, on-line analyzer, a PLC control system and a sampling manifold with instrumentation to support the process. All measured parameters are monitored by the PLC control system. Readings from the on-line unit and instruments are used by the PLC to optimize chemical feed pumps for both external/supplemental carbon and coagulant.

The final effluent low in nitrogen, phosphorous, BOD and suspended solids is discharged from the filters to UV disinfection. Filter backwash is returned to the head of the plant for reprocessing.

	BOD mg/l	TSS mg/l	TKN mg/l	TN mg/l	NO3 mg/l	P mg/l
Influent	140	176	65.33	71.06	5.7	7.6
Effluent	6.4	2	0.76	1.75	0.84	0.17
Specification	12	5	N/A	3	N/A	0.3

Figure 6: Treatment Plant Performance For May '09

Results

The plant has been operating since July of 2007. It is currently loaded significantly below the design. The system utilizes the built-in flexibility of the Biolac® System Wave Oxidation Nutrient Removal Process design to manipulate DO levels to optimize nitrification and denitrification. In spite of the significant under loading, the facility is able to produce the specified effluent.

Case Study II

The City of Denton Maryland operates a 0.8 MGD wastewater treatment plant to serve its population of 3,000. The plant was designed to handle growth and pending regulations for nutrient removal.

Problem

The State of Maryland, in conjunction with other States discharging effluent into the Chesapeake Bay, was drafting tough standards to reduce the level of nutrients being discharged into this ecologically fragile, slow moving estuary. In preparation for meeting these standards, the City of Denton and their consulting engineer, Buchart Horn of Baltimore MD and York, PA, began incorporating nutrient removal into their plans for a new wastewater treatment plant.

Solution

The City installed a two-basin Biolac Wastewater Treatment Plant. This long sludge age process creates a very large, stable biomass capable of treating widely fluctuating loads with few

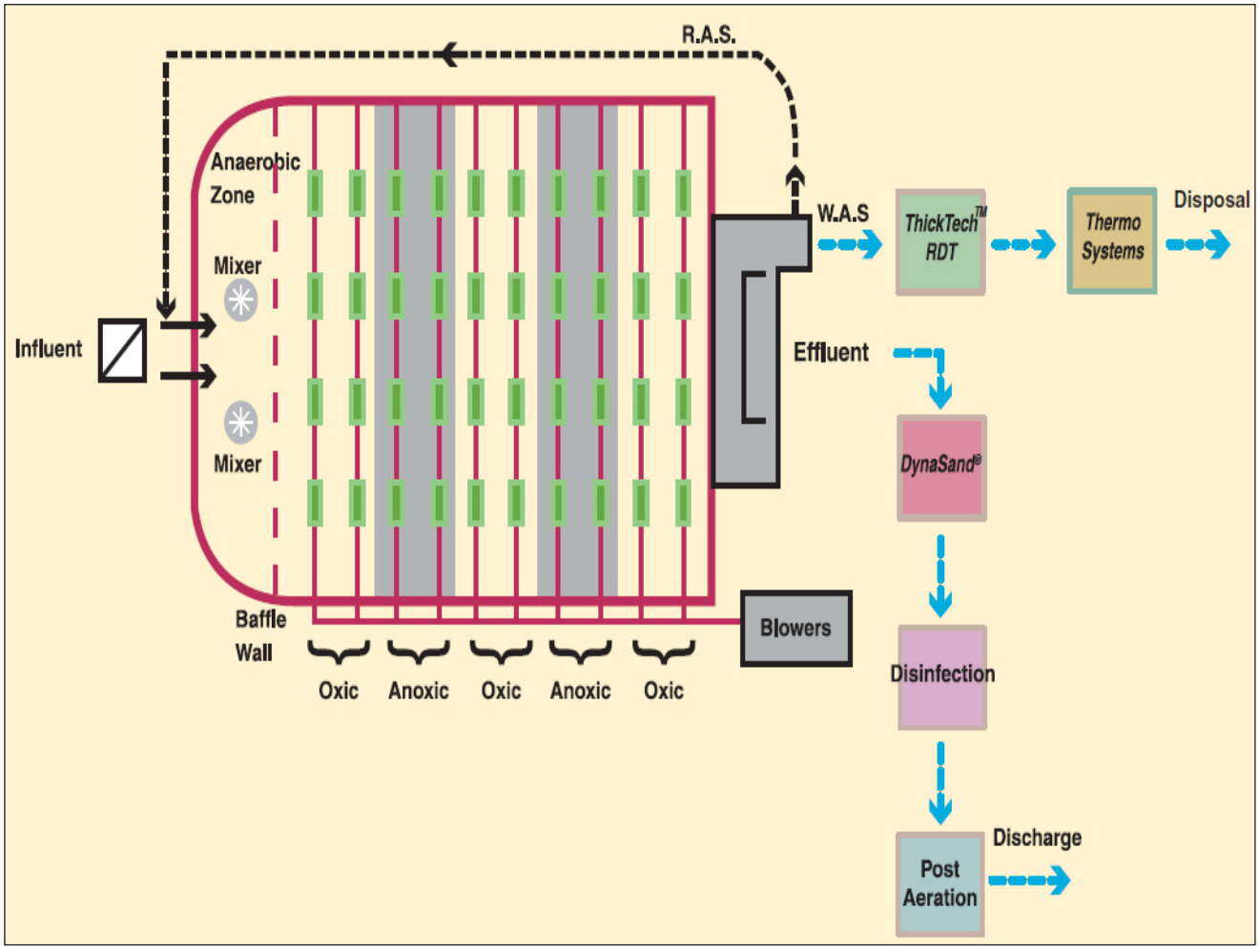


Figure 7: Wave Oxidation - Biological Nutrient Removal

Figure 8: Aerial view Of The Denton Wastewater Facility

operational changes. At this time, only one Biolac basin is in use. Not only is the basin providing secondary treatment for biodegradable organics, it is also operating as a Wave Oxidation System to reduce nitrogen to levels acceptable for discharge into the Bay.

The Wave Oxidation process regulates air distribution creating moving waves of oxic and anoxic zones within the Biolac basin. This repeated cycling nitrifies and denitrifies the wastewater. The process requires little operator attention; the results are optimal; and the reliability is unparalleled.

Results

Denton has been operating its wastewater facility since 2000 with reliable and consistently excellent results. The plant routinely achieves effluent BOD and TSS levels well below 10 mg/L. In addition, effluent total nitrogen is often below 3 mg/L and consistently below 6 mg/L.

About The Article

This article has been contributed by Parkson Corporation, a leading provider of advanced solutions in water recycling and treatment. Headquartered in Fort Lauderdale, with offices in Chicago, Montreal, Dubai and partners in Latin America and India, Parkson is an Axel Johnson Inc. company. Ashutosh S. Vakharkar is the Technical Leader- Sales and Business Development, Parkson India. He can be reached at: AVakharkar@parkson.com. www.parkson.com