

CASE STUDY

DynaSand® EcoWash™
Laurel, DE



DynaSand® EcoWash™ Enhanced Nutrient Removal Filtration System at Laurel, DE

The customer

The town of Laurel is located in Sussex County in southern Delaware. The town of approximately 4,000 people is mostly residential. The wastewater treatment plant discharges into the Broad Creek, which is a tributary of the Nanticoke River and then to the Chesapeake Bay.

The challenge

The Chesapeake Bay is the largest estuary in the US and has a significant problem with high levels of nutrients such as nitrogen and phosphorous.

In an effort to eliminate the nutrient excess in the bay, the Chesapeake 2000 Agreement established Enhanced Nutrient Removal (ENR) limits for wastewater plants discharging into the bay tributaries of 5 mg/L of Total Suspended Solids (TSS), 3 mg/L Total Nitrogen (TN) and 0.3 mg/L Total Phosphorus (TP).

The Wastewater Treatment Plant (WWTP) at Laurel, DE was required to upgrade their existing facultative lagoon system to an ENR capable system to meet the new regulations established for the Chesapeake Bay watershed. The new permit requirements at Laurel WWTP are based on Total Mass Daily Loading (TMDL) for Total Nitrogen (TN), Total Phosphorous (TP), Biological Oxygen Demand (BOD), and Total Suspended Solids (TSS). The TN limit is 33 lbs/day and the phosphorous limit is 8.4 lbs/day based on a design flow rate of 0.7 MGD and 21,000 gpd of screened septage.

The journey

George, Miles and Buhr Engineering (GMB) in Salisbury, MD was selected to design the ENR upgrade at Laurel WWTP. The project was partially 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 many possible solutions, including extended aeration and oxidation ditches, the project was designed and bid based around Parkson Corporation's Biolac® treatment system and DynaSand® filter technologies because it provided the most cost effective and simple solution.

Similar performing biological ENR systems in the area have been awarded based on other technologies for over \$16.40 per influent gallon. The system designed around Parkson's ENR system cost the town only approximately \$11.43 per gallon, or 30% less than other systems.

The upgrade included a fine screening system, a forced-vortex grit removal system, a Biolac® with the Wave Oxidation (WaveOx) modification system for biological treatment with fermentation zone for phosphorous removal and twin parallel integral clarifiers. The secondary effluent is taken into a DynaSand® ENR filtration system, followed by UV disinfection process and cascade post aeration as the last process.

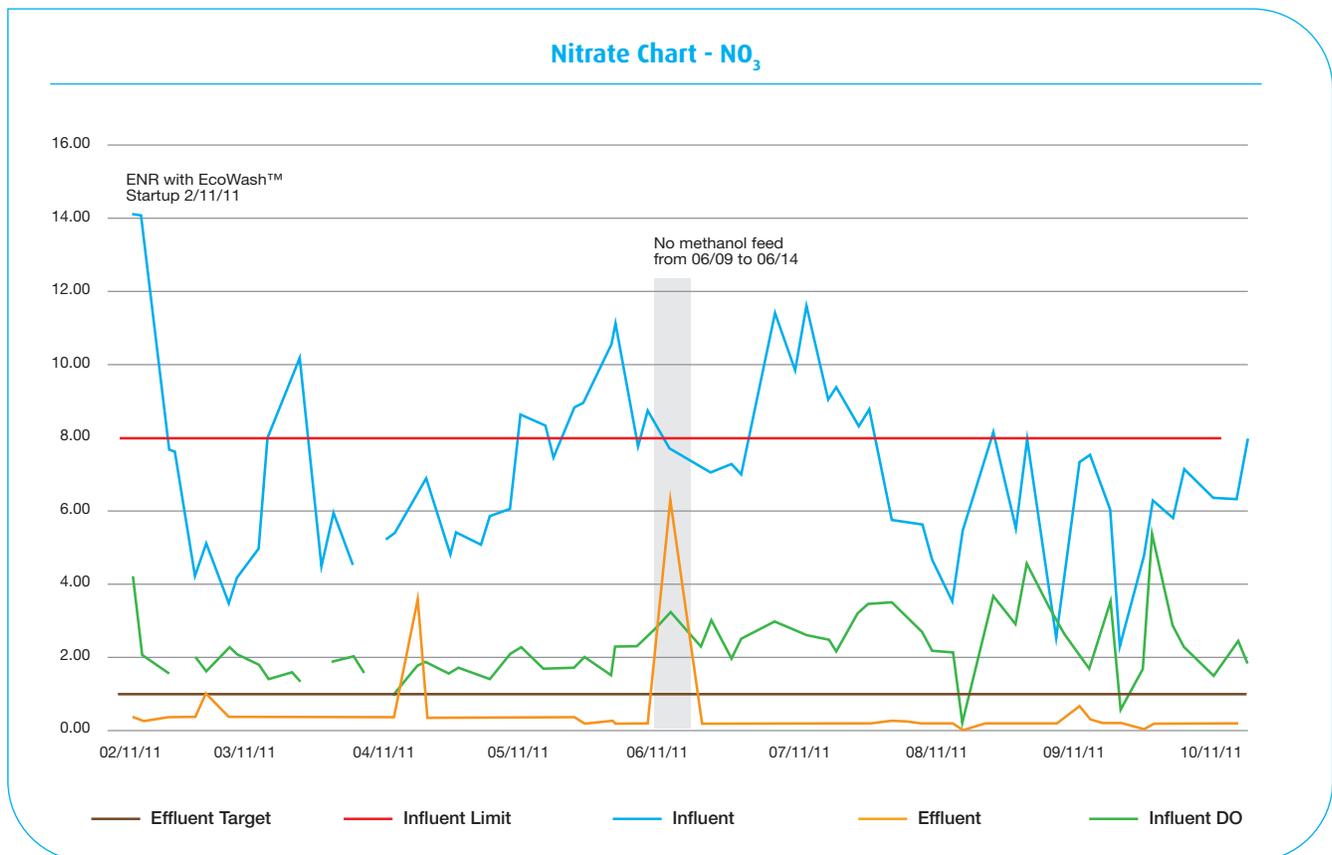
The Parkson Biolac® WaveOx system is an extended aeration process (SRT 30-50 days) which includes an anaerobic fermentation BioP zone for biological phosphorus removal. Raw influent and return activated sludge are combined in this zone under anaerobic conditions prior to discharge into a single extended aeration basin. Integral to the Biolac® extended aeration process are two parallel secondary clarifiers. Excess biological solids are wasted out of the Biolac® process and are pumped to one of the former treatment lagoons without additional treatment. There are no odors due to the high degree of biological stability of the sludge.

The DynaSand® ENR filtration system is designed to polish the effluent from the Biolac® WaveOx to remove nitrate and phosphorous in one step, meeting the ENR effluent requirements. The DynaSand® ENR filtration system consists of two (2) cells with three (3) modules per cell. Each module has 50 ft² of filtration surface area, providing a total of 300 ft² of filtration area. The DynaSand® ENR also includes a ChemScan nutrient analyzer to monitor influent and effluent nitrate, phosphate, ammonia, and nitrite. Additional instrumentation is provided to monitor influent DO, effluent ORP, pH, and turbidity. The ENR upgrade was completed in 2007, accomplishing the target effluent limits of the plant.

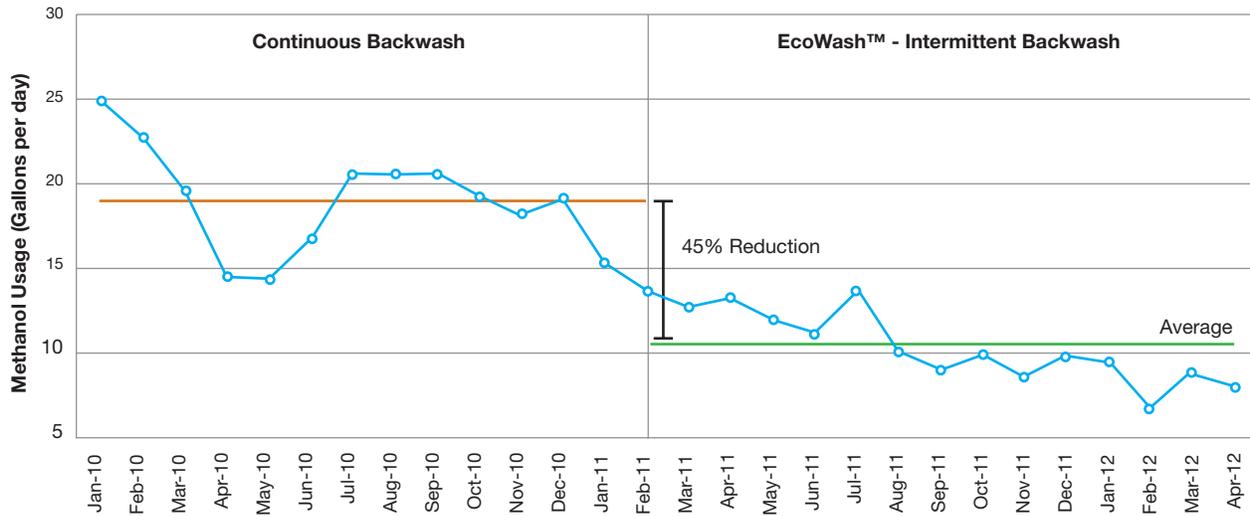
In 2010, Parkson developed the DynaSand® EcoWash™ system, which improves the DynaSand® filter by changing the continuous



backwash into an intermittent backwash process. The intermittent backwash allows solids to accumulate in the sand bed, creating a thin layer (known as Schmutzdecke) that reduces the voids between the sand grains improving the solids capture rate of the filter. The reduction of the sand washing frequency reduces the volume of reject water that has to be reprocessed through the plant, improving the efficiency of the DynaSand® filters. Additionally, the EcoWash™ system extends the life of the airlift pumps and reduces the energy consumption by reducing the air compressor running time and the reprocessing of the reject flow.



Laurel, DE WWTP - DynaSand® ENR Filtration System Methanol Consumption



Parkson and Laurel WWTP decided to test the EcoWash™ process at this plant to prove the advantages of intermittent versus continuous backwash for an ENR application in an up-flow filtration system.

The DynaSand® filters at Laurel were retrofitted from continuous to intermittent backwash in February 2011. The EcoWash™ retrofit of the existing units was easy to install, taking less than ten (10) business days to complete the conversion and start-up of the EcoWash™ process. This conversion included the installation of: new airlift pumps, automated reject valves, sand movement sensors (DynaSensor™), headloss sensor, and a new PLC control panel. The EcoWash™ retrofit also included minor modifications of the existing air control panels.

The discovery

The continuous backwash DynaSand® filter met the effluent requirements of the plant. However since the process is running at less than 50% design loading, the single-basin biological process upstream discharged high spikes of nitrates to the influent that would affect the effluent of the overall plant. In addition, the secondary effluent contributed high DO into the filters (between 4-6 mg/l), which inhibited the denitrification process in this anoxic biological process. To reduce the DO levels the engineers deemed it necessary to install a modulating valve between the clarifier and the filters, to flood the launders of the clarifier and reduce the cascade effect that was creating the DO addition in the secondary effluent.

Another complicating factor is that due to the low hydraulic loading to the tertiary filters and during the low flows at night, the reject

(continuous backwash) volume would range between 20 to 40% of the plants feed flow. This condition leads to a large backwash flow to be reprocessed through the biological process, reducing the overall efficiency of the plant.

In order to monitor the performance of the EcoWash™ system, an independent laboratory took samples twice a week from the influent and effluent of the DynaSand® filtration system. The plant laboratory also analyzed the same samples for the same parameters and kept records of the new filtration mode of operation. The online nutrient analyzer data was compared to this data to ensure that the system was properly calibrated.

The solution

The independent laboratory testing was conducted from February until October 2011 and then it was reinitiated from January to February 2012 to gather additional data during the winter season. The results showed that the DynaSand® EcoWash™ filter consistently provided effluent nitrate (NO₃-N) concentrations below detection limit of 0.2 mg/L even with instantaneous influent nitrate as high as 14 mg/l and 12 mg/l. For influent DO conditions as high as 5.5 mg/l, the DynaSand® EcoWash™ maintained an effluent nitrate of less than 0.2 mg/l. For the design and operation of a denitrification system, the addition of an external carbon source is required and is controlled to avoid BOD and COD increase at the filters. The results of the DynaSand® EcoWash™ show that the plant was able to reduce the methanol consumption by 45% versus continuous sand washing, taking the daily consumption from 19 to 10.5 gallons per day. The current methanol usage with the EcoWash™ system is equivalent to a ratio of 2.9:1 for methanol to nitrate, which

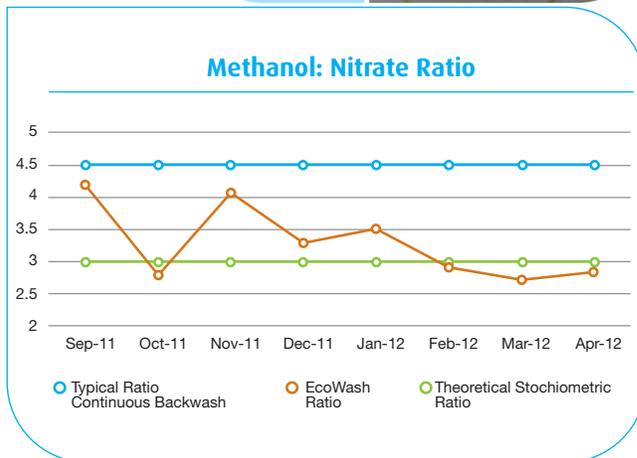
is the theoretical value from stoichiometric calculations. Also, the denitrification objectives were consistently met under sustained winter wastewater temperatures as low as 11°C.

The EcoWash™ also reduced the reject flow by 90% from 0.11 MGD to 0.01 MGD. The compressor running hours were also reduced by 90% from 20 to 2 hours per day. The reject flow at Laurel is pumped to the head of the plant by two reject pumps. The running time of the reject pumps was also reduced by 90%, bringing additional savings to the plant operation. The effluent flow of the plant is more consistent during low flow conditions since the backwash flow is active for 10% of the time.

Another significant advantage of the implementation of the EcoWash™ system is the life extension of the airlift pipe. Since the airlift wears out over time due to sand scouring during backwash, the reduction in backwashing time to 10% will extend the airlift life by as much as 10 times.

Lessons learned

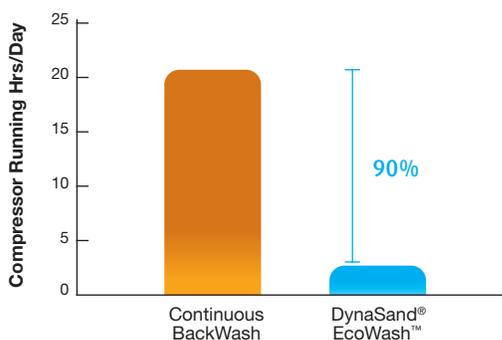
During the EcoWash™ start-up and acclimation period for the denitrification process, the frequency of backwash was set at four (4) hours of backwash OFF and 20 minutes of backwash ON. After a couple of weeks of operation at this backwash frequency, the filter started to develop septic conditions. The frequency of backwash was increased and the odor disappeared within a few days. It is recommended to have a more frequent backwash for ENR applications to avoid the possibility of any odors and septic conditions.



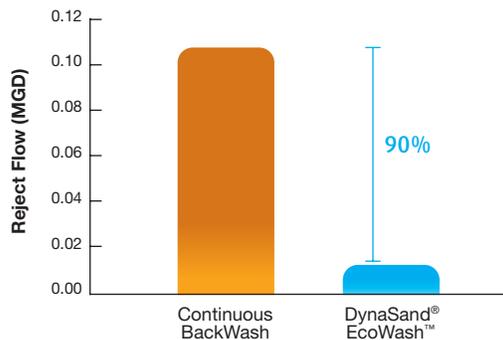
The results

Parkson and Laurel WWTP are very satisfied with the results obtained after the implementation of the EcoWash™ process at this existing DynaSand® ENR installation. The overall savings of the EcoWash™ implementation are \$50,000/year which account for savings of energy from the compressor and reject pumps, savings on reprocessing the backwash flow, airlift life extension, and methanol consumption. ■

Compressor Running Hours at Laurel, DE



Reject Flow Reduction at Laurel, DE



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