Adsorption Clarifier® Retrofit Improves Plant Operations

Westfield Updates Existing Trident® Package Plant

CASE STUDY

Location: **Westfield, New York**
Owner: **Village of Westfield-Benjamin Schwartz Water Treatment Plant**
Engineer: **Clark Patterson Lee**

Problem

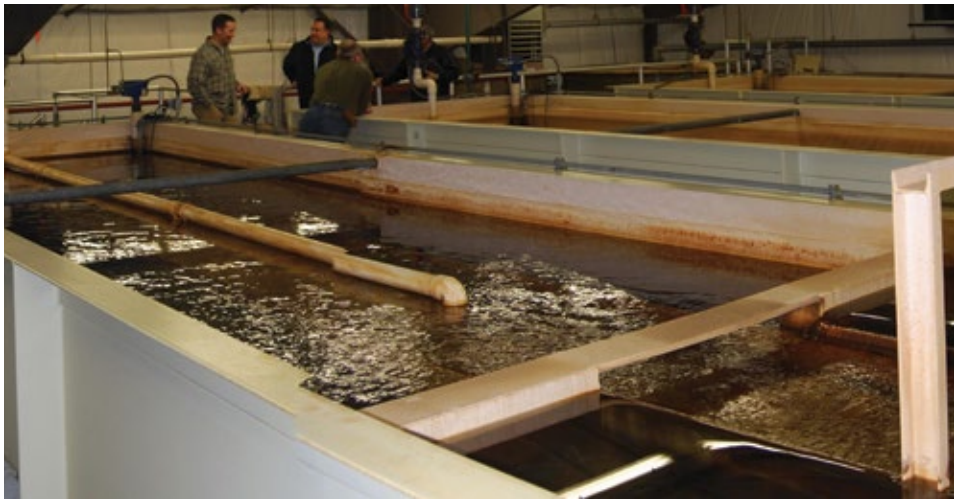
The Benjamin Schwartz water treatment plant (WTP) in Westfield, New York, installed a state-of-the-art Trident® packaged treatment system in 1995 to treat surface waters from two sources: Minton Reservoir and Chautauqua Creek. Each unit of the three-tank system was designed to produce 1 MGD (158 m^3/h) of treated water. The plant operates 8-10 hours per day and, in the fall, up to 16-20 hours per day to meet local grape harvesting demands.

Operations personnel have changed over the years and while this natural turnover resulted in a significant loss of historical knowledge, it also brought a fresh set of eyes to the plant's operations.

By 2016, the current plant managers – Erin Schuster and Andrew Thompson – realized that years of use had taken a toll on the system's performance. Knowing that WesTech had made several advancements to the Trident system over the years, the two managers determined that the plant would benefit from repairs and updates to the latest Trident technology.

Several problems were evident to the WesTech engineers who visited the site in 2016:

- The buoyant media in an Adsorption Clarifier® was coming out of the unit's weep holes, a condition that warranted further investigation.
- The stainless-steel static mixers were severely eroded from the chemistry the plant feeds to its raw water.
- Clarifier runtimes were very long (24 hours) compared with filter runtimes (12 hours) – a condition that was completely opposite of what was expected. (Filter runtimes are typically two or more times longer than clarifier runtimes.)



Twenty-one years in operation had taken a toll on the original system.

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Analysis of Alternatives

The first step was to find out why water and media were leaking from the weep holes on both sides of the double wall between a unit's clarifier and filter compartments. Applying air pressure through the openings while the filter and clarifier compartments were full of water revealed that the leak was coming from the clarifier compartment.

The plant's raw water averages from 10-20 NTU, with storm-related spikes up to 300-400 NTU. To reduce the turbidity, the plant feeds ferric chloride as a coagulant with cationic polymer and carbon. The raw water and chemistry, which contain abrasive particles, entered the Adsorption Clarifier compartment through a raw-water header and was constantly hitting the double wall between the clarifier and filter. Over the years, this had worn a hole through the first wall.

Normally 48 inches (1.2 meters) deep, Adsorption Clarifier media loss had reduced the actual bed depth to approximately 24 inches (0.6 meters), resulting in lower solids retention. Solids that should have been captured in the Adsorption Clarifier media were passing to the filter, resulting in short run times between backwashes.

The Adsorption Clarifier media coming out of the weep holes was indicative of media coated with a material that was not allowing it to retain its buoyancy. Finally, the unit's surface-only wash was not thoroughly cleaning the filter bed.

Recommended Solution

Based on data and analysis, the plant opted to repair or replace worn components and upgrade the older surface washers, which were followed by a water-only backwash, with the air-water backwash technology available in current Trident units.

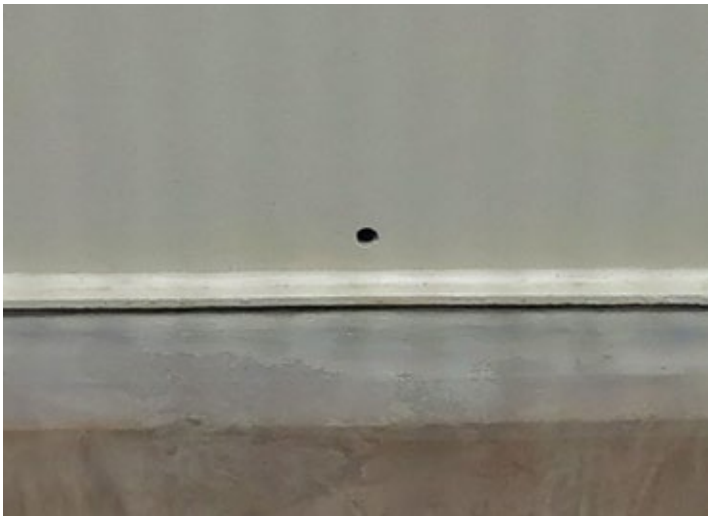
The Trident process consists of upflow adsorption clarification with buoyant media followed by mixed media filtration in a packaged treatment system. Coagulant is added ahead of the Adsorption Clarifier section.

As the treated water flows upward through the buoyant media, the tortuous path provides flocculation, also called contact flocculation. The floc that is produced is captured within the void spaces of the buoyant media or is removed via adsorption onto the media. As solids accumulate in the Adsorption Clarifier buoyant media, headloss builds up. When terminal headloss is achieved, a flush consisting of raw water combined with air is used to flush out the solids.

The filter section contains a filter bed of mixed media consisting of anthracite, sand, and garnet, which provides high quality filter effluent. As solids accumulate in the filter media, headloss builds up. When terminal headloss is achieved, a filter backwash consisting of filtered water combined with air is used to backwash solids out. Both the clarifier and filter are periodically cleaned using an air-water flushing system.

Replacing plugged Adsorption Clarifier nozzles enhanced performance.

The waste volume produced during these processes depends upon the water quality. The higher the turbidity in the raw water, the more frequently the Adsorption Clarifier flushes and the filter backwashes. Using headloss as a trigger to initiate a flush or backwash, as opposed to a timer-based trigger, can maximize clarifier and filter runtime, which can minimize waste production.



Adsorption Clarifier buoyant media had been leaking from the unit's weep hole.

Implementation

Because the plant often operates two units with the third in standby, the implementation team opted to perform the upgrades sequentially, one unit at a time (always leaving two units operational). The repairs included replacing the Adsorption Clarifiers' media and inspecting their air distribution system. The team also repaired or replaced nozzles (as needed), static mixers, and filter inlet and effluent function valves.

The upgrade consisted of:

- Removing the existing surface wash arms, filter media, and support gravel
- Inspecting the existing header and lateral underdrain
- Replacing the support gravel
- Adding an in-bed air wash grid
- Replacing the filter media
- Adding (or replacing) the existing blowers
- Adding air scour valves

While each unit was down, the plant repaired and repainted the tanks. It completed the repairs and upgrades in 2019.

Results

Managers Schuster and Thompson were very pleased with the overall operation of the treatment units. The plant's net production increased, efficiency improved, and the waste production decreased following the repairs and updates. Thompson reported tremendous improvement in solids capture, which saved an impressive 17,761 gallons (67 m^3) of wastewater per operating unit per day. Thompson also mentioned that, on average for all three units, the plant's Adsorption Clarifier runtimes changed from 24 hours to 17.4 hours and the filter runtimes went from 12 hours to nearly 29 hours.

Several enhancements contributed to these successful outcomes:

- Replacing the plugged air nozzles in the Adsorption Clarifier compartment allowed the flush process to better clean the buoyant media across the entire bed.
- Upgrading the filter section with an air-water backwashing system improved the performance of the filters, providing a more rigorous and thorough bed turnover that releases more solids contained in the bed.

Filter bed media was installed atop the new in-bed air grid for air-water backwashing.

The plant repaired and painted the tanks during the repair-upgrade process. The three updated Westfield units are now in production.

Benefits

- Increased filter runtime between backwashes resulted in a significant reduction in waste volume and a reduction in the amount of finished water used for backwashes, improving net production.
- With no need to take the units offline to do a backwash, the plant was able to save time while producing more finished water (21 min x 700 gpm = 14,700 gallons – or 56 cubic meters).

Clearly, ensuring that the Adsorption Clarifier was properly capturing solids prior to the filter section significantly improved the performance of the Trident system. The plant is now able to reduce approximately 40 percent of its former wastewater production per day. By realizing the benefits of relatively simple but necessary upgrades to the Trident system, the current managers helped to ensure that their plant operates as efficiently as possible.

Simple but necessary upgrades to the Trident system improved plant efficiency.

Waste Volume Calculation (1-½ TR-420 STR)				
Before	Waste Volume (gallons)	Frequency (hr)	Number of Flushes per Day	Total Waste Produced (gallons)
Clarifier Flush	7,000	24	1	7,000
Filter Backwash	17,500	12	2	35,000
			Total	42,000
After	Waste Volume (gallons)	Frequency (hr)	Number of Flushes per Day	Total Waste Produced (gallons)
Clarifier Flush	7,000	17.4	1.38	9,655
Filter Backwash	17,500	28.8	0.83	14,583
			Total	24,239
Total Daily Wastewater Savings (gallons) Per Operating Unit				**17,761**
Total Daily Wastewater Savings (gallons) 2 Units Operating				**35,522**

The upgrades saved a significant amount of water.

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