



AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

SUCCESS STORIES

PLANT NAME AND LOCATION

CITY OF BROCKTON ADVANCED WATER RECLAMATION FACILITY – BROCKTON, MA

DESIGN DAILY FLOW / PEAK FLOW

48 MGD (7,600 m³/hour) / 96 MGD (15,200 m³/hour)

AQUA-AEROBIC SOLUTION

(4) AquaDiamond® CLOTH MEDIA FILTERS WITH OptiFiber PES-14® MICROFIBER CLOTH FILTRATION MEDIA

AquaDiamond® CLOTH MEDIA FILTERS UTILIZE MICROFIBER MEDIA TO ACHIEVE 0.1 mg/L TOTAL PHOSPHORUS LIMIT

With the current national emphasis on restoring the water quality of America's urban waterways, the City of Brockton, Massachusetts, Advanced Water Reclamation Facility (AWRF) wanted to stay ahead of the regulatory cycle – in particular, phosphorus discharge limits set forth by the National Pollution Discharge Elimination System (NPDES) program of the United States Environmental Protection Agency (U.S. EPA). For this region of the country, the U.S. EPA has proposed total phosphorus (TP) discharge limits of 0.1 mg/L.

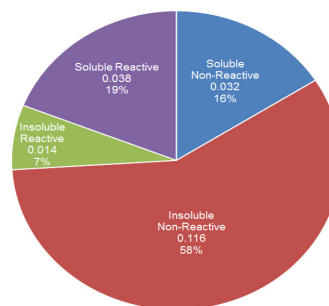
The Brockton plant's existing treatment scheme included physical settling (primary treatment), activated sludge treatment (secondary treatment) and final filtration (tertiary treatment) using two AquaDiamond® cloth media filters (CMFs) from Aqua-Aerobic Systems, Inc. Even though the filters performed to a level well below the current phosphorus discharge limit of 0.2 mg/L, Plant Superintendent, Dave Norton began looking for ways to not only improve the plant's removal efficiency to meet the anticipated 0.1 mg/L limit, but to achieve it with minimal equipment modification and without raising operating costs with chemical addition.

Following preliminary analytical evaluations of incoming phosphorus levels (see Influent Phosphorus Speciation chart), the Brockton AWRF staff, working with Aqua-Aerobic Systems, conducted full-scale tests using OptiFiber PES-14® microfiber cloth media installed on one of the AquaDiamond filtration units and compared its performance to the unit using the existing OptiFiber PES-13® pile cloth media.



Filter units fitted with the OptiFiber PES-14® microfiber media.

INFLUENT PHOSPHORUS SPECIATION



Analytical evaluations of influent phosphorus levels confirmed that soluble non-reactive phosphorus (sNRP) levels were low enough – about 0.03 mg/L – than the proposed new tertiary treatment protocol would produce effluent with less than 0.1 mg/L total phosphorus.

Each unit provides 238 m² (2,560 ft²) of filtration area and is rated for a nominal average daily flow of 1,900 m³/hour (12 MGD) and a maximum daily flow of 3,800 m³/hour (24 MGD). Throughout the four-month evaluation period from December 2012 to April 2013, the two filters received common influent from the plant's secondary clarification system (which was treated with ferric chloride prior to settling). Feed quality and discharge quality were monitored for phosphorus as well as total suspended solids, turbidity, pH, iron and alkalinity. Testing was conducted in three phases to explore filter performance:

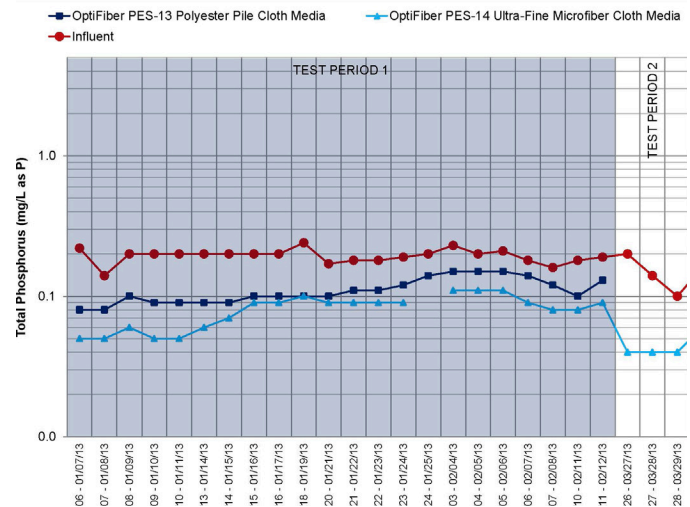
1. During normal operating conditions of approximately 6 m³/m²/hour (2.4 gal/min/ft²)
2. At the average design hydraulic loading rate (HLR) of 8 m³/m²/hour (3.25 gal/min/ft²)
3. At the peak HLR conditions approaching 16 m³/m²/hour (6.5 gal/min/ft²).

The two filter units operated under identical flow and loading conditions during the full-scale study. The results show that the OptiFiber PES-14 microfiber media consistently reduced phosphorus levels to below the 0.1 mg/L target (see Full-Scale Test Data of Total Phosphorus Removal graph). Additionally, the microfiber media outperformed the existing pile cloth media with respect to final total suspended solids, turbidity, particle size distribution and iron concentrations and fared extremely well during average design and peak HLR testing (See Full-Scale Test Data Comparing Filter Media table).

The plant has not observed any negative hydraulic impacts in going from the original pile cloth media (PES-13) to the microfiber media (PES-14). "We all anticipated a potential 20-25 percent reduction in hydraulic pressure loss across the filters," says Norton. "I don't believe we saw that. Also, I do not believe we have seen the increase in backwashing volume which was predicted."

By taking the initiative, the Brockton AWRF has demonstrated that it can meet the anticipated future discharge standards for total phosphorus of 0.1 mg/L. Furthermore, because of this demonstrated success, the plant, working in conjunction with Aqua-Aerobic Systems and its consulting engineering firm, has installed and commissioned a third AquaDiamond CMF (with the OptiFiber PES-14[®] microfiber media) and a fourth is under construction and expected to be on-line in the Spring of 2014. The AquaDiamond filter unit fitted with the original pile cloth media (the control unit in the full-scale test) is also being retrofitted with the microfiber media. According to Norton, "Retrofitting the filter units from the original pile cloth media to the microfiber media had minimal impact on the current equipment and was relatively simple."

FULL-SCALE TEST DATA OF TOTAL PHOSPHORUS REMOVAL



The OptiFiber PES-14[®] microfiber cloth media produced effluent with an average total phosphorus concentration of 0.08 mg/L, representing a 27% reduction as compared to effluent TP concentrations from the existing OptiFiber PES-13[®] pile cloth media of 0.11 mg/L.

FULL-SCALE TEST DATA COMPARING FILTER MEDIA

| Parameter | Influent | Effluent Using OptiFiber PES-13 [®] Pile Cloth Media | Effluent Using OptiFiber PES-14 [®] Microfiber Cloth Media |
|--------------------------------------|----------|---|---|
| Total Phosphorus (mg/L) | 0.19 | 0.11 | 0.08 |
| Dissolved Phosphorus (mg/L) | 0.07 | 0.08 | 0.06 |
| Total Reactive Phosphorus (mg/L) | 0.05 | --- | --- |
| Total Non-reactive Phosphorus (mg/L) | 0.15 | --- | --- |
| Total Suspended Solids (mg/L) | 3.89 | 1.04 | 0.66 |
| Turbidity (NTU) | 0.77 | 0.32 | 0.23 |
| pH (s.u.) | 6.85 | 6.96 | 6.84 |
| Iron (dissolved) (mg/L) | 0.08 | 0.08 | 0.05 |
| Iron (mg/L) | 0.44 | 0.26 | 0.12 |
| Alkalinity (CaCO ₃) | 95.60 | 123.00 | 111.00 |

The OptiFiber PES-14[®] microfiber cloth media outperformed the original pile cloth media in phosphorus removal with additional reduction in solids, turbidity, pH, iron and alkalinity.