Innovative Energy Conservation Methods/Technologies in Water/Wastewater Sectors for Moving Towards Net Zero

Innovative Uses of Pile Cloth Media Filtration: Strengthening Primary and Wet Weather Treatment Resilience

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Wastewater treatment plants worldwide are grappling with a growing array of challenges, stringent nutrient limits, more intense and frequent wet weather events, rising energy costs, and aging infrastructure. To meet these demands, utilities are increasingly adopting solutions that are compact, energy-efficient, and capable of delivering multiple treatment benefits within a small footprint. One such solution gaining momentum is pile cloth media filtration, particularly for advanced primary treatment and managing wet weather flows.

Beyond Tertiary: Evolving Cloth Media Filtration Applications

Originally designed for tertiary treatment, pile cloth media filtration has advanced to address upstream processes and peak flow scenarios. Today, these systems are being implemented to supplement or even replace primary clarifiers, increase secondary treatment throughput, and minimize capital investments tied to large storage tanks. They also support energy and resource recovery by enhancing solids capture and boosting biogas production – all while improving effluent quality and overall system robustness.

How the Technology Works

Cloth media filters are typically built in a disk format, using an outside-in flow pattern that creates three distinct solids removal zones (Figure 1), which are particularly vital when handling high solids in primary or wet weather applications.

- The **top or "floatable" zone** allows fats, oils, and grease to accumulate and overflow a scum weir, removing floatables from the system.
- The **middle "filtration" zone** captures solids on the cloth's surface, forming a mat that adds resistance and causes the water level to rise. When a preset level or timer is reached, the disks rotate, and the backwash pump pulls clean water from inside the disk to flush solids off the filter surface. This process expands the fibers, effectively releasing solids trapped deep within (Figure 2).
- The **bottom "solids" zone** allows heavier particles to settle and be intermittently removed from the hopper via collection laterals and the backwash pump.

Advanced Primary Treatment: A Tool for Energy and Resource Gains

Using pile cloth media filters for advanced primary treatment offers a strong alternative to conventional clarifiers. Unlike sedimentation, these systems consistently achieve high total suspended solids (TSS) and biological oxygen demand (BOD) removals, without chemical additions, and with a much smaller footprint. This enables facilities to divert more carbon to anaerobic digesters, increasing biogas yields, and cutting aeration energy demands in biological treatment process. Across various installations and pilot studies, pile cloth media filters in primary applications routinely remove over 80% of TSS and 45-65% of BOD (Caliskaner, 2020), with exact performance depending on the wastewater's characteristics and loading.

Case Study: Minden Road WWTP, WV, USA

At the Minden Road facility in Oak Hill, West Virginia, the city needed to expand capacity from 6 MLD (1.6 MGD) to 10 MLD (2.65 MGD) on a tight site. Instead of constructing new clarifiers or biological tanks,

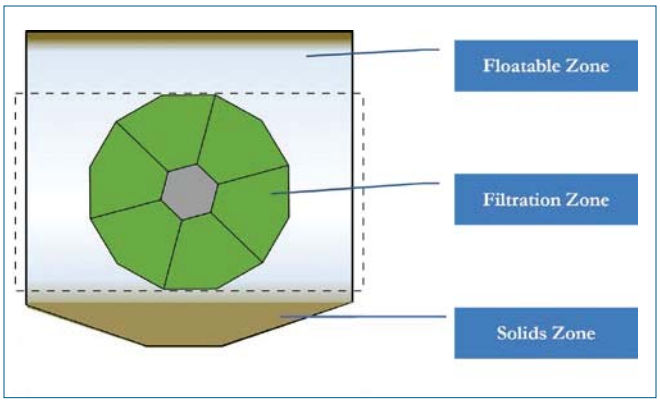

Figure 1: AquaPrime®/ AquaStorm® Filter- Solids Removal Illustration

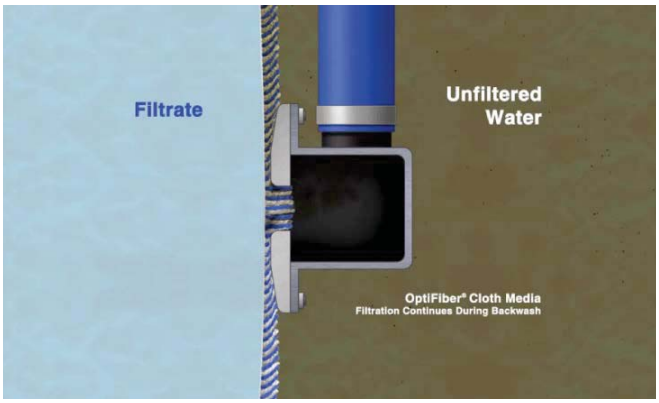

Figure 2: Pile Cloth Media Filtration- Backwash Illustration

they installed an AquaPrime® pile cloth media filtration system ahead of their existing sequencing batch reactors (SBRs).

Pilot trials in 2016 showed excellent TSS and BOD reductions, enabling the SBR to increase cycles from 5 to 8 per day by lowering organic loads. This allowed them to expand biological treatment without new tankage. Since startup, the system has managed flows from 2.65 MLD (0.7 MGD) to 16.7 MLD (4.4 MGD) while taking up just 214 m^2 (2,300 ft^2), even incorporating thickening equipment above the wet weather basin (Dyson, 2024).

Oak Hill's project demonstrates how pile cloth media filtration can:

- Reduce capital spending and land requirements
- Enhance biological process performance
- Support phased plant expansion despite site constraints

Wet Weather Management: High-Rate Filtration Approach

Storm events often pose the toughest challenges for treatment plants, overwhelming conventional processes. Many utilities respond by building large equalization tanks, tunnels, or blending facilities – solutions that demand significant investment and space.

Pile cloth media filters provide an enhanced high-rate treatment (EHRT) option that can be deployed during storms to intercept excess flows, remove solids, and improve disinfection outcomes. Operating automatically with little to no chemical addition, these systems maintain effluent quality meeting secondary standards even under peak conditions.

Case Study: Tomahawk Creek WWTF, KS, USA

Johnson County's Tomahawk Creek facility is a standout example (Figure 3). Initially projected to require over $200 million in storage and equalization, the utility instead adopted a flexible filtration approach that handles:

- Tertiary polishing under normal conditions
- High-rate treatment during storm flows

A single system now manages average flows of 72 MLD (19 MGD) and peaks up to 435 MLD (115 MGD). The AquaStorm® cloth media filters deliver TSS < 5 mg/L in dry weather and < 20 mg/L during storms, supporting stringent nutrient targets. This strategy significantly reduced land and capital needs while providing operational versatility, establishing the facility as a national benchmark for resilient wet weather treatment (Fitzpatrick, 2024).

Key Insights

Pile cloth media filtration is no longer confined to tertiary polishing. It is proving to be a versatile, multi-stage solution that delivers benefits across the entire treatment train, including:

- Robust solids and BOD removal
- Reduced energy and chemical use
- Compact, modular designs that are easy to scale
- Increased potential for biogas recovery
- Reliable performance under highly variable flows

Utilities like those in Oak Hill and Johnson County show how smart integration of pile cloth media filters can drive sustainability, optimize operations, and meet growing capacity needs – all without major infrastructure overhauls. As regulatory and economic pressures build, pile cloth media filtration stands out as a scalable, future-ready option for daily operations and long-term planning.

For references in this article, contact *influents@weaocommittee.org*.

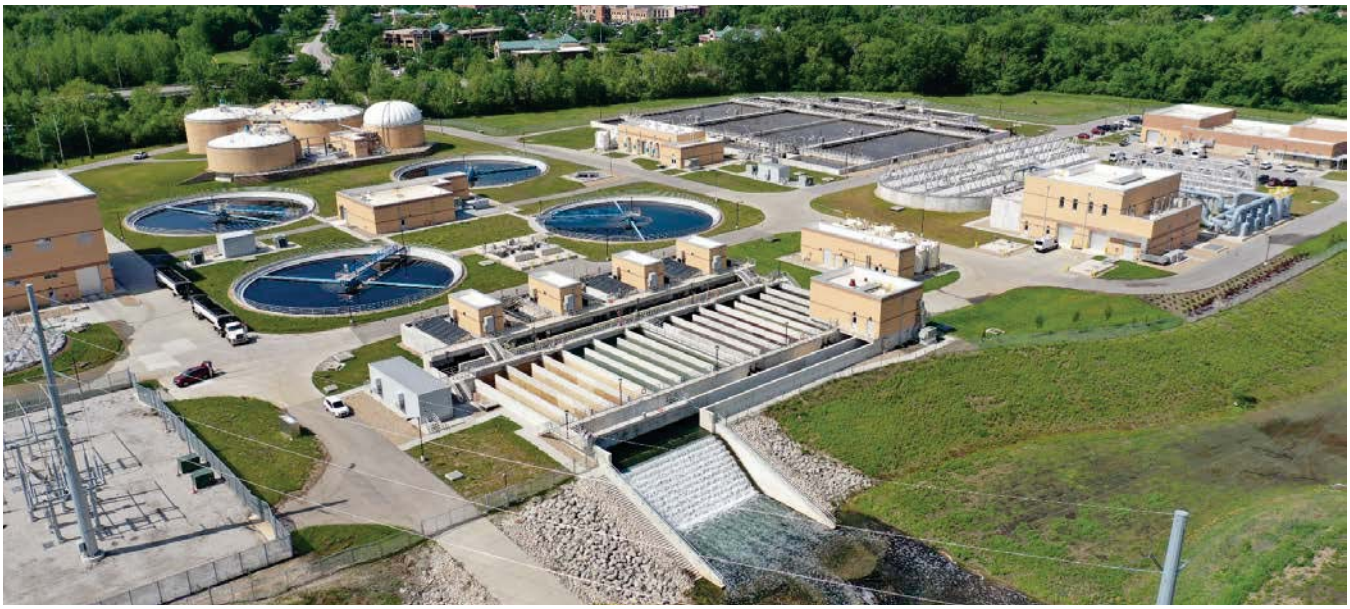

Figure 3: Aerial View of the AquaStorm® Cloth Media Filter Installation at Tomahawk Creek WWTF, Kansas