# Cloth Media Filter Retrofit Increases Filtration Capacity in Existing Sand Filter Basins of WWTPs in USA

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## Introduction

Low-head, shallow-bed, traveling bridge sand filtration systems (Figure 1) have been used worldwide, including the Gulf Cooperation Council (GCC) region, dating back to the 1970s for tertiary reduction of suspended solids. After decades of operation, many of these tertiary filtration systems have reached their effective life and are facing performance and operational issues such as diminished hydraulic capacity, excessive backwash rates and media loss. Short circuiting due to media clogging, fouling of the porous plates and deterioration of the plate seals can also produce deterioration in the operational efficiency. In addition, many plants require additional filtration capacity but lack the site space to install additional basins.

Three wastewater treatment facilities who were confronted with failing traveling bridge sand filters and a need for expanded flow capacity are examined, including: the Fox Metro Water Reclamation District plant (FMWRP) (Chicago suburb of Aurora, IL); the Trinity River Authority of Texas (TRA) (Dallas/Fort Worth metropolitan area); the Donald C. Tillman Water Reclamation Plant (DCTWRP) (the City of Los Angeles) upgraded existing sand filters with cloth media filters. Recent innovations in filtration technology have resulted in the development of cloth media filters that are capable of achieving high removal efficiencies at significantly increased hydraulic loading rates compared to traditional sand media filters. The application of cloth media produced an increased filtration surface area and, combined with substantially higher flux rates, resulted in a significant increase in filtration capacity while accommodating the existing plant's hydraulic profile and civil structures. The cloth media AquaDiamond® filters were retrofitted in the existing sand filter basins at these three plants. Shortly after installation, process performance tests were conducted to confirm compliance to the design specifications. Results from the three sites illustrate an increase in treatment capacities by 240% through the use of cloth media filtration technology while exhibiting comparable solids removal rates at design flow with an improved ability to achieve elevated performance during high solids loading events.

## Cloth Media Filters

The principles of filtration with cloth media are similar to sand media, but the mechanisms used to achieve performance objectives differ. A random, woven pile fabric filter media removes the very fine particulate matter which does not settle to the tank bottom. The depth of the woven pile fabric creates a tortuous flow path which enables the capture of additional solids particles. As flow passes through the cloth media, solids are retained on and within the cloth fibers, forming a solids-separation mat which provides an additional filter layer that enhances filtration. As solids build on the media, the pressure differential across the media increases. Once the water level reaches an operator-defined set point, the microprocessor automatically initiates a backwashing process whereby a suction manifold removes excess solids which have accumulated on the cloth media surface.

The AquaDiamond® filter is specifically designed for retrofit applications in existing sand filter beds. Long laterals supporting pile-fabric media are suited for converting rectangular basins into cloth media diamond filtration units. Horizontal rows of diamond-shaped laterals are mounted on the basin bottom. Figure 2 illustrates the AquaDiamond® retrofit in these three different WWTPs.

**Results and Discussions**

Process performance tests were conducted on three cloth media filter installations in accordance with the contractual obligations. The testing protocols approved by engineers and/or customers were executed to test the filter's performance at specified operational conditions. Results have demonstrated that the cloth media filters could consistently achieve reuse quality effluent of no more than 5 mg/L TSS and/or no more than 2 NTU turbidity under the designed hydraulic conditions of 45,000 $m^3$/d (12 MGD) per filter average flow and 90,000 $m^3$/d (24 MGD) per filter peak flow and filter influent TSS concentrations ranging from 10 mg/L to 30 mg/L. During the test period in Fox Metro installation, the filter experienced "upset" conditions with maximum influent TSS of 171 mg/L at a flow rate of 18.36 MGD. The results demonstrated the filter met the effluent TSS objective of ≤ 5 mg/L under this "upset" operational condition and it quickly recovered after influent went back to normal conditions. The average daily backwash rates were generally less than 2.5% of the forward flow during 24-hr tests.

**References**

P. B. Baumann, P.E.; C. Kieffer; T. Morrall; R. Bauer, P.E., Fox Metro Water Reclamation District Solves Filtration Problem With Innovative AquaDiamond® Cloth Media Filter, WEFTEC 2006, Dallas, TX.

Figure 1: Low Head Shallow Bed Traveling Bridge Sand Filter

(a)

(b)

(c)

Figure 2: Retrofit of Cloth Media AquaDiamond Filter® in Existing Sand Filter Basin (a) Fox Metro WRF (6) Model 1680 Units; (b) TRA Central, Dallas, TX (6) Model 1680 Units; (c) D.C. Tillman WWTP, Los Angeles, CA, (8) Model 1680 Units

Table 1: Process Performance Test -Fox Metro WRF (04-July-07 to 24-July-07)

| Date | Filter Flow ($m^3$/d) | | Influent TSS mg/L | | Average Effluent TSS (mg/L) | Backwash Rate |
|---|---|---|---|---|---|---|
| | Maximum | Average | Maximum | Average | | |
| 1 | 59,500 | 53,785 | 11 | 9.8 | 2.2 | 0.63% |
| 2 | 55,526 | 42,506 | 10 | 6.9 | 2.7 | 0.56% |
| 3 | 48,448 | 39,705 | 12 | 6.8 | 3.5 | 0.56% |
| 4 | 56,132 | 40,462 | 12 | 6.2 | 2.0 | 0.50% |
| 5 | 51,362 | 36,752 | 12 | 6.5 | 2.4 | 0.60% |
| 6 | 46,101 | 36,336 | 10 | 4.9 | 2.9 | 0.56% |
| 7 | 46,896 | 37,396 | 11 | 6.8 | 2.7 | 0.51% |
| 8 | 55,375 | 39,478 | 9 | 4.8 | 2.2 | 0.80% |
| 9 | 46,063 | 36,790 | 9 | 6.2 | 2.8 | 0.43% |
| 10 | 44,436 | 36,336 | 8 | 4.7 | 2.5 | 0.51% |
| 11 | 50,719 | 39,856 | 6 | 4.4 | 1.9 | 0.50% |
| 12 | 51,060 | 38,645 | 8 | 4.5 | 1.9 | 0.48% |
| 13 | 68,206 | 41,484 | 106 | 14.3 | 3.4 | 1.17% |
| 14 | 69,493 | 58,819 | 171 | 25.3 | 5.2 | 1.41% |
| 15 | 67,600 | 53,217 | 110 | 14.4 | 2.2 | 0.68% |
| 16 | 63,437 | 49,962 | 8 | 5.7 | 2.2 | 0.40% |
| 17 | 68,887 | 52,990 | 47 | 7.6 | 2.4 | 0.49% |
| 18 | 56,056 | 43,868 | 7 | 4.8 | 2.5 | 0.55% |
| 19 | 48,864 | 40,462 | 10 | 5.8 | 2.8 | 0.49% |
| 20 | 45,042 | 38,039 | 10 | 6.6 | 4.3 | 0.56% |
| 21 | 48,978 | 40,613 | 15 | 6.2 | 3.0 | 0.53% |

Table 2: Process Performance Test - TRA WWTP (11-Feb-2008 to 17-Feb-2008)

| Date | Filter Flow ($m^3$/d) | | Influent TSS (mg/L) | | Effluent TSS (mg/L) | | Backwash Rate |
|---|---|---|---|---|---|---|---|
| | Maximum | Average | Maximum | Average | Maximum | Average | |
| 11-Feb-08 | - | 49,761 | - | 10.2 | - | 1.7 | 1.69% |
| 12-Feb-08 | 90,840 | 28,433 | 29.1 | 9.6 | 5.0 | 3.0 | 1.63% |
| 13-Feb-08 | 90,840 | 26,514 | 58.9 | 12.6 | 1.6 | 1.6 | 2.23% |
| 14-Feb-08 | 90,840 | 46,586 | 33.1 | 17.7 | 3.4 | 2.0 | 2.02% |
| 15-Feb-08 | - | 47,241 | - | 14.0 | - | 2.0 | 1.63% |
| 16-Feb-08 | - | 47,260 | - | 15.0 | - | 1.0 | 1.67% |
| 17-Feb-08 | - | 40,772 | - | 15.0 | - | 1.0 | 1.56% |