

Biological Filtration

ESSD Washtroughs, MULTIWASH® Backwash and MULTICRETE™ II Underdrain

CASE STUDY

Location: Albuquerque, New Mexico
Owner: Albuquerque Bernalillo County WUA
Engineer: CH2M
Contractor: PCL/Triad Joint Venture

Problem

The City of Albuquerque concluded in the 1990s that their aquifer drawdown exceeded its recharge. The City needed to look into a new water source to provide 80-92 MGD of water to its 600,000 population—representing 50% of the water demand in the state of New Mexico. In addition, the USEPA was preparing to lower the arsenic MCL from 50 ppb to 10 ppb, making Albuquerque's groundwater one of the largest water sources impacted by the regulation. The solution was to tap into Rio Grande surface water rights to meet 70-80% of the water demand. To meet the rest of the demand, a blend of groundwater would keep the arsenic concentrations below the MCL. This became known as the San Juan-Chama Drinking Water Project by the Albuquerque Bernalillo County Water Utility Authority (ABCWUA). CH2M was selected as the consulting engineering firm. The new water treatment plant finished construction in 2008.

Switching over from a groundwater to surface water source presented several challenges. Taste and odor compounds and disinfection by-products were among the challenges.

Solution

The engineer selected a "multiple-barrier treatment process," that had success at other plants such as El Paso, TX; Woodland & Davis, CA; Fresno, CA; and Tampa, FL. The process provides redundancy to remove organics by first using enhanced coagulation with a high-rate clarification process followed by ozone and biofiltration (O₃/BAF). WesTech/General Filter supplied the biological filter underdrains and wash troughs.

The plant has twelve 26 ft. x 40 ft. biological filters containing 60 inches of granular activated carbon (GAC) and 12 inches of sand. The filters receive ozonated water. The operators have the ability to feed sodium hypochlorite or hydrogen peroxide to control the biological growth, if necessary.

The filter components include General Filter ESSD low-profile media retaining washtroughs with baffles to separate the air

O₃ + BAF Process

Parameter	In	Out
NTU	4-5	0.03-0.04
TOC	1-2	0.8-1.4

from the water during MULTIWASH® air/water backwash to prevent GAC media loss. The MULTICRETE™ II underdrain system has an accessible underdrain plenum and plastic media retaining nozzles to prevent corrosion from the GAC and to maintain a low filter profile by eliminating the need for gravel support layers.

Implementation

The sorptive capacity of the GAC exhausted quickly within six months after startup. Fortunately, the water utility relies on biological treatment rather than sorption to remove organics.

Water Quality (Raw)

Parameter	min.	avg.	max.
TOC (mg/L)	2	3.9	6
Alk. (mg-CaCO ₃ /L)	96	121	175
pH	7.8	8.3	8.9
Temp. (°F)	41	62	83
Fe (mg/L)	0.7	2.4	11.2
Mn (mg/L)	ND	ND	ND

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 SWIRE WATER

Changing out all the GAC media in the ABCWUA plant every six months would have cost about \$5M wholesale, compared to \$0.5M to top off approximately 6-9 inches every four years. Without the biological process, this could be a cost-prohibitive operating expense for utilities considering this process.

The ABCWUA plant manager and chief engineer reported that the filters work well without any problems and are maintenance free. The water utility now has time to optimize the backwash process to minimize waste volume and media loss.

Results

Turbidity: The water utility is preparing to become a subscriber of the AWWA Partnership for Safe Water since the filter effluent is less than 0.1 NTU over 99% of the time. The filters currently reduce 4-5 NTU turbidity down to 0.03-0.04 NTU.

The filters are designed to operate up to 6 gpm/ft².

Organics: The surface water plant reduces raw total organic carbon (TOC) by approximately 60%. One-third of that reduction occurs in the filters. The plant relies on biological, not sorptive, processes in the filters to reduce organics. In fact, after the filters were topped off with new GAC in 2012, there was a brief decrease in the TOC removal efficiency while the filters re-established their biomass in the top layer.

Backwash Process

Step	Rate	Duration
Combined Air/Water	3 cfm/ft ² air 5 gpm/ft ² water	5 minutes
Re-stratification	15 gpm/ft ² water	10 minutes
Filter-to-waste	3-6 gpm/ft ² water	15 minutes

Chemical Systems

Chemical	Purpose	Active Dose (mg/L)
Ferric Chloride	Coagulant	15-50
Polymer	Settling aid	0.2-1.0
Lime	Raise pH	20-40
Ozone	Oxidant/disinfection	1.0-2.0
Sodium Bisulfite	Quench O ₃	0.75-1.0
Sodium Hypochlorite	Disinfection	1.5-2.5
Polyphosphate	Corrosion inhibitor	0.5-1.0

Backwash: The filters typically backwash every 60-100 hours of operation. The 100 hours setpoint is a state regulated maximum filtration time between backwashes. The filters usually backwash based on filter run length or differential pressure (8 ft. of water setpoint). The first step is a low-rate air/water backwash with 3 cfm/ft² air and 5 gpm/ft² water. The second step is an air purge/re-stratification high-rate backwash with 15-17 gpm/ft² water. The water rates are adjusted with varying water temperatures. A filter to waste step is included at the end of the backwash process.

Switching over from a relatively pristine groundwater source to a surface water source could have had some negative effects to its customers like taste and odor. Fortunately, the ozone + biofiltration process has helped remove organics and contributed to good tasting finished water for over half a million customers in Albuquerque, NM.

SURFACE WATER BIOLOGICAL FILTRATION

