



Iron, Manganese, and PFAS Removal Filtration at the Littleton, MA Whitcomb Ave. WTP Using Two Stage Biofiltration and G.A.C. Pressure Filters

Background

The City of Littleton, MA contracted with Blueleaf, Inc. of Charlston, MA to conduct a field pilot study to determine the efficiency of a biological filtration process to remove iron and manganese followed by granulated activated carbon process (GAC) to remove PFAS from three well water sources. The treated water must meet EPA and State of MA maximum contaminant levels for drinking water standards (Fe = 0.30 mg/l, Mn. = 0.05 mg/L, PFAS = 4 PPT).

Blueleaf field personnel conducted a pilot study at the well sites using two filter columns with silica sand media to remove iron and manganese. The first column removes iron, the second column removes manganese, and a third filter column with G.A.C. media removes PFAS.

The raw well water contains sufficient dissolved oxygen (DO) (1 to 3 mg/l) to allow adsorption of the ferrous iron to the media and subsequent biological oxidation to the ferric form without the addition of compressed air. The manganese media column was pretreated with compressed air to provide DO (6 to 10 mg/L) to support biological colonies that oxidize manganese to a state where they can precipitate onto the sand media.

The manganese removal process also requires pretreatment with potassium hydroxide to increase the raw water pH to optimize the growth of the manganese oxidizing bacteria. Non-chlorinated filtered water is pumped from storage to backwash the iron and manganese from the sand media. The third filter using GAC media is not backwashed as the GAC is replaced when exhausted. Pilot Study test parameters included raw and filtered water iron, manganese, PFAS, pH, and dissolved oxygen. The Blueleaf pilot study report indicated that the biological and GAC filters removed the contaminants to below EPA and State of Massachusetts drinking water standards.

Full Scale Biological Filtration System

Tighe & Bond consulting engineers (Worcester, MA) designed the full-scale WTP. Their specification includes a 2,100 gpm two-stage biological automatic pressure filtration system to remove iron and manganese consisting of three 12 ft. diameter vertical pressure filters to remove iron and three 12 ft. diameter vertical filters to remove manganese. Compressed air is injected ahead of the manganese filters to provide the D.O. necessary to maintain the biologically active process to remove iron and

manganese on the silica sand media. An underdrain system constructed of a header and 316L stainless steel wedge wire wrapped laterals provide the required flow control and backwash water distribution to assist filter media backwash. An air blower feeds air to an air wash distributor consisting of a 316L stainless steel header and 316L stainless steel wedge wire wrapped laterals.

Instrumentation, Ancillary Equipment, and Controls

The automated bio-filtration process includes the following instruments, equipment, and controls:

- Filter control panel (FCP) consisting of a PLC based computer with a door mounted HMI compatible with plant SCADA, necessary hardware components, timers, operator interface terminal, enclosure, relays switches, alarms, I/O and other items necessary for a complete operational system.
- Magnetic flow meter downstream of each filter vessel to transmit flow rate to the FCP.
- Magnetic flow meter to read the backwash water flow rate to each filter.
- One differential pressure transmitter for each vessel.
- Filter air monitoring station.
- Each filter vessel includes five (5) electric actuated butterfly valves with limit switches to transmit the valve position to the FCP.
- Filter backwash water supply pump transmitter.
- Backwash air scour flow and transmitter.
- Filter air supply compressor and flow meter.
- Positive displacement blower.
- Miscellaneous pressure gauges, etc.

Analytical Equipment (online type)

- Iron filter influent DO
- Iron filter effluent pH, water temperature, DO
- Manganese filter influent water temperature, pH, DO
- Manganese filter effluent pH, water temperature, DO

Construction of the Whitcomb Ave. WTP

Winston Builders Corporation (Westborough, MA) was issued the contract to construct the new 1.8 MGD Whitcomb Ave WTP. The WTP includes a 10,500 Sq. Ft. building, biofiltration and GAC filters, below grade storage tanks, pumping equipment, electrical and chemical feed systems. Construction of the WTP began in June, 2021. As of September 2023, the WTP is substantially complete.

Winston Builders selected Pureflow Filtration Div. (Whittier, CA) to supply the two-stage biofiltration iron and manganese filtration system. Pureflow supplied the complete biofiltration system including the pressure filter vessels, internal underdrains, inline static mixers, blower, media, control valves / electric actuators, instrumentation, water quality analyzers, and filter control panel. As of September 2023, Pureflow field personnel are involved in the start-up commissioning and operator training phase of the project.