Dissolved Air Floatation (DAF) Implementation for Pretreatment at Clear Lake

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PROJECT OVERVIEW

- Harbor View Mutual Water Company
- Serves 250 single family homes at Riviera West on Clear Lake
- Existing WTP at end of useful life
- Direct filtration of Clear Lake water = trouble!
PROJECT LOCATION
WHAT YOU WILL LEARN TODAY

- Basics of Dissolved Air Floatation (DAF) systems
- DAF performance on Clear Lake water
- Considerations for water treatment applications
WTP Improvements Project Overview

- Existing WTP Treatment Process - 170 gpm
  - Screening → KMnO4 → Coagulant → DAF → Pressure Filters → GAC → Chlorine Contact

- Primary Contaminant: Algae
Algae Treatment Challenges

- Algae difficult to settle in clarifiers, particularly if not killed (oxidized)
- Blue-green algae (Cyanobacteria) produce Cyanotoxins, which can irritate skin and stomach
- Algae can produce Geosmin and MIB, causing “earthy” “musty” taste and odor
- If algae cells are oxidized and lysed, additional Geosmin, MIB, and TOC may be released
  - Elevated DBPs
- Stringy algae difficult to backwash out of filters
What is DAF?

Release dissolved air, creating microbubbles (<100 micron) that nucleate on solid particles and adhere, causing solids to float to surface.
BASIC DAF Process

Feed Water

Flocculation Tank

Flocculants

Float Layer

Mechanical Scrapers

Distribution Baffle

Sludge

Float Sludge

Air Saturated Water

Compressed Air

Saturation Tank

Recycle Water

Effluent

Underflow Baffle

Outlet Weir

Recycle Pump
Treatment Plant Layout

- DAF
- REC.
- PRESSURE FILTERS
- GAC CONTACTORS
- POST DAF EQ/FLOC
- CHEM
- FLOAT SLUDGE TANK
HVMWC DAF Design Criteria

- 2 stage flocculation
  - Stage 1: 5 minutes at $G = 50-90 \text{ s}^{-1}$
  - Stage 2: 5 minutes at $G = 20-40 \text{ s}^{-1}$

- Floatation Zone Surface Loading Rate = 2.2 gpm/ft$^2$ - High Rate DAF Loading Rates of up to 16 gpm/ft$^2$ possible in other installations

- Recycle Rate = 17.5% of throughput

- Saturator Pressure = 75 psi

- Volumetric Air Released = 7 ml/L
Air Saturation System

- Air from Compressor
- Level Control Valve
- Saturation Tank
- Recycle Pump 1
- Recycle Pump 2
- Recycle Outlet
- Recycle Inlet
Saturation Tank

- Specify minimum air saturation efficiency
- Tank internals may include baffles or packing to encourage air dissolution
- Conduct air saturation testing onsite at startup
Air Saturation System

- SIMPLE SYSTEM: CONSTANT BLEED OF EXCESS AIR
- MORE ELABORATE: ACTIVELY CONTROL AIR FLOW RATE TO MAINTAIN LEVEL
Air Saturation System

- **Solenoid Valve** starts and stops air flow with treatment plant
- **Air flow rotameter**
Dissolved Air Release

Pressure Relief Valve

- Easily adjustable
- Located outside tank
- Some bubble agglomeration may happen between valve and release point through distribution orifices
Dissolved Air Release
Dissolved Air Release

Release Nozzles

- Located inside tank, not adjustable
- Clogging may be an issue
- Micro bubble formation likely optimized
Floatation Zone Float Sludge Removal

- Chain @ Flight Scraper Typical
- Speed Adjustable 2-10 feet/min
- Time cycle (on/off) operation
- Let float sludge layer build to 2-4% solids
Settled Sludge Removal

SETTLED SLUDGE CONVEYOR
Coagulant Selection

- Goal is light pinfloc
- Flocculation mixing speed adjustable for control
- Heavy floc may not float
- Separate polymer typically not needed to build float layer
- Aluminum Chlorohydrate / Polymer (Poly DADMAC) Specialty BLEND Coagulants may be effective
- Air bubbles and algae are negatively charged
Coagulant Selection

HVMWC currently feeding 2 specialty coagulants upstream of DAF concurrently

- One reacts slowly - forms light pin floc in DAF
- One reacts quickly - forms heavier settleable floc that is more filterable in pressure filters

Provisions for pressure filter-aid polymer chemical feed
Later Summer Operations

- Large Heavy Floc Coagulant
Early Winter Operations

[Graph showing turbidity (NTU) and coagulant dose (mg/L) over time from 10/31/15 to 12/31/15 with highlighted periods labeled "SHORT FILTER RUNS" and different colors representing large heavy floc coagulant and pin floc coagulant.]
Pre-Oxidation

- HVMWC currently feeds potassium permanganate at raw water pump station
- Preliminary testing shows pre-oxidation not required for adequate DAF performance for algae
- Oxidation downstream of DAF may provide some benefit to subsequent coagulation, flocculation, and filtration steps
Benefits of DAF vs. Sedimentation

- Smaller footprint
- Pre-oxidation may not be necessary
- Thickened float sludge waste may go directly to a dewatering process
DAF Application for Water Treatment

- Good for high algae load / minimal high SG TSS load
- Not great for high turbidity (sediment) storm events
- May be used at high rate (small footprint) upstream of sedimentation for algae removal
  - Algae problems with Trident Microfloc systems
- Filter aid polymer for filters
- Seasonal use
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Questions?