

Using Biological Activated Carbon in Drinking Water Treatment

Case Study: Fresno Surface Water Treatment Facility

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City of Fresno Water System

- Serves \approx 500,000 people
- Maximum Day Demand \approx 200 mgd
- 1,700 miles of distribution system piping



Potable Water Supply

- Until recently, Fresno obtained all of its potable water from the groundwater aquifer beneath the City
 - 250 wells spread across 115 square miles
- Falling groundwater levels led the City to construct the Surface Water Treatment Facility
 - 30 mgd facility started delivering water in June 2004
 - Treats water collected from the San Joaquin and Kings River basins

City of Fresno Surface Water Treatment Facility



Surface Water Treatment Facility

- Initial maximum capacity = 30 mgd
- Supplies about 15% of summer water demand and 33% of winter demand
- Treats water delivered via the Enterprise Canal

Enterprise Canal



Water Quality/Treatment Concerns

- Enterprise Canal vulnerable to contamination:
 - Access by cattle
 - Agricultural irrigation return water
 - Agricultural land runoff
 - Roadway runoff
 - Pesticide/Herbicide overspray

Water Quality/Treatment Concerns

- Compatibility of surface water with groundwater system:
 - Surface water TDS \approx 25 mg/L
 - Groundwater TDS \approx 250 mg/L
- Algae (taste & odors)
- Reliable compliance with new drinking water regulations:
 - ESTWR, D/DBP Rule, Lead and Copper Rule, etc.

Enterprise Canal Raw Water Quality

- *Cryptosporidium*: non-detect to 57 oocysts/100L
- *Giardia*: nd to 53 cysts/100L
- Average fecal coliform: 293 MPN/100ml
- Turbidity Range: 2 to 130; Avg = 12 NTU
- Dissolved Org. Carbon: 0.5 to 12; Avg = 3 mg/L
- Alkalinity: 8 to 94; Avg = 12 mg/L as CaCO₃
- Calcium: 1 to 18; Avg = 7 mg/L as CaCO₃

Water Treatment Evaluation

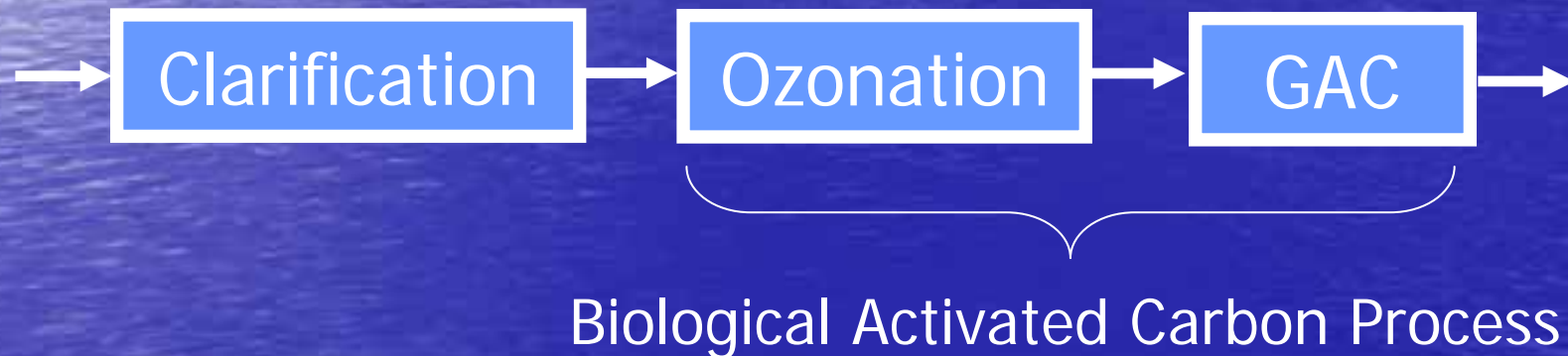
- Corrosion pilot tests:
 - Treated water pH: 9 to 9.3
 - Treated water alkalinity: 25 mg/L as CaCO_3 minimum

Water Treatment Evaluation

- Provide clarification ahead of filtration to remove DBP precursors and reduce turbidity
- Provide activated carbon to assist with DBP precursors and address tastes and odors
- Provide advanced disinfection and filtration systems to address *Crypto* and other pathogens:
 - Membrane filtration or
 - Ozone followed by granular media filtration.

Water Treatment Evaluation

- Evaluation of economic and non-economic factors recommended the use of conventional treatment with ozonation followed by granular activated carbon (GAC) filter media



Biological Activated Carbon Process



- Ozone is a powerful oxidant and is effective at inactivating pathogenic microorganisms such as *Giardia* and viruses
- At high doses and long contact times, ozone is effective at inactivating *cryptosporidium*
- Ozone also destroys taste and odor causing compounds in water

Biological Activated Carbon Process



- Ozone reacts with natural organic matter (i.e., TOC) to form aldehydes and other lower molecular weight compounds that are less reactive with chlorine in forming THMs and HAAs, thus assisting with meeting the DBP regulations
- The transformed organics are biodegradable by bacteria
 - Biodegradable organic matter (BOM)

Biological Activated Carbon Process



- Granular Activated Carbon (GAC) adsorbs organic matter from water including
 - DBP precursors
 - taste and odor causing compounds
- GAC also provides an excellent medium for bacteria to grow
 - Large surface area for bacteria to attach

Biological Activated Carbon Process



- It is important to remove the biodegradable organic matter (BOM) produced by ozonation before the water is introduced to the potable water distribution system
- BOM is a food source for bacteria and could result in problematic bacteria growth in water pipelines and storage reservoirs

Fresno Surface Water Treatment Facility

- The SWTF started water delivery to system on June 2004
- THMs and HAAs have been well below the regulated levels
- No bacteria problems in the water distribution system
- Low levels of water quality complaints by water customers

City of Fresno Surface Water Treatment Facility

