

process optimization & regulation compliance with TOC monitoring in Helena, MT

challenge

The City of Helena, MT, operating the Ten Mile Water Treatment Plant and Missouri River Treatment Plant, faces seasonal water quality changes. It's two sources create treatment challenges in meeting regulations and maintaining quality effluent.

Low alkalinity and varying source water quality at the Ten Mile Plant make it difficult to meet required Total Organic Carbon (TOC) % removal, to comply with the EPA Disinfectant/Disinfection Byproduct (DBP) Rules within current plant processes and infrastructure. Seasonal organic, taste & odor compounds and classification as a Zero Discharge Facility make operational costs of the Missouri River Plant a concern.

Summer demand can reach 15 MGD while winter demand drops to 3 MGD typically 100% supported by the Ten Mile Plant. The Missouri Plant is used for peaking or backup, such as when plant upgrades are needed. Recently the Ten Mile Plant has upgraded clearwell covers, PLC systems, filters, and media. The unique water quality challenges of these two plants and two sources are shown in **Table 1**.

Table 1: City of Helena Water System

plant info	treatment process	challenges
<ul style="list-style-type: none"> • Ten Mile Water Treatment Plant • Est. 1991 • 10 MGD Cap 	<ul style="list-style-type: none"> • Coagulation, flocculation • contact absorption clarifiers • sand and anthracite coal filters • sodium hypochlorite 	<ul style="list-style-type: none"> • High Organics • Seasonal run-off • Pine beetle kill • Low Alkalinity
<ul style="list-style-type: none"> • Missouri River Treatment Plant • Est. 1959 • 8.9 MGD Cap. 	<ul style="list-style-type: none"> • Coagulation, flocculation, sedimentation basins, • sand and anthracite coal filters • sodium hypochlorite 	<ul style="list-style-type: none"> • High TDS • Seasonal Taste & Odor Issues • Zero Discharge Facility

The Missouri River Plant pumps water from the Missouri River to the Helena Valley Regulating Reservoir then to the plant. Since the reservoir provides water for irrigation and fish & wildlife use, they cannot treat the reservoir. As a result, the plant treats any organic, taste, and odor compounds that are present. Classified as a Zero Discharge Plant, the Missouri River Plant uses its backwash water for managed irrigation and recycles it back to the plant to be retreated. While recycling backwash water may allow for water conservation and savings on permits, due to seasonal quality changes, total operational costs must be evaluated to determine overall impact.

The Ten Mile Plant is gravity fed from a reservoir at the top of the Rocky Mountain Divide via Ten Mile Creek. It was built in 1991 when the city lost its filtration waiver for turbidity compliance. Additionally, the use of contact absorption clarifiers reclassified the facility from direct filtration to conventional treatment which requires compliance with TOC % removal. With low alkalinity (typically 15-25 mg/L), the plant falls into elevated TOC % removal classification during spring runoff when source TOC exceeds 4 mg/L TOC as highlighted in **Tables 2** and **3**.

Table 2: Typical TOC Values

plant	raw TOC	finished TOC
Ten Mile Water	3-4 ppm (up to 8 ppm runoff)	2-3 ppm
Missouri River	3-4 ppm	2 ppm

Table 3: EPA DBP % TOC Removal Requirements⁽¹⁾

source TOC (mg/L)	source alkalinity mg/L as CaCO ₃		
	0-60	>60 to 120	>120
>2.0 to 4.0	35.0%	25.0%	15.0%
>4.0 to 8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

solution

The challenge of meeting required TOC % removal at the Ten Mile Plant led the City of Helena to partner with state regulators. Compliance was achieved with a treatment plan combined with real-time water quality monitoring.

Not only did TOC data help them understand real-time TOC % removal but also seasonal changes in source water TOC. The value of the data led them to acquire a Sievers* M5310C TOC Laboratory Analyzer for the Ten Mile Plant to pilot and enact treatment changes that led to more consistent water quality and better compliance. Prior to on-site TOC analysis, the city relied on sending samples to third party contract labs. These results took 1-2 weeks leaving the plant blind to both changes in water quality and process effectiveness. The following plant changes were put into effect with the help of on-site TOC analysis:

- Moved chemical addition point (PAC & coagulants) to the front of the plant as opposed to directly before the filters.
- Piloted different chemicals to test TOC % removals as well as color and turbidity removals including polyaluminum chloride, aluminum sulfate, and reduction in use of cationic polymers.

With relatively high alkalinity and low source TOC, the Missouri River Plant easily meets its 25% TOC removal requirement, but it benefits from TOC data to properly help dose PAC to overcome taste & odor issues. Future consideration of ozone for taste & odor management would benefit from optimized ozone to TOC dosing for cost savings and process efficiency.

conclusion

On-site TOC analysis helps the City of Helena test the efficiency of process changes in real-time and can be used to drive data-driven treatment decisions.

As the city continues to grow, upgrade and expansion requirements must consider the challenges of each source water and funding opportunities. In the future, smarter controls will ensure effluent quality meets customer needs and regulation requirements even with challenging and changing water sources.

references

1. Stage 1 Disinfectants and Disinfection Byproducts Rule: A Quick Reference Guide. United State Environmental Protection Agency. May 2001. www.epa.gov/safewater. EPA 816-F-01-010.