

CASE STUDY • MUNICIPAL WASTEWATER

Removing Dissolved Copper (Cu^{2+}) at a Municipal Wastewater Plant

In a full-scale, one-year plant trial, a new metal precipitant and an organic/inorganic coagulant drove dissolved copper below 1.4 ppb — well under a 3.1 ppb discharge limit.


94%

 DISSOLVED COPPER
REMOVED

70%

 DISSOLVED ZINC
REMOVED

<1.4 ppb

 EFFLUENT COPPER
ACHIEVED

At a plant in the Sierra Mountains of Northern California, dissolved copper in the influent varied between 28 ppb and over 70 ppb, and the facility was exceeding its 3.1 ppb discharge limit. A Water-Effect Ratio (WER) study confirmed a very high concentration of dissolved copper prior to dilution into the nearby river.

A bench study was conducted and a treatment program designed to meet the plant's discharge limit. The plant began feeding DZ 9830 at 10 mg/L into the aeration-basin discharge — chemically bonding dissolved copper into copper sulfide — and DZ 1687 at 10 mg/L at the secondary-clarifier inlet to build a dense floc particle.

— Results — secondary clarifier effluent (prior to filtration)

DATE	INFLUENT Cu	EFFLUENT Cu	Cu REMOVAL	INFLUENT Zn	EFFLUENT Zn	Zn REMOVAL
Mar 11	35 ppb	2.0 ppb	94.3%	87 ppb	27 ppb	68.9%
Mar 15	28 ppb	1.6 ppb	94.3%	109 ppb	22 ppb	79.8%
Mar 30	58 ppb	1.4 ppb	97.6%	100 ppb	24 ppb	76.0%
Aug 16	46 ppb	3.8 ppb	91.7%	96 ppb	42 ppb	56.3%

Effluent sampled at the secondary clarifier prior to filtration. Removal of 94% of dissolved copper and ~70% of dissolved zinc was achieved.

— Chemical precipitants

Dissolved-metal removal is driven by the pH of the solution or by metal precipitants. For dissolved copper ions, the traditional method raises the pH of the wastewater with caustic soda, lime, or soda ash, creating an insoluble metal hydroxide. But metal hydroxide is a water-loving ion that produces excessive, difficult-to-dewater sludge, and it is amphoteric — increasingly soluble at both low and high pH. The optimum pH to remove copper is 8.1.

A metal precipitant like DZ 9830 creates a copper-sulfide ion that precipitates over a broad pH range. Metal sulfides are not amphoteric, and they form a dense, easy-to-dewater sludge. Because metal sulfides have a lower solubility than metal hydroxides, higher removal of dissolved copper is achievable than with the traditional hydroxide approach.

In some wastewater systems, naturally occurring chelating agents prevent normal precipitation of a metal hydroxide. DZ 9830 used with DZ 1687 has produced a wastewater effluent below 0.5 ppb in full-scale plant trials — economically. DZ 1687 is a cationic organic/inorganic coagulant that builds a dense particle to improve the settling rate of the metal sulfide precipitate.

WHY IT WORKS

Copper sulfide precipitates across a broad pH range, forms a dense easy-to-dewater sludge, and reaches lower solubility than metal hydroxide — enabling effluent below 0.5 ppb in full-scale trials.



For a copy of the aquatic toxicity reports, contact deepak@dz-worldwide.com.