TECHNICAL BRIEF • MUNICIPAL & INDUSTRIAL WASTEWATER

Removing Dissolved Copper in Wastewater Treatment

How do you meet a dissolved-copper discharge limit of 1.6, 3.1, or 6.1 ppb — cost-effectively? A look at reverse osmosis, deionization, and chemical precipitation.

Three technologies can reach low dissolved-copper levels: reverse osmosis (RO), deionization (DI), and chemical precipitation. Each differs sharply in removal, complexity, and operating cost.

Comparing the three approaches

METHOD	MECHANISM	REMOVAL	KEY TRADE-OFFS
Reverse Osmosis	Membrane filtration	~90% of all ions	High-pressure pumps, up to 20% reject, high capital/energy/maintenance ($0.03–0.05/gal)
Deionization	Ion exchange (H^+ swap)	Cu to ~0.1 ppb	High capital, frequent regeneration, spent-acid disposal, costly resin replacement
Chemical Precipitation JC 9830 + JC 1687	**Metal-sulfide precipitation**	**Cu < 0.5 ppb**	**Broad pH range, dense easy-to-dewater sludge, economical**

RO and DI are effective but capital- and operating-cost intensive. Chemical precipitation with metal sulfides reaches the lowest effluent levels most economically.

Reverse Osmosis (RO)

RO membranes remove dissolved copper effectively, generating ~90% removal of everything. The trade-offs are significant: expensive high-pressure pumps, a rejection rate up to 20%, ongoing maintenance and replacement cost, treatment cost of $0.03–0.05/gal, energy cost, and disposal of spent cleaning solutions. Operational parameters (NTU, TSS, solids loading, silt density index) must all be managed.

Deionization (DI)

DI removes dissolved copper to as low as 0.1 ppb by ion exchange: copper-laden water passes through cationic and anionic resins, exchanging copper for hydrogen ions until the resin is exhausted, then regenerated with sulfuric acid. The trade-offs are high capital investment, disposal of spent cleaning solutions, frequent regeneration, and high resin-replacement cost.

Chemical precipitation — the Jenfitch approach

Dissolved-metal removal is driven by solution pH or by metal precipitants. The traditional route raises pH with caustic soda, lime, or soda ash to form an insoluble metal hydroxide — but hydroxide is amphoteric (increasingly soluble at both low and high pH) and produces excessive, hard-to-dewater sludge. The optimum pH for copper removal is 8.1.

Using the metal precipitant JC 9830, Jenfitch forms a copper-sulfide ion that precipitates over a broad pH range. Metal sulfides are not amphoteric, form a dense easy-to-dewater sludge, and have lower solubility than hydroxides — enabling higher copper removal. Paired with JC 1687, a cationic organic/inorganic coagulant that builds a dense, fast-settling particle, the program has produced effluent below 0.5 ppb in full-scale trials, economically. It also works where naturally occurring chelating agents block normal hydroxide precipitation.

94%
DISSOLVED COPPER REMOVED

70%
DISSOLVED ZINC REMOVED

<0.5 ppb
EFFLUENT COPPER (OTHER TRIALS)

Full-scale, one-year plant results — JC 9830 (10 mg/L) + JC 1687 (10 mg/L)

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%

Values in parts per billion (ppb); effluent sampled at the secondary clarifier prior to filtration. In other studies, the same program achieved non-detect levels for dissolved copper.

LOOKING FOR ALTERNATIVES?

If you need to remove dissolved copper or zinc, contact us at sales@jenfitch.com or call (925) 289-3559 ext. 102 for a copy of the aquatic-toxicity reports.