

**Copper in the Urban Water Cycle:  
Sources and Sinks, Benefits and Detriments,  
and Corrosion in Soft Waters**

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**ABSTRACT**

In recent years, stringent world-wide regulation of copper in drinking water, wastewater discharge and sludge has prompted utilities to carefully evaluate copper sources and sinks, benefits and detriments, and mitigation. This work compiled the individual efforts of researchers and utilities to provide a basis for holistic decision-making. Mass balances suggest that between 14-61% of copper in wastewater originates from home plumbing. Dosing of pure copper sulfate “root killer” by consumers, which is of unlikely value, accounted for up to 27% of copper inputs. Removal of copper in wastewater treatment ranged from 24-90%, suggesting a potential for optimization of these processes if desired. Finally, though utilities are pressured to reduce copper inputs at all stages of the urban water cycle, substantial benefits including human and wastewater bacteria micro-nutrition, water disinfection and algae control should not be overshadowed.

To better understand copper inputs from corrosion in soft waters, a 12 month study was executed. Free chlorine (0.7 mg/L) was determined to have minimally adverse effects on copper release at pH 9.5 but no significant effect at pH 7.0, and higher temperatures usually increased copper release. Organic matter including soluble and particulate NOM, sodium alginate, and gum xanthan, tended to worsen copper release. Their direct effects included complexation and mobilization of pre-existing copper scale as particulates. Indirect effects were also discovered, including a propensity of gum xanthan and alginate to decrease pH, increasing copper release, and also to produce a microbiologically unstable water, decreasing the dissolved oxygen necessary for fueling corrosion reactions. The range of organic matter effects could be placed within a unified conceptual framework.