



Quinoline and Drinking Water

WHAT IS QUINOLINE?

Quinoline (C₉H₇N) is a semi-volatile organic compound that is used as a pharmaceutical (anti-malarial) and flavoring agent, and is an intermediate chemical in the manufacture of other products, such as, pesticides and dyes. Quinoline is also present in cigarette smoke, coal, and coal tar. Coal tar is the primary source of commercial quinoline (USEPA, 2016; Collin and Hoke, 2000).

HOW IS ONE EXPOSED TO QUINOLINE?

Exposure to quinoline could occur by taking an anti-malarial drug, consuming food or beverages with quinoline as an additive, or through inhalation of cigarette smoke (USEPA, 2001). Quinoline is soluble in water and is known as an environmental contaminant near facilities that process coal and oil shale. Therefore, drinking water supplies could be affected near coal and oil operations.

During the first half of the 1900s, coal tar was commonly used in the drinking water industry as a lining material to prevent steel corrosion of reservoirs and pipelines. Over the past 20 years, SFPUC removed all coal tar linings in City reservoirs and removed or relined a portion of the pipelines that contained coal tar. However, there are still approximately 23 miles of large transmission pipeline with coal tar lining in contact with SFPUC's drinking water and quinoline may be detected, especially when sampling is performed after water stagnates in these areas.

WHAT ARE THE RISKS OF QUINOLINE?

The United States Environmental Protection Agency (USEPA) classifies quinoline as a probable human carcinogen. According to USEPA, quinoline concentrations in drinking water of 0.01 to 1 µg/L (part per billion, ppb) are associated with a cancer risk of 1 in a million to 1 in 10,000 over a lifetime of exposure, respectively.

HOW ARE FEDERAL AND STATE REGULATORS RESPONDING TO QUINOLINE IN DRINKING WATER?

Currently, there are no federal or California standards to regulate quinoline in public water systems. USEPA included quinoline as one of about 100 substances on its Contaminant Candidate List 4 (CCL 4), a list published in 2016 to help USEPA establish priorities for possible regulatory actions in the future.

HOW CAN I REDUCE POTENTIAL QUINOLINE EXPOSURE FROM DRINKING WATER?

San Francisco's drinking water consistently meets all federal and state drinking water standards and is safe to drink throughout the service area. SFPUC's monitoring and mitigation efforts have made it unlikely that even trace levels of quinoline would be present at a customer's tap. Therefore, no additional steps are necessary by customers.

However, if customers wish to pursue additional, precautionary measures, commonly available pitcher filters and kitchen tap filters with activated carbon are capable of removing a wide range of organic compounds such as quinoline.

Furthermore, USEPA's Unregulated Contaminant Monitoring Rule 4 (UCMR 4) published in 2016 required utilities to monitor treated drinking water for 30 unregulated contaminants, including quinoline. SFPUC completed the required UCMR 4 monitoring in January 2019 and, as summarized below, low levels of quinoline (0.02 to 1.5 µg/L) were detected at some locations.

UCMR 4 Quinoline Monitoring Results for San Francisco Water System, 2018 - 2019

Location	Test Results (µg/L)
Point of Entry	Non-detect (<0.02) to 0.029
Distribution System Pump Station	Non-detect (<0.02) to 1.500
Distribution System Reservoir Outlets	Non-detect (<0.02) to 0.026

In response to these UCMR 4 detections, SFPUC conducted systemwide quinoline monitoring in December 2019, including raw source waters, transmission pipelines, and distribution system taps in San Francisco. Most results in December 2019 were non-detect, however, quinoline was detected in some distribution samples (0.02 to 0.21 µg/L). These detections appeared to be influenced by (1) the presence of coal tar lining and (2) water stagnation from non-operational periods (**see data table of all quinoline monitoring results**). Consumers would not have long-term exposure to elevated quinoline levels (>0.10 µg/L) as complete outages due to maintenance are rare. Furthermore, quinoline levels measured upstream and downstream of the elevated detections in 2018/2019 were non-detect or near the detection level (<0.02 to 0.022 µg/L).

HOW IS SFPUC RESPONDING TO THESE LOW-LEVEL QUINOLINE DETECTIONS?

There are no federal or California regulatory limits for quinoline in drinking water and, after UCMR 4, there are no additional monitoring or reporting requirements for quinoline. However, due to the detection of quinoline at some locations, SFPUC is taking proactive, voluntary actions to minimize, and eventually eliminate, the presence of quinoline in drinking water. These steps include:

Short-term measures

- Monitor and assess pipelines that have been out of service for prolonged periods of time.
- Mitigate elevated quinoline levels from maintenance outages and non-operations by:
 - o flushing
 - o conducting additional monitoring in affected locations, and
 - o minimizing customer delivery of affected water.

Long-term measures

- Ensure new reservoirs and pipelines only use NSF-approved lining materials (NSF International is an independent organization that conducts testing and establishes public health standards for materials that come in contact with drinking water.)
- Remove coal tar linings from existing pipelines during water system upgrades.
- Implement protective strategies on coal tar lined pipes when removal of coal tar is not feasible. For example, encapsulate coal-tar linings with new NSF-approved linings to prevent coal tar from contacting and leaching quinoline into drinking water, or insert a smaller pipe inside the existing coal tar lined pipe, a technology known as slip-lining.
- Conduct systemwide quinoline monitoring every 6 years to track long-term improvements, as part of SFPUC's Contaminants of Emerging Concern (CEC) program.



CONSUMER RESOURCES: REGULATION/HEALTH

- NSF International: Public Health and Safety Organization
www.nsf.org
- SFPUC: 2019 Progress Update, Contaminants of Emerging Concern
www.sfwater.org/Modules/ShowDocument.aspx?documentID=13956
- USEPA: Contaminant Candidate List 4 (CCL 4), Chemical Contaminants
www.epa.gov/ccl/chemical-contaminants-ccl-4

*Valve installation
with NSF-approved
polyurethane lining
(January 2015)*

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