

Integrated Report Improvements

Chromium

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State of Oregon
Department of
Environmental
Quality

Chromium background

Aquatic life surface water quality criteria are in effect for chromium(III) (trivalent ion) and chromium(VI) (hexavalent ion) as identified in OAR 340-041-0033 Table 30. Because separating both ionic forms for routine measurement is technically and financially prohibitive, most laboratories (including DEQ's laboratory) measure total chromium. Total chromium is a measure of all forms of chromium in a sample, giving the amount of both the trivalent and hexavalent forms together. Chromium is naturally present in both the soil and geological formations in our region. However, oxidation from microbial and biological activity tends to halt at the stable, ubiquitous chromium(III) state in surface waters.

Chromium is a naturally occurring element in rocks, animals, plants, soil, and volcanic dust and gases¹. Chromium occurs in the environment predominantly in one of two valence states: trivalent chromium (Cr III), which occurs naturally and is an essential nutrient, and hexavalent chromium (Cr VI), which, along with the less common metallic chromium (Cr 0), is most commonly produced by industrial processes². Chromium (III) is essential to normal glucose, protein, and fat metabolism and is thus an essential dietary element. The most important industrial sources of chromium in the atmosphere are those related to ferrochrome production. Other contributors are: ore refining operations, chemical and refractory processing, cement-producing plants, automobile brake lining and catalytic converters for automobiles, and leather tanneries.

Assessment History

DEQ's 2010 and 2012 Integrated Report Assessment Methodology did not distinguish between chromium(III) and chromium(VI) oxidation states. DEQ applied the most stringent aquatic or human health criteria to evaluate total chromium data.

In these cases, chromium(VI) is the most stringent criteria in either freshwater or saltwater environments (Table 1). This approach tends to overestimate toxicity by presuming the samples represent the chromium(VI) ion when the water sample is most likely primarily comprised of the less toxic and more common chromium(III) ion.

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DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

¹ Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Chromium. U.S. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1998

² <https://www.epa.gov/sites/production/files/2016-09/documents/chromium-compounds.pdf>

Table 1. Numeric water quality criteria for chromium(III) and chromium (VI) from Table 30.

Chemical	Human Health Criteria		Aquatic Life Criteria (Freshwater)		Aquatic Life Criteria (Saltwater)	
	Water + Org (µg/L)	Org Only (µg/L)	Acute (µg/L)	Chronic (µg/L)	Acute (µg/L)	Chronic (µg/L)
Chromium(VI)	---	---	16 ^C	11 ^C	1100 ^C	50 ^C
Chromium(III)	---	---	Calculate ^{C,F}	Calculate ^{C,F}	---	---
	^C Criterion is expressed in terms of “dissolved” concentrations in the water column. ^F The freshwater criteria for this metal is expressed as a function of hardness (mg/l) in the water column. To Calculate the criterion use formula under					

Oregon’s human health criteria for chromium(III) and chromium(VI) were withdrawn in 2004 and the withdrawal was approved by EPA in June 2011. The aquatic life criteria in OAR 340-041-0033 Table 30 include criteria for two oxidation states of chromium - chromium(III) (trivalent) and chromium(VI) (hexavalent). The criteria for chromium(III) are hardness dependent (Table 1).

DEQ reviewed 79 aqueous total chromium samples³ submitted by EPA for the time period September 2004 through June 2007 extracted from the National Water Quality Portal in July 2017. Seventy-four of the seventy-nine samples (94%) were reported as either estimated or non-detect. Five of the 79 samples (6%) reported measured total chromium data, with four of the five samples reported as estimated values between method detection and minimum reporting limits. One measured value of 24.5 µg/L exceeded the chronic aquatic life chromium(VI) criteria of 11 µg/L and chromium(III) criteria of 24 µg/L⁴ (Table 2).

Table 2. Numeric water quality criteria for chromium(III) and VI at common hardness values.

Hardness, mg/L	Chromium III (chronic), µg/L	Chromium VI (chronic), µg/L
25	24	11
50	42	11
75	59	11
100	74	11
125	89	11
150	103	11
175	117	11
200	131	11

³ Samples were collected in locations with possible industrial sources

⁴ A default hardness value of 25 mg/L was used to calculate chromium(III) criteria.

Chromium Listings

Currently, there are three Category 5 listings for chromium. Two of the waterbodies were included on the 2002 303(d) list based on data collected in 1989 and 1992. The listing for Gales Creek was added in 2012 based on data collected in 2009-2010. There are twelve Category 3B chromium listings on the 2012 303(d) list, three of which were added in 2012. DEQ will re-evaluate any listings where new data are provided. Absent data to make an assessment decision, previous Category 5 listings will be brought forward to the 2018 303(d) list. DEQ encourages interested parties to submit any data they would like to see re-evaluated during this assessment.

DEQ Recommendation

DEQ is recommending for the 2018 Integrated Report that where chromium data are available as total chromium, and the chromium(III) (trivalent) criteria are exceeded, waterbodies will be identified as Category 5. When chromium data are available as total chromium, and the chromium(VI) (hexavalent) criteria are exceeded, waterbodies will be identified as Category 3B: Insufficient Data; Exceedances and target follow up monitoring for laboratory confirmation of chromium(VI) levels, specifically. In general, DEQ does not expect to have more Chromium(VI) data than it has had in previous Integrated Reports; therefore, it is preferable to identify these waters for follow-up monitoring to confirm the risk of chromium toxicity before assigning these waters a final status.

Alternative formats

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