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CHROMIUM FACT SHEET

Contaminant	In Water As	Maximum Contaminant Level
Chromium (Cr)	Trivalent Cr(III): Cr^{3+} Hexavalent Cr(VI) dichromate $Cr_2O_7^{2-}$ Hexavalent Cr(VI) chromate CrO_4^{2-}	**US EPA (for total Chromium):** MCL* = 0.10 mg/L (or ppm) MCLG** = 0.10 mg/L **WHO† Guideline** = 0.05 mg/L **California MCL:** Cr-6 = 0.010 mg/L Total Cr = 0.05 mg/L
Sources	Trivalent chromium is naturally occurring Hexavalent chromium is produced by certain chemical processes	
Potential Health Effects	Nausea, gastrointestinal distress, stomach ulcers, skin ulcers, allergic reactions Kidney and liver damage Reproductive problems Lung and nasal cancer	
Treatment Methods **Point-of-Entry** **Point-of-Use**	<u>Trivalent</u> Reverse Osmosis (TFC, CTA) Distillation Strong Acid Cation Resin <u>Hexavalent</u> Reverse Osmosis (TFC, CTA) Distillation Strong Base Anion Resin Weak Base Anion Resin <u>Organic Complexes</u> Reverse Osmosis (TFC, CTA) Activated Carbon	

*Maximum Contaminant Level (MCL) — The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.

**Maximum Contaminant Level Goal (MCLG) - The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.

WHO† - World Health Organization

Trivalent chromium occurs naturally in the environment and can be found in rocks and soil. It can also be found in fruits, vegetables and meat. Cr^{3+} is used to make bricks, metal alloys and chemical compounds. Hexavalent chromium does not occur naturally in the environment. It is produced by certain chemical processes and is considered toxic. Metallic elemental chromium or chrome does not occur naturally in the environment. It is used to make steel and other metal alloys and is produced from chrome bearing ore.

HEALTH EFFECTS

It is suggested that Cr^{3+} is not considered a significant health risk, while the more soluble Cr^{6+} is considered toxic. Two of the more common forms of this type of hexavalent chromium are dichromate ($Cr_2O_7^{-2}$), found at a pH below 5, and chromate (CrO_4^{-2}), found at a pH above 6. Cr^{6+} thus forms negatively charged anionic complexes. Cr^{6+} is used in the plating industry, paint production, as well as an anticorrosive alloy in steel and iron production. Cr^{6+} was also used as an anti-corrosion agent in boiler water and cooling tower water treatment. It is considered a health risk whether it contacts the skin, it is inhaled, or it is ingested. It can cause nausea, gastrointestinal distress, stomach ulcers, skin ulcers, allergic reactions, kidney and liver damage, reproductive problems, lung and nasal cancer. It is believed that hexavalent chromium (Cr^{6+}) will be reduced to Cr^{3+} causing DNA damage in the cell. It is possible, under the right chemical environment for chromium to convert between the different forms.

The EPA has set a maximum contaminant level (MCL) and the MCLG for total chromium of 0.1 ppm (100 ppb) in drinking water. The USEPA is currently evaluating to determine if a new drinking water standard for hexavalent chromium, Cr^{6+} is needed. Tap water has an average of 0.4 to 8 ppb total chromium; air has an average of 0.1 ppb (OSHA has set a workplace indoor air limit of 100 ppb based on a 40 hour workweek). Soil has an average chromium value of 400 ppm.

TREATMENT METHODS

Residential **Point-of-Use** **Point-of-Entry**	<u>Trivalent</u> Reverse Osmosis (TFC, CTA) Distillation Strong Acid Cation Resin <u>Hexavalent</u> Reverse Osmosis (TFC, CTA) Distillation Strong Base Anion Resin Weak Base Anion Resin <u>Organic Complexes</u> Reverse Osmosis (TFC, CTA) Activated Carbon
Municipal	Reduce Cr(VI) to Cr(III), with chemical means such as reaction with ferrous iron, followed by coagulation and filtration

Visit WQA.org or NSF.org to search for products certified to WQAS-200, NSF/ANSI 53 and 58 for chromium reduction.

Trivalent chromium is a cation and can be removed from water with a strong acid cation ion-exchange resin in the sodium form. Salt (NaCl) is used as the regenerant, however chromium may not be completely removed from the resin during the regeneration process. A periodic acid strip will help remove Cr^{3+} from the resin, followed by a normal salt regeneration to convert the resin to the sodium form. A second regeneration may be necessary if the pH of the service cycle is too low. Acid stripping may be done at a regeneration plant, however, consumers could use a resin cleaner, as with iron, or add ¼ cup of citric acid per bag of salt once every 3 months. In general, cation resins will have a higher affinity for chromium than for manganese and iron, therefore iron and manganese will break through before chromium does. Consult with the resin manufacturer for specific chromium loads on the resin bed and regeneration recommendations.

Hexavalent chromium can be removed from water by a number of methods. A strong base anion exchange system will reduce both dichromate and chromate. The resin is regenerated with salt, however an occasional treatment of a combined salt and caustic solution will be required since a portion of the chrome will not be stripped from the resin. The service cycle can be extended if the pH of the raw water is less than 5. A weak base anion resin can also be used if proper pretreatment and regeneration are used; treatment designers should consult their resin manufacturer for details. Chromate is an oxidizer and will attack and breakdown ion exchange resin over time. Resin should not be stored or shutdown when the resin is in the chromate form. Heat may also be generated which can have a negative impact on the resin.

Organic complexes of chromium can be reduced with a combination of reverse osmosis and granular activated carbon.

Reverse osmosis and distillation will reduce all types of chromium found in water. Proper pretreatment for hardness, iron, manganese, and silt or turbidity control is required for successful and trouble free results.

The treatment methods listed herein are generally recognized as techniques that can effectively reduce the listed contaminants sufficiently to meet or exceed the relevant MCL. However, this list does not reflect the fact that point-of-use/point-of-entry (POU/POE) devices and systems currently on the market may differ widely in their effectiveness in treating specific contaminants, and performance may vary from application to application. Therefore, selection of a particular device or system for health contaminant reduction should be made only after careful investigation of its performance capabilities based on results from competent equipment validation testing for the specific contaminant to be reduced.

As part of point-of-entry treatment system installation procedures, system performance characteristics should be verified by tests conducted under established test procedures and water analysis. Thereafter, the resulting water should be monitored periodically to verify continued performance. The application of the water treatment equipment must be controlled diligently to ensure that acceptable feed water conditions and equipment capacity are not exceeded.

Visit WQA.org to locate water professionals in your area. Note that Certified Water Specialists have passed the water treatment education program with the Water Quality Association and continue their education with recertification every 3 years.

REGULATIONS

In the United States, the EPA under the authority of the Safe Drinking Water Act (SDWA) has set the Maximum Contaminant Level (MCL) and the MCL Goal (MCLG) for chromium at 0.10 mg/L. This is the health-based level at which no known or anticipated adverse effects on human health occur and for which an adequate margin of safety exists. This means that utilities must ensure that water from the customer's tap does not exceed this level in at least 90 percent of the homes sampled. The utility must take certain steps to correct the problem if the tap water exceeds the limit and they must notify citizens of all violations of the standard.

In the state of California, the MCL is 0.05 mg/L for total chromium in drinking water. Specifically for chromium-6, California has finalized the public health goal (PHG) at 0.02 ppb and has newly adopted a MCL for Cr-6 which is 10ppb. Additionally, total chromium and chromium-6 are on the US EPA's List 1 for assessment according to the Unregulated Contaminant Monitoring Rule (UCMR).

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