

CHROMATE PAINTS

What is Chromium?

Chromium is a metallic element. It can exist in its elemental form, where it has the same number of protons and electrons (24). It can also form compounds with other elements in which some of the outer electrons (valence electrons) of Chromium can be displaced to form different ions (or species) of Chromium. For example, Chromium(III), or Cr^{3+} , is missing 3 electrons and combines with other elements to form a variety of naturally occurring and man-made compounds.



What is Hexavalent Chromium?

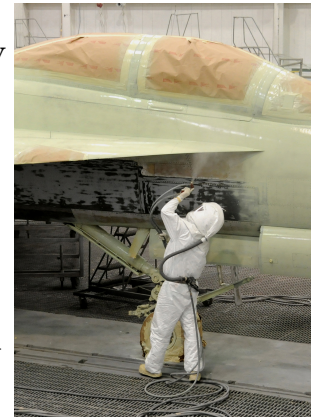
Hexavalent Chromium, or Cr(VI) , or Cr^{6+} , is a man-made ion or species of Chromium that has 6 valence electrons removed, hence the name. It only exists when combined with other elements to form certain chemical compounds, such as **Strontium Chromate** (SrCrO_4), Calcium Chromate (CaCrO_4), Zinc Chromate (ZnCrO_4), Lead Chromate (PbCrO_4), Sodium Dichromate ($\text{Na}_2\text{Cr}_2\text{O}_7$) and Chromic Acid (H_2CrO_4).

Industrial Uses of Cr(VI) Compounds

Hexavalent Chromium compounds, in one form or another, have been used for many decades. Chromic Acid is used in chrome electroplating. Sodium Dichromate is used as a dye and wood preservative. Cr(VI) compounds were long used to prevent corrosion in gas pipeline equipment (See, e.g., the *Erin Brockovich* movie).

Chromate Paints

The aluminum alloy components of airplanes are subject to corrosion, and if unchecked can cause structural failure. In the 1980s, the anti-corrosion paints and coatings in use at the time contained high levels of *volatile organic compounds* (VOCs) - toxic solvents that would vaporize at room temperature. Partially in response to new air pollution regulations, the military and commercial aircraft industries (among others) began using epoxy coatings - typically as a first-coat primer - that would meet low VOC requirements. The epoxy paint was sold in two parts: a gallon of base component that contained a pigment, and a quart of catalyst or hardener that was added to the base component shortly before application.



The pigment constituted about 10% of the base component and was typically a fine powder of Strontium Chromate, Barium Chromate or Zinc Chromate - compounds that contained hexavalent chromium, usually written as " Cr(VI) ". The Cr(VI) would chemically bond to the aluminum in the aircraft components and cause the paint to strongly adhere to the surface. Military specifications were revised to specifically require the pigments in these coatings to contain **Strontium Chromate** or similar compounds (e.g., MIL-P-23377F (5 May 1989), MIL-P-85582A (8 Feb 1988)).

Health Effects of Cr(VI)

The Cr(VI) ion is highly reactive, and will often cause oxidation and reduction reactions to occur when in solution with other compounds. Because of its physical similarity to Sulfur, it can be transported into cells via sulfate channels where it can wreak havoc. It is genotoxic and produces oxidative stress. IARC classifies all Cr(VI) compounds as "*carcinogenic to humans* (Group 1), but recognizes that the partially water-soluble Cr(VI) compounds, such as **Strontium Chromate**, and Zinc Chromate are the most carcinogenic.

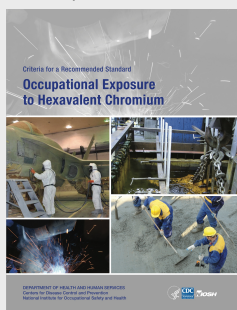
OSHA Regulations

In the 1990s, the OSHA permissible exposure limit (PEL) for hexavalent chromium compounds, including Strontium Chromate paints, was 0.052 milligrams (mg), or 52 micrograms (μg), per cubic meter of air (m^3). This could often be achieved by providing the worker with a half-faced respirator and employing a spray booth.

In 2008, after a protracted legal battle, OSHA lowered the PEL for all Cr(VI) compounds by a factor of 10, to 5 $\mu\text{g}/\text{m}^3$. 1910.1026. OSHA estimated that "[a]pproximately 558,000 workers are covered by the provisions of the new standard."

In explaining the need to lower the PEL, OSHA stated that at the PEL of 52 μg , workers faced a "significant risk to material impairment of their health". OSHA also stated that "significant risk remains at a PEL of 5 $\mu\text{g}/\text{m}^3$ ", but the agency was legally constrained from lowering the PEL any further. (See, 71 Fed Reg 10100).

NIOSH does not operate within the same constraints as OSHA, and thus it had a lower recommended exposure level (REL). NIOSH currently recommends that airborne exposures to all Cr(VI) compounds be below 0.2 $\mu\text{g}/\text{m}^3$.



Heubeck Law, P.C.

John C. Heubeck, Esq.

400 Continental Blvd., 6th Floor
El Segundo, CA 90245
(424) 218-5424

john@HeubeckLaw.com
marc@HeubeckLaw.com

Strontium Chromate

Even when compared to other hexavalent chromium compounds, Strontium Chromate is *extremely* carcinogenic. For example, in a 1986 study of the potential carcinogenicity of various chromates, Strontium Chromate was implanted in the lungs of 99 rats, and produced bronchial tumors in 63 of them. The other chromates tested did not come close to the toxicity of Strontium Chromate. Levy (1986).

On the strength of this study and others, various regulatory and advisory agencies now recognize that Strontium Chromate is especially dangerous. For example, the ACGIH set the threshold limit value (TLV) for Chromic Acid at 0.05 mg/m^3 and the TLV for Strontium Chromate 100 times lower, at 0.0005 mg/m^3 .

The *partial* solubility in water of Strontium Chromate (and several other Chromates) explains its high carcinogenicity. When prepared as a pigment, the material is put through a hammer mill. A percentage of the resulting powder is extremely small - less than 2 microns. When chromate paint mist is inhaled, small particles of Strontium Chromate enter the lungs and become lodged in the alveoli. They do not quickly dissolve. Instead, the Strontium Chromate slowly leaches into the adjacent cells where it can produce a localized lung tumor, with a latency period of roughly 20-years.



Historic Exposures

Strontium Chromate paints were typically applied by a pressurized spray gun that generated a substantial amount of overspray. When possible, the painting would be performed in a large spray booth. Because Strontium Chromate powder would not dissolve in the base coat, it could also be re-released into the air during sanding of the paint.

In the 1990s, exposures up to 52 micrograms per cubic meter of air were common and permissible. In 2006, OSHA finally joined other agencies and organizations in acknowledging that such exposures were too high. In response to these regulatory changes, chromate paints are now rarely used. Unfortunately for those who used these products in the 1990s and early 2000s, the damage has already been done.

For more information about Cr(VI) exposure, or any chemical exposure case, contact us. Our knowledge and experience can add significant value to the case.