

Chromium or compounds thereof

Definition of causal agent

Chromium is a hard solid, blue-white to steel-grey, lustrous metal very resistant to wear and corrosion. It is found in nature only in the combined state and it forms a number of compounds with oxidation states ranging from -II to +VI; the compounds of +III (chromic) and +VI (chromates) are the most used for industrial purpose. Cr(VI) is an oxidizing agent that may react with reducing (organic) matter to form the most stable Cr(III).

Soluble Cr(VI) compounds: ammonium chromate, potassium chromate, sodium chromate, potassium dichromate, sodium dichromate, ammonium dichromate, chromic trioxide (chromic anhydride or chromic acid).

Non-soluble or slightly soluble Cr(VI) compounds: barium chromate, lead chromate, calcium chromate, strontium chromate, zinc chromate, mixed zinc and potassium chromate.

Cr(III) compounds: chromium acetate, chromic oxide, chromium orthophosphate, chromium pyrophosphate, chromium sulphate, chromium sulphide.

Main occupational uses and sources of exposure:

The stainless steel production and welding (in which the chromium VI and chromium III could be found); manufacture of alloys (VI and III), metal-plating industry (VI and III); manufacture of pigments (VI and III, chrome yellow); chromate production from iron chromate (VI); wood preservation (VI, chromic anhydride); tanning leather industry (III except for 2 bath processes used in the past and in which chromium VI was employed); smaller amounts are used in chemical manufacturing, textiles (dyeing, silk treating, printing, moth proofing wool), toners for copying machines, magnetic tapes, lithography, photography (fixing baths), and as catalysts; traces of chromium in cement. Chromium picolinate (III) is used as a dietary supplement

Toxic effects

The physiological responses to chromium and its compounds are wide and vary functionally depending of the different oxidation states and the toxicological potential; further, within each valency group, toxicity can vary according to solubility.

In humans and animals, Cr(III) is an essential trace nutrient required for normal energy metabolism (Glucose Tolerance Factor). In contrast, the strong oxidizing potential of Cr(VI) explains much of their irritating and toxic properties.

1. Local effects

□ Irritant and corrosive effects

Chromium (VI) (aerosols, dusts, liquid) irritates or even corrodes the skin and the mucous membranes of the eyes and respiratory tract (the spraying of chromic acid can give rise to serious eye lesions and intense exposure to chromic acid particulates may give rise to pulmonary oedema). Also acute oral Cr(VI) toxicity is probably a result of bleeding due to irritation and corrosion (gastroenteritis, hepatic necrosis, acute tubular necrosis with renal failure).

Chrome ulcers (chrome “holes”)

Deep, round holes, clearly marked, usually at the base of the nails, the finger joints, the skin between the fingers, the back of the hand and the forearm (may also appear at other sites). The lesions are only slightly painful, tend to be clean, if at all, but they take a long time to heal and scars are left.

Perforation of the nasal septum

Intense Cr(VI) airborne exposure for two weeks, or less intense exposure for several months (maximum latent period 10 years) may cause painless ulceration, accompanied by foul nasal discharge, sited approximately 1.5 to 2 cm from the lower anterior part of the nasal septum but may extend to the upper posterior part.

See section on ***Occupationally caused irritation of the skin and mucous membranes*** in Annex I entry nr. 202.

□ Allergic effects

Allergic dermatitis

Cr(VI) penetrates undamaged skin (the ulcer does not seem to bear any relationship to the development of allergic sensitization) and subsequently combines with proteins. Contact hypersensitivity due to chromium compounds is caused by a direct effect as haptene into the skin, where chromium is conjugated with autologous proteins to form a full antigen.

See section on ***Occupationally caused allergic contact dermatoses*** in Annex I entry nr. 202.

Asthma

Respiratory sensitization, by inhalation of Cr(VI) compounds may develop (chemical substances of low molecular mass), resulting in generalized bronchospasm and typical asthmatic attacks, which occur on subsequent low exposure levels to dusts, aerosols or welding fumes.

See Annex I entry nr. 304.06 on ***Allergic asthmas caused by the inhalation of substances consistently recognised as causing allergies and inherent to the type of work.***

2. Systemic effects

□ Chronic obstructive bronchopneumopathy

Prolonged inhalation of Cr(VI) particulates can cause chronic respiratory irritation with hyperaemia, chronic inflammation of the lung, chronic bronchitis, bronchopneumonia, and emphysema.
Respiratory function: reduction in FEV₁ and maximal expiratory flow.
Possibility of complication in the form of an infection.

Exposure criteria:

Minimum intensity of exposure: Occupational exposure confirmed by

- history and a study of working conditions providing evidence of prolonged or repeated exposure to Cr(VI),
- and, if available;
 - biological monitoring
 - workplace air monitoring.

Minimum duration of exposure: 10 years

Maximum latent period: Five years.

□ Lung cancer

There is no evidence that exposure to metallic chromium or Cr(III) compounds causes cancer in man, while Cr(VI) soluble and insoluble compounds have been linked with increased risk for human lung cancer (dose-response relationships have been established). Cr(VI) carcinogenesis may result from the formation of mutagenic oxidative DNA lesions consequential to the intracellular reduction to the trivalent form.

Carcinogenicity by the oral route of exposure cannot be determined.

Exposure criteria:

Minimum intensity of exposure: Occupational exposure confirmed by

- history and a study of working conditions providing evidence of prolonged or repeated exposure to Cr(VI) compounds,
- and, if available;
 - biological monitoring
 - workplace air monitoring

Minimum duration of exposure: 1 year

Minimum induction period: 15 years

Maximum latent period: not determinable.

See section on ***Occupational cancers*** in the **Preface**.