June 2023

The SCOEL recommendation document covers the following substances:

Substance name	EC number	CAS RN
Chromium metal	231-157-5	7440-47-3
Inorganic Chromium (II) compounds		
Inorganic Chromium (III) compounds including chromite ore		

This text is not part of the official SCOEL Recommendation and is provided to give additional helpful information to the reader as regards chemicals addressed by the SCOEL Recommendation. The list is non-exhaustive and is presented for information purposes only.

Recommendation from the Scientific Committee on Occupational Exposure Limits for Chromium Metal, Inorganic Chromium (II) Compounds, and Inorganic Chromium (III) Compounds

8 hour TWA	:	2.0 mg/m^3 total dust (calculated as Cr)
STEL (15 mins)	:	(insoluble compounds)
Additional classification	:	-

Substance:

Chromium metal Cr

CAS N° : 7440-47-3
MWt : 52

Inorganic chromium (II) compounds
Inorganic chromium (III) compounds

EU classification for dichromium tris(chromate), chromium III chromate and chromic chromate:

O ; R8 Contact with combustible material may cause fire.
Carc. Cat. 2; R45 May cause cancer
C; R35 Causes severe burns
R43 May cause sensitization by skin contact
N; R50-53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Conversion factor: not appropriate

Occurrence/use:

Chromium is a very hard transitional metal element with a MPt of 1850-1900°C and an extremely low water solubility. Under normal circumstances it is stable in air. A number of inorganic chromium (II) and chromium (III) compounds exist, including

chromite ore [Cr(III)], the predominant naturally occurring form of chromium. All these compounds exist as solids at ambient temperatures, with a wide range of water solubilities. In aqueous solution the Cr(II) ion is readily oxidised to Cr(III) and therefore it is anticipated that the toxicological properties of Cr(II) and Cr(III) would be similar.

This proposal does not address the toxicology or the effects of occupational exposure to chromium (VI) compounds, some of which are recognised human carcinogens.

Some chromite ore is used to produce metallic chromium, but most is reduced to ferrochrome, an iron/chromium alloy, or is converted to sodium dichromate, from which a range of further chromium-containing compounds and products are manufactured. The major use of metallic chromium is in the production of alloys. Chromium compounds are used principally in electrolytic plating and anodising processes, in the production of pigments and dyestuffs, tanning agents, paints, wood preservatives, dyeing fixatives, photographic sensitisers, catalysts and refractory materials.

Exposure to chromium metal, Cr(II) and Cr(III) occurs in a wide range of industries. In some circumstances there may be concomitant exposure with Cr(VI).

Health Significance:

No toxicokinetic data are available on chromium metal, although extremely poor absorption would be expected from inhalation, oral or dermal exposure. No toxicokinetic data are available on Cr(II) compounds, although behaviour similar to that of Cr(III) compounds of comparable water solubility would be anticipated. In animals inhalation of Cr(III) compounds resulted in fairly rapid absorption of a small proportion of the dose, the extent of absorption depending upon the water solubility. Substantial proportions remained in the lungs for long periods of time. In the blood, Cr(III) remained almost entirely in the plasma, mainly bound to transferrin. Absorption via the gastrointestinal tract or skin is poor. Similar results are indicated in humans.

In animals the toxicity data available on chromium are very limited, although low toxicity would be anticipated in view of the poor bioavailability. Exposure of rabbits to 3.1 mg/m^3 (respirable) Cr metal, 6h/d, 5d/w, for 4 weeks had no effect on lung structure or alveolar function (metabolic or phagocytic activity); other tissues were not examined (Johansson *et al*, 1980). Carcinogenicity studies have involved parenteral dosing and have focused on administration site tumours; such studies are of no value in assessing more relevant routes of exposure.

Water-soluble Cr(III) compounds given orally, in single doses to rats and mice, exhibited moderate toxicity (LD50 values 140-422 mg Cr(III)/kg). Cr(III) was not irritating to the skin or eyes, unless in solutions of very low pH, however skin sensitisation was produced in animals.

The poor bioavailability of Cr and Cr (II) and (III) compounds suggests that the likely critical effect would be on the respiratory tract. Rabbits exposed to 0, 0.6 or 2.3 mg/m^3

Cr(III) as chromium (III) nitrate, 6h/d, 5d/w for 4-6 or 17-21 weeks showed no clinical signs or histopathological differences in lung tissue between test and control animals (Johansson *et al*, 1986a, 1986b, 1987). There were some changes in the appearance and *in vitro* functioning (increases in metabolic activity and reduced phagocytic activity) of alveolar macrophages taken from the treated groups but this did not seem to result in any detrimental effects on the health of the rabbits.

In general, negative genotoxicity results were obtained when Cr(III) compounds were tested for point mutations or DNA damage in bacteria, and for gene mutations, unscheduled DNA synthesis or cell transformation in mammalian cells, consistent with very poor uptake of Cr(III). The results of *in vitro* clastogenicity tests were equivocal. Genotoxicity has been inadequately investigated *in vivo*, although negative results were obtained in the few studies available (HSE, 1989).

Effects of Cr(III) on reproduction in animals have been poorly investigated.

There is no good evidence of adverse health effects in humans arising from occupational exposure to Cr metal, Cr(II) or Cr(III) compounds. Skin sensitisation has been reported in certain circumstances. In a cross-sectional examination of 106 workers in two West German factories (one producing chromic sulphates and the other chromium oxides) of which subgroups based on workstations were exposed to mean concentrations of 0.78-2.92 mg/m^3 Cr_2O_3 [equivalent chromium content 0.53-2.0 mg Cr(III)/m^3] or to 0-2.7 mg/m^3 $Cr_2(SO_4)_3$ [equivalent chromium content 0-0.72 mg Cr(III)/m^3] respectively, showed no evidence of skin problems, or of unusual haematology or clinical chemistry. Examination of respiratory symptoms and chest x-rays showed no apparent problems, although lung function tests (FVC and FEV_1) showed some possible decrements in FEV_1. Interpretation was not possible due to previous dusty occupational histories (Korallus *et al*, 1974).

Recommendation:

For Cr(III), there is evidence from investigations in both animals and man that repeated exposure to concentrations in the region of 0.5 - 2.3 mg Cr(III)/m^3 does not result in adverse effects on the lungs (Johansson *et al*, 1986a, 1986b, 1987; Korallus *et al*, 1974). No reliable information exists on the effects of higher concentrations. An 8-hour TWA of 2.0 mg/m^3 total dust (based on Cr) is therefore recommended. No STEL or "skin" notation was considered necessary. The toxicological data available on Cr metal and Cr(II) compounds are very limited. However, it is predictable that the properties and activity of Cr(II) would be similar to Cr(III), and that Cr metal would be even less biologically active. An 8h TWA of 2.0 mg Cr/m^3, with no STEL, would therefore be appropriate for all forms of Cr under consideration. These limits apply to chromium metal, and Cr(II) and Cr(III) insoluble compounds only.
At the levels recommended, no measurement difficulties are foreseen.

Cr(VI) is a carcinogenic chromium species which is evaluated differently.

Key Bibliography:

HSE (1989). HSE Toxicity Review 21: The toxicity of chromium and inorganic chromium compounds. HMSO, London.

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