Update to the Inhalation Unit Risk (IUR) for Cobalt Sulfate Heptahydrate

OEHHA Air Toxics Hot Spots Program

Daryn Dodge

Staff Toxicologist

Air and Toxicology Risk Assessment Section

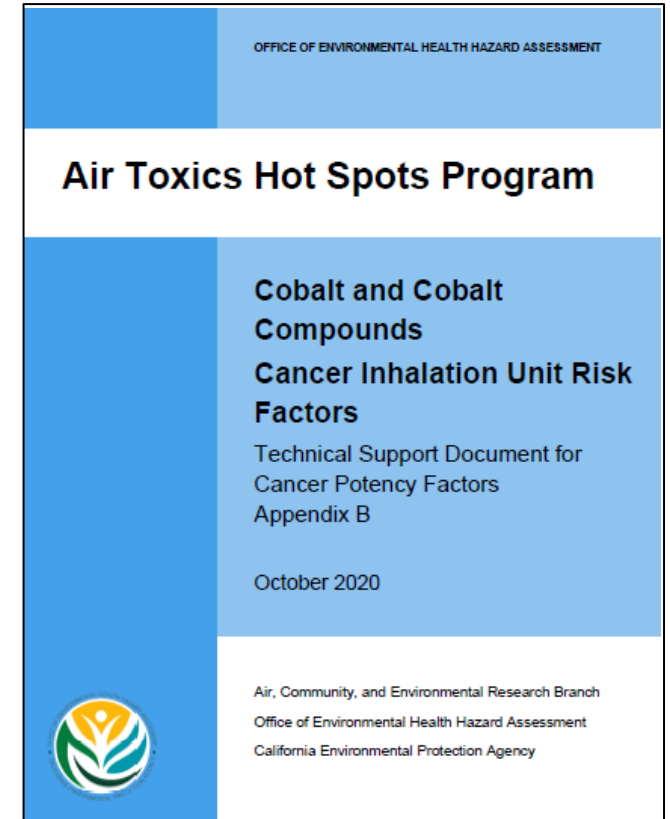Office of Environmental Health Hazard Assessment

Two Corrections for Cobalt Sulfate Heptahydrate IUR

1. IUR corrected for true molecular weight (MW) fraction of cobalt presented in the National Toxicology Program (NTP) 2-year exposure studies in rats and mice

2. IUR corrected due to calculation error

Cobalt and Cobalt Compounds Cancer IUR Factors

- IUR document released in October 2020

  - Cobalt metal and poorly soluble compounds

    IUR = 7.7×10^{-3} per µg/m^3

  - Cobalt sulfate heptahydrate and water-soluble compounds

    IUR = 8.6×10^{-4} per µg/m^3

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

Air Toxics Hot Spots Program

Cobalt and Cobalt Compounds Cancer Inhalation Unit Risk Factors

Technical Support Document for Cancer Potency Factors Appendix B

October 2020

Air, Community, and Environmental Research Branch
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

2022 Correction for NTP Technical Report 471

"In the originally published version of this manuscript, there is an error in the Materials and Methods section. The aerosolized particles are correctly identified and characterized as cobalt sulfate hexahydrate, however, the following statement "thus the concentrations reported are of cobalt sulfate hexahydrate rather than to the anhydrous salt" is incorrect. The inhalation exposure concentrations that appear in the text, tables and figures are all correctly expressed as mg/m3 of (anhydrous) cobalt sulfate rather than as cobalt sulfate hexahydrate. The authors regret the error.

"These details have been corrected only in this correction notice to preserve the published version of record."

Toxicological Sciences 188(2): 276, Aug 2022, https://doi.org/10.1093/toxsci/kfac063,

Published 20 June 2022.

OEHHA

Cobalt Sulfate Exposures

- An aqueous solution of cobalt sulfate heptahydrate was aerosolized for the exposures

- In the chambers, the rodents were exposed primarily to the hexahydrate form

- Exposure concentrations of 0.3, 1.0 and 3.0 mg/m^3 are expressed as the cobalt sulfate anhydrous salt, and not as the heptahydrate as stated in the NTP report.

OEHHA

Correction for the MW Fraction of Cobalt

- Because the cobalt ion is considered to be the primary factor for cancer risk, the calculated Cancer Slope Factor was normalized to the content of cobalt in the 2020 IUR document:

$$58.9 \ Co \ / \ 263.1 \ CoSO_4 \times 6H_2O = 0.22$$

- Because exposure concentration were expressed as the anhydrous salt, actual Co MW fraction should be:

$$58.9 \ Co \ / \ 155.0 \ CoSO_4 = 0.38$$

- Cancer potency will change by 1.7x (0.38 / 0.22)

Calculation Correction

- A calculation error made by OEHHA was also found

- In the final calculation of the CSF, the cobalt-normalized CSF was corrected to show that the MW fraction of cobalt in cobalt sulfate is divided into, rather than multiplied by, the CSF:

CSF = 13.41 per mg/kg-day / 0.38 = 35 per mg Co/kg-day (cobalt-normalized CSF)

(Previous erroneous CSF was 3.0 per mg Co/kg-day)

IUR Calculation

- Inhalation unit risk:

$$IUR = (35 \ (mg \ Co/kg\text{-}day)^{-1} \times 20 \ m^3/d) / (70 \ kg \times 1000 \ \mu g/mg)$$

$$= 1.0 \times 10^{-2} \ per \ \mu g/m^3$$

- The same CSF of 35 $(mg \ Co/kg\text{-}day)^{-1}$ was also calculated when starting with normalized cobalt concentrations of 0.114, 0.38, and 1.14 mg Co/m^3

    - converted from original concentrations of 0.3, 1.0 and 3.0 mg/m^3

Summary of Changes to Cobalt Sulfate Heptahydrate

- Describes where the Cobalt and Cobalt Compounds IUR document was updated to reflect the corrections

- Footnotes added to note that cobalt sulfate concentrations are expressed as the anhydrous salt

- Added same statement to table legends for tumor incidence

- Modified final calculations in the text to show the corrected CSF and IUR

OEHHA