

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

OEHHA Air Toxics Hot Spots Program

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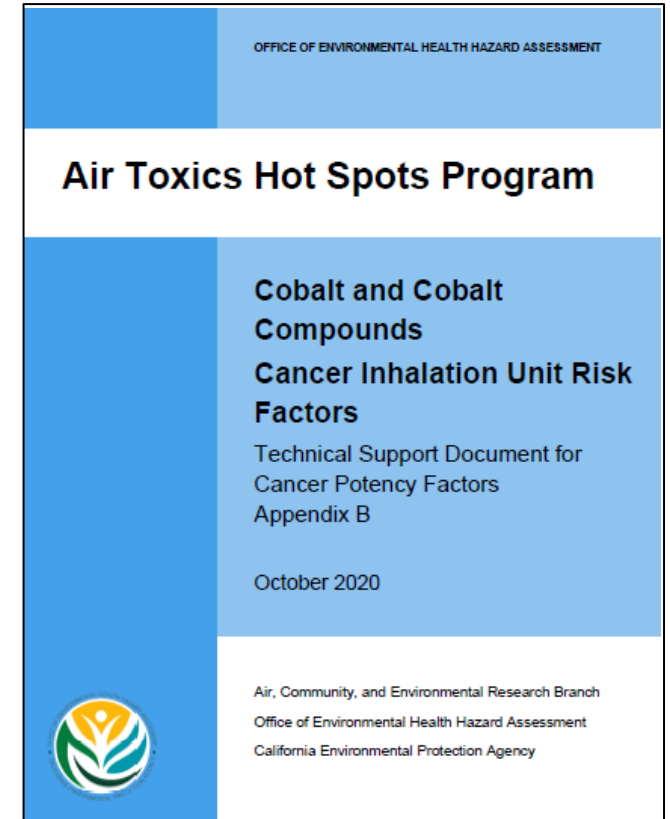
Update to the IUR for Cobalt Sulfate Heptahydrate

1. IUR updated in response to a correction made recently to the NTP report
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
 $IUR = 7.7 \times 10^{-3}$ per $\mu\text{g}/\text{m}^3$
 - Cobalt sulfate heptahydrate and water-soluble compounds
 $IUR = 8.6 \times 10^{-4}$ per $\mu\text{g}/\text{m}^3$



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.



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/m³ are expressed as the cobalt sulfate anhydrous salt, and not as the heptahydrate as stated in the NTP report.



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:

$$58.9 \text{ Co} / 263.1 \text{ CoSO}_4 \times 6\text{H}_2\text{O} = 0.22$$

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

$$58.9 \text{ Co} / 155.0 \text{ CoSO}_4 = 0.38$$

- 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:

$$\text{CSF} = 13.41 \text{ per mg/kg-day} / 0.38 = 35 \text{ per mg Co/kg-day (cobalt-normalized CSF)}$$

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

IUR Calculation

- Inhalation unit risk:

$$\begin{aligned} \text{IUR} &= (35 \text{ (mg Co/kg-day)}^{-1} \times 20 \text{ m}^3/\text{d}) / (70 \text{ kg} \times 1000 \text{ } \mu\text{g}/\text{mg}) \\ &= 1.0 \times 10^{-2} \text{ per } \mu\text{g}/\text{m}^3 \end{aligned}$$

- The same CSF of $35 \text{ (mg Co/kg-day)}^{-1}$ was also calculated when starting with normalized cobalt concentrations of 0.114, 0.38, and $1.14 \text{ mg Co}/\text{m}^3$
 - converted from original concentrations of 0.3, 1.0 and $3.0 \text{ mg}/\text{m}^3$



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



Public Comments

- **OEHHA did not receive any public comments on the draft Cobalt IUR document**
- Public Comment Period: May 5 – June 5, 2023
- Public Workshops were held in:
 - Diamond Bar, CA on May 23, 2023
 - Sacramento, CA on May 31, 2023 (webcast)



Questions?

