COST Action CA18218

Burden of lung cancer associated with occupational exposure to hexavalent chromium

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Occupational Exposure to Cr(VI)

Welding

Cr(VI) electroplating

Plating in baths (electroplating)

Surface treatment by spraying, brush or pen applications or in passivation processes.

Chromate paints, e.g. in the aviation sector

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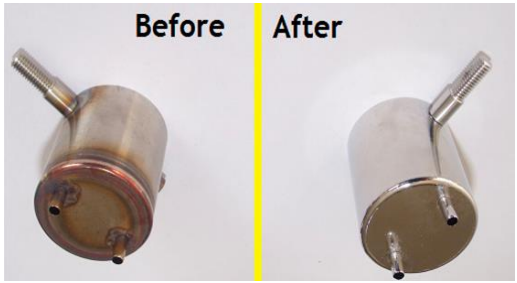

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Viegas S, Martins C, Bocca B, et al. HBM4EU Chromates Study: Determinants of Exposure to Hexavalent Chromium in Plating, Welding and Other Occupational Settings. Int J Environ Res Public Health. 2022;19(6):3683. doi:10.3390/ijerph19063683

Occupational carcinogen

› Front Oncol. 2019 Feb 4;9:24. doi: 10.3389/fonc.2019.00024. eCollection 2019.

The Effect of Hexavalent Chromium on the Incidence and Mortality of Human Cancers: A Meta-Analysis Based on Published Epidemiological Cohort Studies

Yujiao Deng [1 2], Meng Wang [1 2], Tian Tian [1 2], Shuai Lin [1], Peng Xu [1], Linghui Zhou [1], Cong Dai [1], Qian Hao [1], Ying Wu [1], Zhen Zhai [1], Yue Zhu [1], Guihua Zhuang [3], Zhijun Dai [1 2]

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Occupational exposure to hexavalent chromium. Part II. Hazard assessment of carcinogenic effects

Shalenie P. den Braver-Sewradj, Jan van Benthem, Yvonne C.M. Staal, Janine Ezendam, Aldert H. Piersma, Ellen V.S. Hessel

https://doi.org/10.1016/j.yrtph.2021.105045

Association

- lung cancer
- nose and nasal sinus cancer

CrVI → 5-10% lung cancer
1.85-2.4 higher probability

Suspected

- stomach cancer
- laryngeal cancer

Regulations

Occupational Exposure Limit (OEL)

EU Directive 2004/37/EC	10 µg/m^3 (8-h time-weighted average (8-h TWA)) until January 17, 2025 afterwards, OEL = 5 µg/m^3
Welding, Plasma-cutting processes and similar work processes that generate fumes	OEL = 25 µg/m^3 until January 17, 2025 afterwards, OEL = 5 µg/m3

EU-OSHA. Directive 2004/37/EC—Carcinogens or Mutagens at Work; European Agency for Safety and Health at Work: Bilbao, Spain, 2004

EU Directive 2004/37/EC

Evaluation and additional actions:

- present before 31 December 2022, an action plan to achieve new or revised occupational exposure limits values for at least 25 substances, groups of substances or process-generated substances

Transposition

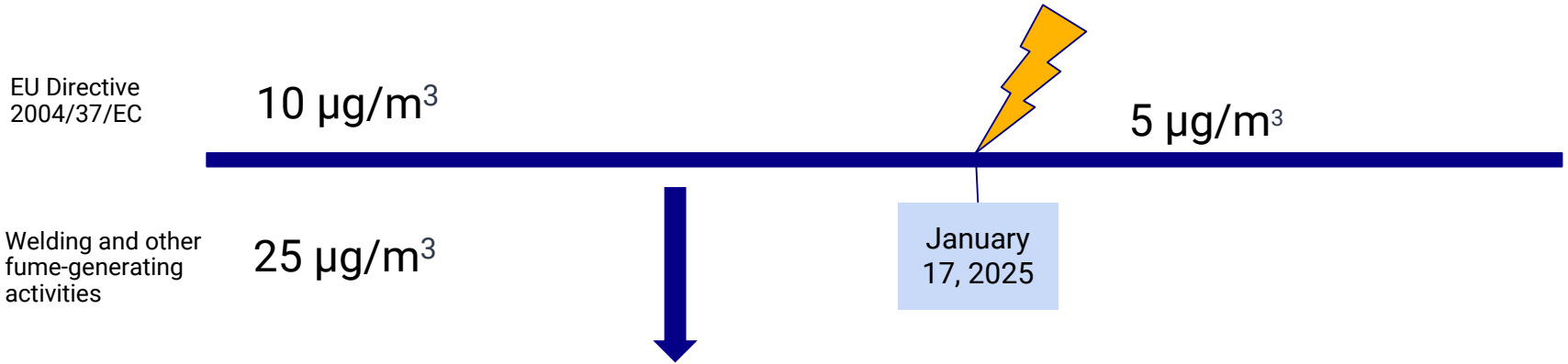
Member States had to comply with the 2017 amendments (directive 2017/2398/EU) by 17 January 2020. Transitional measures (graded lowering of the limit values) apply to hardwood dusts and Chromium (VI).

Some countries also present their own OELs, however they are lower than the one set in the Directive

EU-OSHA. Directive 2004/37/EC—Carcinogens or Mutagens at Work; European Agency for Safety and Health at Work: Bilbao, Spain, 2004

Objective

Determine the burden of lung cancer associated with occupational exposure to hexavalent chromium.



Estimations of BoD in different scenarios

Information Sources

Global Burden of Disease 2019: Incidence; DALYs

Eurostat

Population; Total Workers per sector, per country

Institute of Occupational Medicine Reports

European Commission Reports

Excess risk, estimated changes of concentration exposure

Literature sources

Methodology (1)

Assumptions:

- Number of people exposed per sector did not vary
- Exposure concentrations decreased 7% per year
- Low Exposure with RR=1 (GBD 2019), considered Excess risk=0
- Industries comply with limits set.
- Slope factor drawn from literature: β=1.75
- Excess risk:

β x Cumulative life exposure (40 years) x Baseline lifetime risk of lung cancer (48/1000)

- Calculated **Excess risk per year per person**

Seidler, A., Jähnichen, S., Hegewald, J. et al. Systematic review and quantification of respiratory cancer risk for occupational exposure to hexavalent chromium. Int Arch Occup Environ Health 86, 943–955 (2013). https://doi.org/10.1007/s00420-012-0822-0

Methodology (2)

For each level of exposure

No. cases	=	High Exposed Population	X	Risk/person/year
AF	=	No. Cases	/	Total number of cases in the population
Attributable DALYs	=	DALYs	x	AF

For each scenario: Number of cases & DALYs

Results

No. of Workers exposed to hexavalent chromium in Europe.

Results: Exposure contexts

Category	NACE Code Rev. 1.1	No. of exposed workers	Total
Manufacture of chemicals and chemical products	20	25132	1341960
Manufacture of basic metals	24	24094	1135200
Manufacture of fabricated metal products, except machinery and equipment	25	247253	3671580
Manufacture, repair and installation of machinery and equipment	28+33	171001	4905450
Manufacture of other transport equipment	30	37978	1090850
Other manufacture industries, including furniture	31+32	16282	2405138
Total		521740	14550178

Scenarios

Current (2019) OEL: 10µg/m^3 Welding: 25µg/m^3

Scenario 1

OEL: 10µg/m^3

Welding: 10µg/m^3

Scenario 2

OEL: 5µg/m^3

Welding: 5µg/m^3

Scenario 3

OEL: 1 µg/m^3

Welding: 1 µg/m^3

Scenario 4

OEL: 0.5 µg/m^3

Welding: 0.5 µg/m^3

Scenario 5

OEL: 0.2 µg/m^3

Welding: 0.2 µg/m^3

Scenarios

Current (2019) 4941.6 DALYs 270 cases

Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
4172.7 DALYs	2086.4 DALYs	417.3 DALYs	208.6 DALYs	83.5 DALYs
228 cases	114 cases	23 cases	11 cases	5 cases
DIFF				
768.9 DALYs	2855.3 DALYs	4524.3 DALYs	4733 DALYs	4858.2 DALYs
42 cases	156 cases	247 cases	259 cases	266 cases

Discussion

Study reported 490 cases attributed to Cr(VI) in 2010 vs 270 cases in this analysis (2019)

Exposed population remained stable over the last decade

Stringent regulations in specific industries since 2010

Estimated reduction of exposure concentrations of 7%/year

→ Implement stricter OEL for Cr(VI) exposure

→ Support lung cancer screening for exposed populations

Work should not cause major health losses for workers → Minimise or eliminate the excess risks

Cherrie, J W et al. "Prioritising action on occupational carcinogens in Europe: a socioeconomic and health impact assessment." British journal of cancer vol. 117,2 (2017): 274-281. doi:10.1038/bjc.2017.161
Kauczor H-U, Baird A-M, Blum TG, et al. ESR/ERS statement paper on lung cancer screening. Eur Respir J 2020; 55: 1900506.

Limitations

→ Origin and quality of the data

heterogeneity of the data and its temporal variation

→ Assumptions made can lead to an underestimation of the number of cases and DALYs

→ No data on continuous monitoring occupational exposure to Cr(VI)

→ Imprecision due to the use of aggregated data

→ Other health effects of Cr(VI) on skin, gastrointestinal tract not accounted for

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Escola Nacional de Saúde Pública
UNIVERSIDADE NOVA DE LISBOA

DTU Food
National Food Institute

european burden-eu of disease network

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