

COLLECTIVE EXPERT APPRAISAL: **SUMMARY AND CONCLUSIONS**

Regarding the "expert appraisal for recommending occupational exposure limits for chemical agents"

Assessment of health effects and methods for the measurement of exposure levels in workplace atmospheres for
beryllium and its compounds

This document summarises and presents the work of the Expert Committee.

Presentation of the issue

On 12 June 2007, the French Agency for Environmental and Occupational Health Safety (AFSSET) received a formal request from the French Directorate General of Labour to conduct an expert appraisal with the aim of determining occupational exposure limit values for beryllium.

France currently applies a time-weighted average exposure value for beryllium and its compounds of 0.002 mg.m⁻³ over 8 hours, set by the Government Circular¹ of 12 January 1995.

The Directorate General of Labour asked AFSSET to reassess this value and, if appropriate, to propose new exposure limits for occupational environments based on health considerations.

Organisation of the expert appraisal

AFSSET commissioned the Expert Committee (CES) on expert appraisal for setting exposure limits for chemical agents in occupational environments (OEL Committee) to investigate this formal request. The Committee then mandated two rapporteurs among its experts to write the two summary reports, on the health effects of beryllium and the methods for measuring exposure levels in the workplace. During the course of the study, the Committee judged it necessary to express an opinion on the issue of surface contamination in order to provide better protection for the health of workers. This additional theme required the establishment of a working group of three experts from the Committee and an interview with a Canadian scientist with extensive expert knowledge of this subject.

The work of the rapporteurs was regularly submitted to the Committee. The reports produced take account of observations and additional information supplied by the other Committee members.

This expert appraisal was therefore conducted by a group of experts with complementary skills. It was carried out in accordance with the French Standard NF X 50-110 "Quality in Expertise Activities" to ensure compliance with the following points: competence, independence and transparency and traceability.

¹ Completing and amending the Circular of 19 July 1982 on limits for concentrations of certain hazardous substances in workplace atmospheres.

Description of the methodology

1- For the assessment of the health effects

The summary report on the health effects of beryllium and its compounds is based on bibliographical information based on scientific literature published on this substance up to 2009. The bibliographical search was conducted directly by the rapporteur in the following databases: Medline, Toxline, HSDB, ToxNet (CCRIS, GENE-TOX, IRIS) and ScienceDirect. The rapporteur reassessed the source articles or reports cited as references every time he considered it necessary or whenever the Committee requested it.

2- For the evaluation of methods for measuring exposure levels in the workplace

The summary report lists and classifies existing measurement methods up to April 2009. The list of sources considered in the report is compiled from the principal sources and databases indicating the sampling and analysis protocols for determining occupational exposure. This study was carried out directly by the rapporteur assigned from among the Committee.

The OEL Committee adopted the following reports:

- the health effects report at its meeting on 17 September 2009
- the summary report on methods for measuring exposure levels in the workplace at its meeting of 17 September 2009.

The OEL Committee adopted the summary and the conclusions of the collective expert appraisal on 12 January 2010.

Conclusions of the collective expert appraisal

In the current state of available data, no health effect threshold could be highlighted regarding the proven carcinogenicity of beryllium and its compounds; the OEL Committee considers that the carcinogenicity of beryllium and its compounds in humans involves a non-threshold mechanism of action.

However, the OEL Committee considers that the scientific data currently available, concerning lung cancer following exposure to beryllium and/or its compounds, is insufficient for conducting a quantitative health risk assessment for the purpose of deriving a dose-response relationship at low doses and thus correlate an excess unit risk at such low doses. The OEL Committee nonetheless considers it necessary to recommend a “pragmatic” OEL based on an effect other than lung cancer in order to limit the exposure of workers.

The Committee therefore recommends setting an 8-hour occupational exposure limit value for beryllium compounds of $0.01 \mu\text{g}\cdot\text{m}^{-3}$.

The purpose of this recommendation is to avoid the risk of chronic berylliosis in the workplace. It results from the identification of a LOAEC of $0.20 \mu\text{g}\cdot\text{m}^{-3}$ on the basis of a set of epidemiological studies and then applying a safety factor of 25 to take account of inter-individual susceptibility and the fact that this value corresponds to the lowest concentration level for which effects have been observed. It should be noted that in the light of currently available data, the recommended value of $0.01 \mu\text{g}\cdot\text{m}^{-3}$ should also protect against the sensitising effect of beryllium and its compounds.

Since there is currently no information in the literature enabling the determination of a STEL to protect against possible immediate or short-term toxic effects, the Committee is unable to recommend a value for setting a STEL.

Although skin sensitisation is not a criterion for assigning a “skin” notation, the Committee recommends assigning this notation for beryllium and its compounds as the consequences of sensitisation to beryllium go beyond a simple skin disorder (eczema). Penetration of beryllium by the dermal route can result in general immuno-allergic pathologies of particular concern.

In a context where exposure by inhalation is diminishing because of the reduction in atmospheric concentrations in the workplace, the OEL Committee states that the monitoring of surface contamination levels provides an indispensable complementary tool for the reduction of exposure. It adds that several international organisations have set acceptable levels, used as threshold values for surface contamination by beryllium and its compounds.

For example, Quebec has set a maximum concentration reference value for beryllium of $0.2 \mu\text{g}/100 \text{ cm}^2$ for work surfaces, equipment and objects to be considered beryllium-free.

The Committee states that there are validated measurement methods suitable for assessing occupational exposure. These methods allow the measurement of the 8-hour OEL of $0.01 \mu\text{g}\cdot\text{m}^{-3}$.

The Committee recommends the method with sampling of the inhalable fraction, choice of the reagents for quantitative dissolution and quantification of the beryllium compounds and analysis using inductively-coupled plasma mass spectrometry (ICP-MS), the only suitable method for measuring occupational exposure to beryllium for comparison with OELVs.

ICP-MS is one of the most sensitive methods for measuring beryllium compounds.

Furthermore, to supplement the resources for preventing the risk of sensitisation and/or berylliosis following exposure to beryllium and its compounds, the OEL Committee recommends that the expert appraisal be supplemented with a study for the recommendation of suitable biological exposure indicators, whether or not the latter are combined with a biological limit value.

Finally, the Committee reiterates that:

- the recommended OEL is not intended to protect against the carcinogenic effects of beryllium and its compounds;

- the ALARA (As Low As Reasonably Achievable) principle must be applied when dealing with non-threshold carcinogen;

- since the data available cannot be used to set an STEL, it is advisable not to exceed over 15 minutes concentrations corresponding to five times the 8-h OEL² in order to limit exposure levels to short periods of exposure.

Maisons-Alfort, 12/01/2010

On behalf of the experts of the CES

François Paquet,

Chairman of the CES

² For further details, please consult Part 1 of the Report of the Collective Expert Appraisal for setting exposure limit values to chemical agents in occupational environments of December 2008, which contained recommendations on occupational exposure limit values intended to limit the size and number of exposure peaks over the working day.