

Focus on IFA's work

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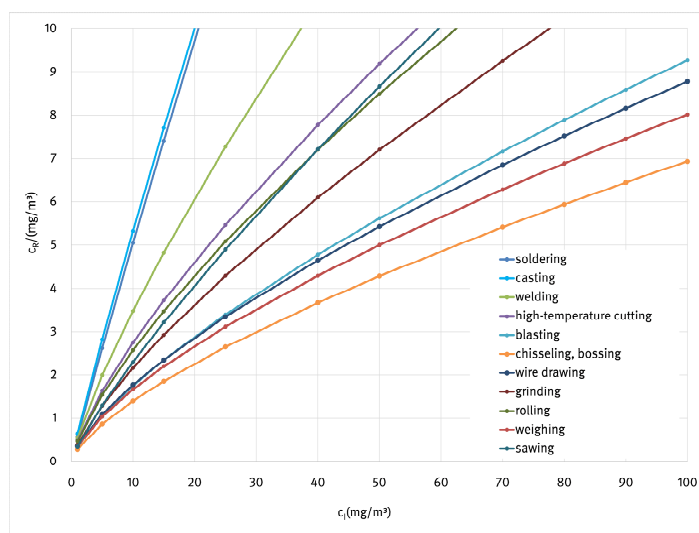
Conversion from inhalable to respirable dust

Problem

Exposure to dusts is the most common form of exposure at workplaces in many industrial sectors. In the construction industry or in metalworking companies for example, dusts may be generated during a wide range of mechanical processes (such as drilling, milling, welding, grinding or shaping), and settled dusts may be raised. Whereas for mineral dusts, the focus for some time has been on the finer dust fraction, it is only in recent years that the view has changed with respect to dusts containing metals. In the past, the assessment criteria applicable in Germany for metals primarily concerned the inhalable dust fraction; now however they increasingly apply to the respirable dust fraction, i.e. the dust that reaches the alveoli.

For formal recognition of cases of occupational disease, in particular, means must exist for retrospective assessment of dust exposure at a workplace.

The advantage of a mechanism for conversion between the respective dust fractions is therefore evident. To date however, few studies on this subject exist, and most deal with selected areas of activity and are not therefore universally valid.



Relationship between concentrations of respirable dust (c_R) and inhalable dust (c_I) for different activities

Activities

The MEGA database of measurement data on exposure to hazardous substances at the workplace, which has grown over a period of decades, is an excellent and representative source of measurement results from all sectors and areas of activity, and enables this topic to be addressed more comprehensively and with wider validity.

The data records in the MEGA exposure database of all parallel respirable and inhalable dust measurements conducted in the years 1989 to 2016 were evaluated in a dissertation conducted at the IFA.

With the criteria of identical measurement parameters and with minor limitations (e.g. measurement range for respirable dust $\leq 10 \text{ mg/m}^3$ and for inhalable dust $\leq 100 \text{ mg/m}^3$; respirable dust concentration \leq inhalable dust concentration), 15,120 pairs of measured values were formed.

With consideration for its content and statistical aspects, this total data record was divided into six activity groups: *surface treatment, high temperature processing, filling/transport/storage, machining/abrasive techniques, forming and other*. In addition, three material groups were formed: *primarily mineral, primarily metal and primarily fibre*. Following mathematical transformation, statistical analyses were performed for all groups and conversion functions determined.

Results and use

The conversion from inhalable to respirable dust is described for all groups by power functions. In none of the cases was it possible for a simple linear relationship between the two dust fractions to be established.

Association of the activity groups with the material groups (combination groups) permits an even better description of certain areas of activity in many cases.

In addition to these groups, smaller groups were formed by trial and error from related activities such as soldering, welding and sawing. These smaller groups yield the best estimates for converting between the dust fractions. They are however specific, describe similar activities and include only selected areas of activity.

All conversion functions were found to be independent of the choice of sampling system and year of sampling. The data structure does not permit conclusive assessment of an influence of the form of sampling (personal or stationary).

The conversion functions determined can now be used to draw conclusions regarding the exposure level at workplaces at which measured values are available for only one of the dust fractions (inhalable or respirable dust), for example in order for historical exposure to be evaluated retrospectively.

The resulting formulae are not equivalent to actual measured values. However, they enable an estimate for the respirable fraction to be calculated from a measured value for the inhalable fraction. At the same time, the analyses have shown that it will be imperative in the coming years to verify and refine the functions by the performance of further measurements. The focus here will lie on activities associated with dust potentially containing carcinogenic metals.

User group

Accident insurance institutions, metrological services, occupational safety and health organizations, OSH professionals and safety delegates

Further information

- Wippich, C.; Rissler, J.; Koppisch, D.; Breuer, D.: Estimating Respirable Dust Exposure from Inhalable Dust Exposure. *Ann. Work Expo. Health* (2020) No 64, 4, pp. 430-444

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