Executive summary

Scope

At the request of the Minister of Social Affairs and Employment, the Health Council of the Netherlands sets health-based recommended occupational exposure limits (HBROEL) for existing substances in the air in the workplace. These recommendations are prepared by the Council’s Dutch Expert Committee on Occupational Safety (DECOS).

In this report, the Committee discusses the health consequences of occupational exposure to grain dust for employees in the grain and animal feed industries. Subsequently, the Committee recommends a health-based occupational exposure limit. The Committee’s conclusions are based on scientific papers published before September 2010.

Physical and chemical properties

The Committee defines grain dust as fine particulate matter originating from several grains, such as wheat (Triticum sp.), oats (Avena sativa), barley (Hordeum vulgare), rye (Secale cereale), sorghum (Panicum miliaceum), and including maize (Zea mays), rice (Oryza sativa), pulses — such as soy beans (Glycine hispida) and peas (Pisum sativum) — and various oil seeds. Flour dusts, originating from milled wheat and rye, and present in flour mills and bakeries are
Grain dust levels should be monitored as 8-hour time-weighted averages of personal gravimetric inhalable dust. In the Netherlands, it is common practice to measure exposure using a standardized technique for collection of inhalable dust.

Limit values

There is no specific limit value for grain dust in the Netherlands. In 2001, the American Conference of Governmental Industrial Hygienists (ACGIH) has re-established a TLV (threshold limit value for 8-hours time-weighted average) of 4 mg/m³ total grain dust (wheat, oats, barley). The Health and Safety Executive in Great Britain has established a Workplace Exposure Limit (WEL) for grain dust of 10 mg/m³ (8-hour time-weighted average).

Effects

Exposure to grain dust may lead to a spectrum of clinical syndromes mainly affecting lungs and airways, but also skin and mucous membranes. Cough, sputum, wheeze and dyspnoea as well as lung function changes that indicate chronic bronchitis and asthma are frequently found after grain dust inhalation. Also grain fever is a well known disease in grain workers. Extrinsic allergic alveolitis is rarely reported. The predominant mechanism of respiratory toxicity is related to immunologic factors and endotoxins in grain dust play an important role in the development of the effects. Exposure to grain dust may lead to non-respiratory effects such as skin disorders; the animal feed industry is, frequently mentioned as an industry with an increased risk for allergic skin disorders, due to the extensive use of additives. Moreover, an increased cancer incidence and mortality may occur among grain workers.

Evaluation and recommendation

The Committee is aware that endotoxins in grain dust contribute significantly to the development of the health effects of grain dust. It points out that the actual endotoxin content in grain dust, expressed as EU per mg dust is extremely variable and that the implementation of a HBROEL for endotoxin (90 EU/m³)
will protect in most, but not in all, situations against health effects of grain dust. Therefore, a HBROEL for grain dust itself is still necessary.

The Committee considers decrease of lung function and especially decrease of forced expiratory volume in 1 second (FEV₁) as critical effect of grain dust exposure.

Two acute and short term exposure studies on grain workers were selected as critical studies for the derivation of a health-based recommended occupational exposure limit (HBROEL) (Corey et al. 1982, Dopico et al. 1983). In addition, a cross sectional study and its 5-year follow-up on effects on lung function of employees in the animal feed industry after chronic exposure were selected as critical studies (Smid et al. 1992, Post et al. 1998).

Using the data from the studies of Corey et al. 1982 and Dopico et al. 1983 the Committee establishes a LOAEL (lowest observed adverse effect level) of 4 mg/m³ inhalable grain dust based on lung function. The Committee considers the use of a standard safety factor 3 sufficient for the calculation of a no observed adverse effect level (NOAEL) of 1.5 mg/m³. Moreover, Dopico et al. report a grain dust exposure level in grain workers with no acute respiratory symptoms. This level is, again, 1.5 mg/m³ inhalable dust, and is considered as a NOAEL for acute symptoms.

The Committee judges that these study populations are a representative sample of the working force. Therefore, the Committee is of the opinion that an additional safety factor to compensate for interindividual differences is unnecessary and that a level of 1.5 mg/m³ (8-hour time-weighted average) can be considered as a HBROEL offering sufficient protection against health effects of acute and short term exposure.

Next, the Committee verifies whether the proposed HBROEL of 1.5 mg/m³ protects against the health effects of chronic exposure to grain dust. Calculated dose-response relationships between grain dust and lung function (Smid et al. 1992, Post et al. 1998) show that chronic grain dust exposure of 1.5 mg/m³ for 8 h a day (time weighted average) during a working lifetime exposure (40 years) leads to an additional loss of FEV₁ with 45 mL. The normal loss of FEV₁ in 40 years in healthy individuals is approximately 1 L. The Committee is of the opinion that an additional average decrease of FEV₁ of 45 mL is not associated with an increase in the number of individuals with abnormal lung function and with increased cardiovascular mortality.

From these data the Committee expects that a health-based recommended occupational exposure limit (HBROEL) for inhalable grain dust of 1.5 mg/m³ as 8-hour time-weighted average offers sufficient protection to the employee at acute, short term and chronic exposure.
Health-based recommended occupational exposure limit

The Committee recommends a health-based occupational exposure limit (HBROEL) for inhalable grain dust of 1.5 mg/m³ as 8-hour time-weighted average.

The Committee does not recommend a separate short-term exposure limit for inhalable grain dust (STEL), or a skin notation.