Solution

Master's degree in environmental science and engineering

Occupational and environmental health

4.2 physico-chemical - measurements

1) Metrology quiz

The limit of quantification for arsenic by atomic absorption is 100 ng. Calculate whether it is possible to verify, with this sensitivity and with a personal filter sample at a flow rate of 2 l/min, if the "ceiling" limit value set at 2µ g/m3 over 15 min is respected or not. Comment on your answer.

Volume taken in 15 minutes = 30 l = 0.030 m3
ELV = 2µ g/m3 = 0.06µ g in 0.030 m3
By sampling the air under these conditions we retain 0.06µ g on the filter, thus 60 ng, which is lower than the limit of quantification by atomic absorption.
➔ It is not possible with this method to check if the limit is respected. To that end, the sampling rate must be increased (> 3.5 l/min).

2) Trouble at the workshop

A company active in the field of metal construction wishes to evaluate the exposure of its employees in one of its workshops (fictitious case). The high dust level in the hall (deposits on the surfaces, presence of a quasi-permanent cloud) has indeed generated complaints and concerns among the personnel (about twenty people in the hall). The workshop in question is dedicated to the work on aluminum frames. Most of the work consists in assembling the frames, though welding and flame cutting are also carried out in the hall.
Which measurement strategy (and for what reason) would you prioritize to assess the situation?

The information given by the company suggests that the emission of dust is related to thermal processes (welding, cutting) and that this is mainly due to the working of aluminum (which in principle must be verified during a preliminary visit). Thermal processes are in principle emitters of fine dust

Aluminum and aluminum oxide dusts are considered as inert dusts from the toxicological point of view (without short term effects, nor specific effect). The reference value to be applied is therefore a TWA - 8h of 3 mg/m3 in respirable dust or 10 mg/m3 in inhalable dust.

➔ Therefore, 8-hour sampling (individual sampling) using a cyclone and a sampling filter is preferred. In the absence of other pollutants, the filters can then be weighed, without resorting to speciation.

➔ Ideally, about 15 measurements should be taken to ensure, with relative confidence (95%), that at least 1 of the samples taken is in the most exposed situations.

➔ in the absence of other sources of pollutants, a direct reading (nephelometry) will allow the identification of the most exposed activities in order to advise the company on targeted prevention measures.

3) Surprise spray

During the winter of 2002-2003, the toxzentrum (reference toxicology center) in Zurich noted an upsurge in hospitalizations (about 200 cases) related to acute respiratory problems following the use of waterproofing sprays. A quick investigation showed that all the incriminated products (several brands) had in common the same waterproofing agent (a fluorinated resin) and that the German company which put it on the market had just changed its composition.

The producing company supplied many wholesalers in Europe with the mother product. They added it to preparations and repackaged it for different uses (waterproofing spray for leather, for textile...)

Although the product is widely distributed, the "epidemic" of respiratory problems has affected only a fraction of the countries concerned. Can you hypothesize why this is so?

- The increase in cases may not have been identified (e.g. due to the lack of a sufficient alert structure)
- Differences in the formulations used could have led to undesirable chemical reactions (unlikely as this has happened with products of different formulation and the polymer used is in principle chemically stable).
- The differences in packaging (geometry of the spray nozzles differing from one country to another) generated granulometric modifications of the aerosol. Only the finest aerosols are likely to reach the alveoli and generate a toxic effect.