

A method to determine methylmethacrylate in air

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To determine the air concentrations of methylmethacrylate monomer and thus obtain information about the safety in the operating theater, a methylmethacrylate Dräger tube was used in connection with a bellows pump. This method gives an instantly readable value correlated with more complicated gas chromatographic measurements.

In order to minimize the air concentration of methylmethacrylate monomer, several mixing systems connected to suction devices are available. The inhalation hazards in the operating theater may be evaluated by using a rather complicated gas chromatographic technique (Darre et al. 1987). We describe a simple method for instant determination of the air concentration of methylmethacrylate monomer.

Materials and methods

A methylmethacrylate 50/a Dräger tube (Dräger Teknik Aps., Generatorvej 6B, DK-2730 Herlev, Denmark) was used in conjunction with a Dräger gas detector pump M 21/31. Before use, the tips of the tube must be broken off and the tube inserted tightly into the pump head. By pressing the bellows pump, air will be sucked into the tube. Ten strokes have to be done. In the presence of methylmethacrylate monomer, the indicating layer in the tube turns from yellow to blue. The indication is based on the reaction of methylmethacrylate with a molybdate-palladium salt reagent. The total length of the blue discoloration

is a measure of the concentration of monomer. The range of measurement after 10 bellow strokes is 50 to 500 parts per million (1 ppm = 4.16 mg/m³). The numerical values on the tube are 50, 100, 200, and 500 ppm.

During hip replacement operations, measuring was done when mixing the cement in a closed mixing box (Vedel box, NC-Nielsen A/S, Sdr. Ringvej 39, DK-2600 Glostrup, Denmark) connected to a suction device. Six measurements were performed according to the operating instructions, holding the detector tube just outside the mixing box. The cements used were Simplex®, and CMW-1®. Additionally five measurements were done during the mixing of CMW-1 in an open mixing bowl, holding the tube 10 cm from the surface of the cement. All the measurements were performed from the beginning of the mixing until 10 bellow strokes had been done during an approximately 2-minute period. The discoloration of the tube, and thus the ppm reading, was recorded.

Results

Mixing of any of the cements in the closed Vedel box showed no discoloration of the tube, and thus no monomer evaporation outside the box was found. Mixing in an open bowl in all five experiments showed clearly discoloration in the interval 200-500 ppm methylmethacrylate monomer.

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Discussion

The occupational hazards during handling of bone cement in the operating theater have recently been reduced by the introduction of effective cement mixing systems with suction devices and gloves that are practically impermeable to methylmethacrylate monomer (Darre et al. 1987). Despite the use of these special mixing systems, the characteristic smell of methylmethacrylate monomer may still be recognized during the use of bone cement.

In Denmark exposure to an average concentration of 75 ppm methylmethacrylate monomer (307 mg/m³) during an 8-hour work day and 40-hour week is considered to be a safe level

(Directorate of National Labor Inspection 1985). The use of the methylmethacrylate 50/a Dräger tube, with a range of measurement from 50 to 500 ppm, is easy and convenient for investigating the concentration of methylmethacrylate monomer in the operating theater. The values measured during mixing of bone cement in an open bowl accords well with values found in gas chromatographic studies (Darre et al. 1987). In these measurements the air concentrations of MMA following mixing and setting of CMW-1 and Simplex cement were 2.28 g/m³ (548 ppm) and 2.30 g/m³ (552 ppm). Neither the present nor the more sensitive gas chromatographic studies revealed any evaporation from the closed Vedel box during the mixing and setting of the cement.

References

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