Guidance Note EH 31 from the Health and Safety Executive

Control of exposure to polyvinyl chloride dust

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Environmental Hygiene 31 (May 1982)

These Guidance Notes are published under five subject headings: Medical, Environmental Hygiene, Chemical Safety, Plant and Machinery and General.

INTRODUCTION

1 This Guidance Note draws attention to the possible health risks which could result from exposure to polyvinyl chloride (PVC) dust.

2 The Health and Safety Commission's Advisory Committee on Toxic Substances has recommended that, in line with the Commission's general policy:

(a) exposure to PVC dust should be kept as low as is reasonably practicable;

(b) in any case exposure should not exceed 10 mg/m^3 for total PVC dust in air and 5 mg/m^3 for respirable PVC dust in air.

3 The effects of exposure to PVC dust are referred to in para 9 and advice is given on assessment and control in paras 10 to 13. Methods of sampling and measurement are described in paras 14, 15 and the Appendix.

MANUFACTURE AND USE

4 PVC is manufactured in the form of a white powder which softens at about 80 degrees centigrade. Before PVC is fabricated, various materials such as stabilisers, plasticisers and antioxidants are added.

5 It is manufactured from vinyl chloride monomer (VCM) mainly by a process in which liquified VCM in the form of a stirred suspension or emulsion in water is polymerised in the presence of an initiator which causes the VCM to polymerise. All PVC polymers contain traces of other reagents used in the polymerisation process to control the size and structure of the particles, e.g. emulsion polymers contain small quantities of emulsifying agents.

6 In its unplasticised form PVC is hard, tough, strong and has good chemical resistance. It is used for a wide variety of construction, domestic and engineering products including pipes, ducts, tanks, bottles and protective claddings.

7 In its plasticised form it is more flexible and is used as an insulation material for electric wires, as a coating for various textile products and for many other applications.

8 Blends of PVC and nitrile rubbers (polyacrylonitrile/butadiene) are used to make rubber items such as hose, automotive seals, shoe soles, cable covers, etc., where the product requires good resistance to oils and the ability to withstand atmospheric attack.

EFFECTS OF EXPOSURE

9 Over the past decade attempts have been made to evaluate the toxicity of PVC dust which have involved 'in vitro' studies and studies on both animals and humans. In some studies on humans the effects of exposure to PVC dust were complicated by concurrent exposure to vinyl chloride monomer. Nevertheless, there is evidence[1] to indicate that PVC dust alone may be associated with respiratory dysfunction and radiographic changes and in one report[2] the possibility of an excess of lung cancer in exposed workers has been raised. The studies do not indicate the concentration of dust to which individuals had been exposed and consequently it is not possible to relate the specified effects to the degree of exposure.

ADEQUATE CONTROL OF EXPOSURE

10 Where exposure to PVC dust cannot be avoided, control should be achieved by material, plant and process controls or other suitable control techniques supplemented where necessary by the wearing of suitable respiratory and other personal protective equipment.

11 Personal exposure should not exceed 10 mg/m^3 for total PVC dust in air and 5 mg/m^3 for respirable PVC dust in air, 8 hour time-weighted average concentrations, and should be further reduced where reasonably practicable. Inspectors will use these exposure limits when assessing compliance with the HSW Act and relevant statutory provisions.

ASSESSMENT OF WORK

12 Work involving PVC should be assessed in order to identify sources of dust, to determine the levels of exposure and to identify any necessary improvement to existing controls or the provision of new controls. The work should be re-assessed whenever changes are introduced which significantly affect the material, plant or process controls.

13 In practice exposure to PVC dust in manufacturing or in user industries is most likely to arise during the following operations:

(a) drying and screening, including cyclones,

(b) handling, transfer and despatch operations,

(c) bagging and weighing,

(d) bag opening and powder transfer,

(e) batch weighing,

(f) mixing and blending,

(g) finishing of PVC articles.

SAMPLING AND MEASUREMENT

14 Where the information available on the levels of exposure to PVC dust is not sufficient for the work to be properly assessed, or where exposure may be in excess of the limits referred to in para 2, the airborne concentration to which persons are exposed should be measured in order to:

(a) verify whether the 8-hour time-weighted average concentration of PVC dust in the breathing zone exceeds these limits on a given occasion, and

(b) monitor the effectiveness of material, plant and process controls.

15 The sampling strategy should be determined having regard to the nature of the work and the duration of exposure. The results obtained should be representative of personal exposure averaged over an 8-hour period. The measuring methods used by HSE for sampling total and respirable dust are described in the Appendix.

STATUTORY REQUIREMENTS

16 No specific regulations have been made under the Factories Act 1961 or the Health and Safety at Work etc Act 1974 to deal with exposure to PVC dust but control is required under the requirements of Section 2 of the HSW Act and Sections 1, 4 and 63 of the Factories Act.

REFERENCES

1 Soutar C A et al (1980) 'Epidemiological study of respiratory disease in workers exposed to polyvinyl chloride dust' Thorax *35,* pp 644-652.

2 Waxweiler, R J et al (1978) XIX International Congress on Occupational Health, Dubrovnik.

3 Hamilton R J & Walton W H (1961) in 'Inhaled Particles and Vapours' (Ed. C N Davies) pp 465-475 (Pergamon, Oxford).

4 Orenstein A S (Editor) (1960) 'Recommendations adopted by the Pneumoconiosis Conference', Proceedings of the Pneumoconiosis Conference Johannesburg, 1959, pp 619-621 (Churchill, London).

FURTHER INFORMATION

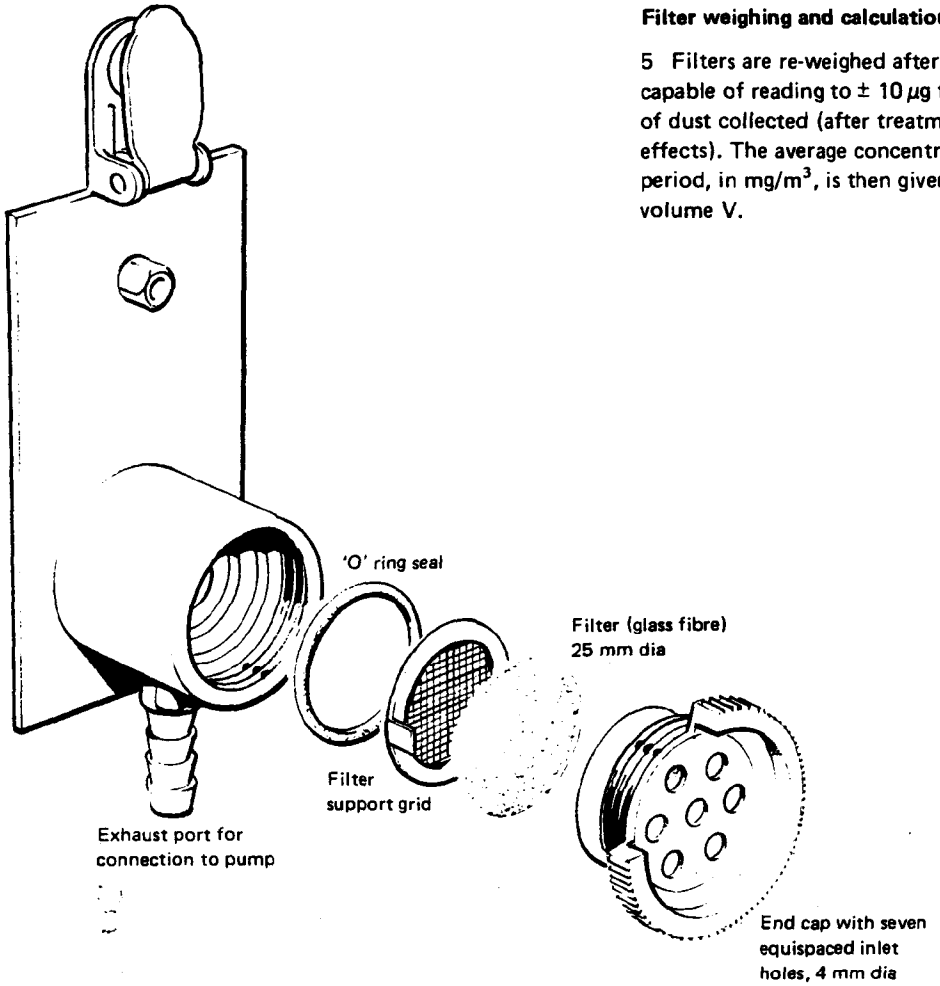
This Guidance Note is produced by the Health and Safety Executive. Further advice on this or any other publications produced by the Executive is obtainable from Baynards House, 1 Chepstow Place, London W2 4TF, or from Area Offices of the HSE.

APPENDIX: SAMPLING AND MEASUREMENT

1 The techniques in current use by the Health and Safety Executive for measuring time weighted average concentrations of "respirable" and "total" PVC dust in the breathing zones of persons at work are described below. In both cases, use is made of personal sampling equipment consisting of a filter holder, worn high on the person's chest (e.g. attached to lapel) within 30 cm of his nose-mouth region. The filter holder is connected to a battery operated portable pump which is attached to a belt worn around the waist and which is capable of running continuously for 8 hours.

Respirable dust sampling

2 The equipment used for respirable dust sampling consists of a cyclone type filter holder fitted with a pre-weighed glass fibre filter (either 25mm or 37mm diameter) and connected via a flow smoother to either a vane type pump or a diaphragm type pump. The design of the cyclone type holder and the sampling flow rate are such that only the respirable fraction of the dust, as defined by the Medical Research Council[3,4], reaches the filter.



Total dust sampling

3 The equipment used for total dust sampling consists of a multi-orifice filter holder, as illustrated below, fitted with a pre-weighed, 25mm diameter, glass fibre filter. The filter holder is connected via a flow smoother to a vane type or diaphragm type pump. The pump flow rate is maintained at 2·0 litres/min. The filter holder is attached to the wearer in such a way that the orientation of the filter is close to the vertical plane.

Air sample volume

4 For each sample obtained by the use of an unstabilised pump, the flow rate is checked, and adjusted if necessary, against an external flowmeter at the beginning and end of the sampling period and at 1 hourly intervals during sampling. The sample volume for each interval is calculated by multiplying the average of the flow rates at the beginning and end of the interval by the interval duration (in minutes). The total sample volume, V, (m^3) is then given by the sum of the volumes for these intervals. Where a stabilised-flow pump is used, the sample volume, V, is given by the flowrate (checked against an external flowmeter) multiplied by the sampling period.

Filter weighing and calculation of TWA concentrations

5 Filters are re-weighed after use on an electro balance capable of reading to ± 10 μg to obtain the weight, W, (mg) of dust collected (after treatment to allow for humidity effects). The average concentration of dust for the sampling period, in mg/m^3, is then given by dividing weight W by volume V.

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