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To  
 AFQ Inspectors (Bands 0-4)  
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 RSG/SSG Specialist Inspectors (Occ Hyg) (Bands 0-3)  
 RSG/SSG Medical Inspectors  
 RSG/SSG Occupational Health Inspectors

## REFRACTORY CERAMIC FIBRE

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### HAZARDS AND PRECAUTIONS

This 2-part OC provides guidance to inspectors and users on the potential hazards from refractory ceramic fibre. The <a href="#">Information Document (ID)</a> may be copied and given to interested persons outside HSE.
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### Introduction

1 Towards the end of 1998 certain types of man-made mineral fibres (MMMFs) will be classified as carcinogens. This OC and ID give information and guidance on hazards and precautions in the use of refractory ceramic fibre, one widely used type of MMMF.

### Background information

2 Refractory ceramic fibre (RCF) comprises a group of several types of man-made vitreous (silicate) fibres, used as insulation material in high temperature applications particularly in the following industries, listed in decreasing order of usage:

- 1) ceramics;

- 2) secondary metal treatment (including foundries);
- 3) petrochemical industry;
- 4) steel and non-ferrous metals (primary treatment);
- 5) chemical processing (general); and
- 6) automotive industry.

3 The main application is as a lining material for kilns and furnaces; also in investment casting it is used extensively as an insulator on the outside of the ceramic moulds to regulate the rate of cooling of the metal after casting. Advantages over traditional refractory brick are that the fibre is light, relatively inexpensive and thermally efficient. However, it is easily damaged and becomes brittle and friable after quite limited periods of use and it is not uncommon to find repairs to sections of fibre linings being needed every 2 years or so.

4 The fibres themselves can irritate the skin, eyes and upper respiratory tract but the main concern is that the individual fibres are small enough to penetrate deep into the lungs and possibly lead to the development of lung cancer and mesothelioma. HSE's guidance note (GN) EH 65/30 Review of fibre toxicology (1996) (file 267) concluded that there is clear animal evidence for the carcinogenicity of 4 types of RCF. The European Ceramic Fibres Industry Association (ECFIA), point out that the animal studies involved exposure to extremely high levels (typically 200 times higher than levels found in the workplace) of specially prepared fine RCF fibres and that to date, there is no evidence of any disease in humans.

### Legal changes

5 On 10 November 1997, a European Technical Progress Committee decided that the evidence was sufficient to warrant RCF being classified as a category 2 carcinogen (ie a substance to be regarded as if it were carcinogenic to humans) and the risk phrase R49 ('may cause cancer by inhalation') will apply. The Directive approved by this committee (Directive 97/69/EC of 5 December 1997) and now ratified by the European Commission will be implemented in the UK by an amendment to the Chemicals (Hazard Information and Packaging for Supply) Regulations 1994 (CHIP Regulations) as amended, coming into force no later than 16 December 1998. Further information is contained in [OM 1997/123](#).

6 It has also been agreed that risk phrase R38 ('irritating to the skin') will apply to RCFs.

7 The classification as a category 2 carcinogen will apply to fibres of a certain size only (those less than 6µm length weighted geometric mean diameter). Most RCF products currently marketed in the UK will fall into this category. The main implication is that the Control of Substances Hazardous to Health Regulations 1994 (COSHH) Carcinogens ACoP (file 273) will apply to all work with RCF. Information notes explaining the position in more detail as far as the ceramics industry is concerned were produced by the Ceramics and Heavy Clay NIG and circulated widely in November/December 1997 (see [NIGM 6/A/1998/2](#)). The information they contain may also be relevant to other industries.

8 An additional problem for users is that after being exposed to high temperatures (greater than 1000°C) for prolonged periods as can happen in

kilns and furnaces, it is known that RCF at the surface of the lining devitrifies to crystalline phases including cristobalite, a form of crystalline silica which can cause silicosis. Exposure to simulated 'after-service' fibres did not produce significant excess tumours in animal studies.

9 The new Directive also classifies certain types of mineral wool as category 3 carcinogens. Although mineral wools are used in the above industries they have much wider application, particularly for domestic loft insulation, and are therefore not covered in this OC.

### **Action by inspectors**

10 The attached ID is intended to present contractors, plant manufacturers and users with information on the potential risks they may encounter and advice on precautions they will need to observe when working with RCF. Awareness of this issue should be raised at contacts with relevant clients.

### **Annotation of instructions**

11 OM 1997/123 para 7 - **note** 'See OC 267/3'.

12 OM 1995/100 - **note** 'See OC 267/3'.

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### **ASI headings**

Carcinogens: Control of Substances Hazardous to Health Regulations 1994: fibres: foundries: furnaces: insulation: kilns: lungs: mesothelioma: mineral fibres: pottery: refractories: silicon dioxide (silica): silicosis.

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**Health and Safety Executive**

**Information Document  
HSE 267/3**

## **HAZARDS FROM THE USE OF REFRACTORY CERAMIC FIBRE**

### **INTRODUCTION**

1 This document contains internal guidance which has been made available to the public on the potential risks associated with the use of refractory ceramic fibre (RCF) and the precautions recommended when working with this material. The guidance is considered good practice (rather than compulsory) but you may find it useful in deciding what you need to do to comply with the law. However, the guidance may not be directly applicable in all circumstances and any queries should be directed to the appropriate enforcing authority.

### What is refractory ceramic fibre?

2 Refractory ceramic fibre (RCF) as used for insulation, particularly in kilns and furnaces, is a form of man-made vitreous (silicate) fibre (MMVF) and consists of aluminosilicate fibres which can cause irritation of the skin, eyes and upper respiratory tract, many being fine enough to be inhaled and deposited in the lungs.

3 The main concerns are in relation to potentially serious long-term health effects; experiments in animals have shown that RCFs can produce lung fibrosis, lung cancer, and also mesothelioma (a rare tumour of the lining of the chest cavity usually only associated with exposure to asbestos) following long-term inhalation.

4 Following several years of discussions in expert working groups involving industry and trade union representatives, a European Directive has now been agreed which will result in RCFs with fibres less than 6µm length weighted geometric mean diameter being classified as category 2 carcinogens (substances to be regarded as if they are carcinogenic to humans) towards the end of 1998. Most RCF products currently marketed in the UK will fall into this category. (They will additionally be classified as 'irritating to the skin').

**5 This is not a ban on use**, but it will mean that any work with RCF will be subject to more stringent control measures, under the Control of Substance Hazardous to Health Regulations 1994 (COSHH Regulations), Carcinogens Approved Code of Practice (COSHH Carcinogens ACoP)<sup>1</sup>.

6 The COSHH Regulations require employers to assess risks from their use of hazardous substances and ensure that appropriate control measures are being taken. The COSHH Carcinogens ACoP specifies that the first choice with carcinogenic materials is to prevent exposure by avoiding their use or substitution by a less-hazardous alternative.

7 If it is not reasonably practicable to do this, exposure should be controlled to the lowest level reasonably practicable. Advice on how to achieve this in practice is given at [paragraphs 12-32](#) of this document. The current occupational exposure limit for all forms of man-made mineral fibres, including RCF, is expressed in 2 ways, 5mg/m<sup>3</sup> (total inhalable dust) and 2 fibres/ml, both averaged over an 8-hour period (known as the 8-hour TWA). These are maximum exposure limits (MELs), ie exposure should always be reduced to the lowest level reasonably practicable and should not exceed the limit. These limits are subject to review following the new classification.

8 Air sampling may need to be carried out to be able to predict possible exposure levels. Unless the likely amount of fibres in air during various operations is known, it will not be possible to decide what precautions are appropriate. The [appendix](#) to this document shows typical fibre levels during various activities but these are intended only to be indicative, not a substitute for measurement. There is an approved method for measuring man-made mineral fibres, which is detailed in HSE Guidance Note EH 40 Occupational exposure limits<sup>2</sup>. Further, the European Ceramic Fibres Industry Association (ECFIA)<sup>3</sup> will, through its controlled and reduced exposure programme (CARE), offer assistance in this area.

9 It should also be borne in mind that after firing for a prolonged period of time at high temperatures (greater than 1000°C), RCF at the surface of kiln/furnace linings will devitrify to crystalline phases including crystalline silica, which is also a hazardous material, with a MEL of 0.3mg/m<sup>3</sup> (8-hour TWA). Therefore, during plant maintenance when the lining is disturbed, workers could be exposed to both RCF and crystalline silica.

10 As with any other potentially hazardous material, information on product labels and safety data sheets provided by manufacturers and suppliers should always be consulted and followed. Additional information is available from HSE in GN EH 46 Man-made mineral fibres<sup>4</sup> (due for revision) and the General and Carcinogens ACoPs1 also contain relevant information and guidance.

### PRECAUTIONS IN THE USE OF RCF

11 Exposure to fibres should be prevented or, if this is not reasonably practicable, adequately controlled. The number of people liable to be exposed to RCF and the duration of their exposure should always be kept to the minimum necessary for the work. The following are examples of the precautions which should be observed when using/handling RCF.

#### Dust control

12 The production of dust should be minimised by:

- 1) enclosing dusty processes as far as reasonably practicable;
- 2) using exhaust ventilation, eg when cutting fibre blanket/modules. The work should be positioned close to the hood/ducting to ensure that as much dust as possible is captured;
- 3) keeping fibre materials wrapped when not in use and handling them as little as possible;
- 4) buying in modules made up to the correct size and which are pre-wrapped, eg in polythene. This will reduce dust during cutting, handling and installation;
- 5) designating 'contaminated' areas, where exposure may occur and keeping these as separate as possible from other work operations. Such areas should have warning signs to indicate the risk and the precautions to be taken. Spread of dust from these areas should be prevented; and
- 6) wherever possible, thoroughly wetting fibre in situ before removal from existing plant. (Sampling has shown that wetting can reduce the amount of dust in air by at least a factor of 10).

13 During the manufacture of fibre-lined kilns/furnaces the processes and systems of work should be such as to minimise the generation of, suppress and contain dust by a combination of the above.

14 During maintenance work, eg removing linings from kilns/furnaces where high levels of dust can be predicted, the operation should be wholly or partially enclosed, eg with plastic sheeting. This would be particularly important if the job was being done during normal working hours and other workers could be exposed to dust. Enclosure will, of course, give rise to higher local levels of dust and the enclosure itself should be mechanically ventilated; existing extraction systems (eg the kiln/furnace ventilation system) could be utilised for this purpose; with extracted air filtered or

discharged directly to atmosphere (subject to environmental protection legislation). Otherwise a 'Type H' vacuum cleaner fitted with high-efficiency filtration should be used.

### Respiratory protective equipment

15 As exposure to RCF must be reduced to the lowest level reasonably practicable, appropriate respiratory protective equipment (RPE) will need to be used when maintenance, wrecking, or any other job likely to result in significant levels of dust is being carried out (**this will be the case despite the above precautions being taken**). Respiratory protective equipment must either be CE marked or HSE approved. HSE approval of RPE ceased on 30 June 1995 but HSE approved equipment made before 1 July 1995 can continue to be used, as long as it is suitable and maintained to perform correctly. HSE guidance booklet HS(G)53 *The selection, use and maintenance of respiratory protective equipment*<sup>5</sup> provides further guidance.

16 Respiratory protective equipment should be carefully chosen to ensure that it offers adequate protection. Single use or re-usable respirators with filters will be suitable for most situations when working with RCF. The choice depends on the dust levels predicted in the COSHH assessment. To decide the minimum protection required from a respirator, the concentration of dust in the workplace air should be divided by the MEL ([see para 7](#)). This can then be compared against the assigned protection factor (APF) for the respirator.

17 Types to consider are:

- 1) Disposable filtering facepiece respirators intended for use against toxic dust. Those marked FFP2 and FFP3 have APFs of 10 and 20 respectively which means they **may** be suitable where dust levels **do not exceed** the MEL by a factor of 10 or 20. But it should be remembered that the amount of dust inhaled should always be reduced as far as reasonably practicable below the MEL. This type of respirator should be disposed of at the end of each shift.
- 2) Re-usable half-mask respirators fitted with particulate filters. These may be an alternative and those fitted with P2 or P3 filters have APFs of 10 and 20 respectively. Pre-filters and cartridges should be changed regularly, according to manufacturers' guidelines.
- 3) Powered respirators including those with helmets or hoods. These have higher protection factors (APFs of 20 and 40 for TM2 and TM3 types respectively) and are suitable for situations where high concentrations of dust are likely. The appropriate grade of filter should be chosen and the equipment kept clean and maintained in accordance with manufacturers' instructions. The integral visor provides protection for the face and eyes and where impact protection against high velocity particles is needed it should meet appropriate EN specification. Where a helmet to an EN specification is incorporated this can help protect against head injury. This type of RPE should be worn when kiln wrecking or the removal of large sections of fibre is in progress.

18 It is important to remember that respirators fitted with particulate filters will **not** provide protection against gases and vapours and are **not** suitable for oxygen-deficient atmospheres.

19 The respirator selected should be suitable for the task (eg heavy work), the environment (eg hot) and fit the wearer correctly. It should be comfortable and properly used, eg the user should ensure a proper seal around the nose and other parts of the face where the respirator makes

contact. (People with beards, or stubble will **not** be able to get a proper seal with a disposable or half-mask respirator and should therefore, use a positive pressure hood or visor). Re-usable respirators should be kept clean, maintained in accordance with the manufacturers' recommendations and thoroughly examined for signs of wear and tear at least every 3 months; a record of the examinations needs to be kept, as specified in the COSHH Regulations.

20 To ensure that respirators achieve their APFs or perform better when in actual use, the guidance in HS(G)53 should be followed. **It is also important to err on the side of safety and choose a higher standard of RPE rather than one which may only provide the minimum amount of protection.**

21 Respirators are not suitable for environments which are immediately dangerous to life and health, ie where people breathing the atmosphere, in some cases even momentarily, would be quickly overcome, unable to escape without assistance or could suffer irreversible health effects. This sort of situation may arise when the atmosphere is deficient in oxygen (less than 17%), contains toxic substances at dangerous levels or a combination of both. In such cases, suitable breathing apparatus must be worn.

22 Whatever sort of equipment is chosen, workers should be trained and instructed in its correct use, its limitations, and the importance of keeping it clean and in good condition.

### **Protective clothing**

23 Protective overalls should be worn when handling RCF. For dusty operations, loose-fitting one-piece disposable overalls, preferably with a hood, should be used, and disposed of at the end of each shift. Thought should be given to minimising exposure to any residual dust clinging to overalls when they are being taken off. Wearing gloves when handling RCF will help prevent skin irritation.

### **Hygiene/welfare**

24 Eating, smoking and drinking in areas where there is risk of contamination by RCF should be prohibited. Breaks for food and drinks should be taken in a separate, designated 'clean' area and overalls should be removed and hands washed before eating.

25 Washing facilities and, where necessary, showers should be provided to enable workers to maintain an appropriate standard of personal hygiene.

26 When contractors are carrying out work, arrangements should be made between their employer and the person in charge of the site for adequate welfare facilities to be made available.

### **Housekeeping and waste disposal**

27 A good standard of housekeeping should be maintained to prevent secondary exposure from settled dust. Waste and offcuts should be removed frequently. Cleaning should be carried out by a method which does not give rise to dust, ie **not** dry sweeping. Any residual material should be vacuumed with a suitable industrial vacuum cleaner fitted with high efficiency (HEPA) filtration. Wherever possible, waste materials should be

wetted.

28 Waste fibre should be carefully placed directly into heavy duty plastic bags (NB If the material is thrust too vigorously into the bag, dust will be blown back out). All waste should be double-bagged in heavy-duty plastic bags and clearly labelled to indicate the contents.

29 From the date of classification as a carcinogen, RCF will be a 'special waste' and will need to be disposed of accordingly, ie with a consignment note and at a licensed disposal site. For further information contact the local Environment Agency office (SEPA in Scotland).

30 Refractory ceramic fibre being transported on the road will **not** be subject to regulations concerning the carriage of dangerous goods as these regulations apply to materials which could cause immediate danger to the emergency services and other road users. (The fact that a material is classified as toxic under the Chemicals (Hazard Information and Packaging for Supply) Regulations 1994 does not necessarily mean that the carriage regulations would apply).

### **Monitoring exposure**

31 Because exposure to a carcinogen could result in a serious health effect, monitoring of exposure levels by personal sampling and/or environmental measurements should be carried out at least every 12 months unless the employer is satisfied from the assessment of the work and the effectiveness of the control measures that exposure is being adequately controlled. The purpose of monitoring is to determine the extent of exposure, in comparison with the MEL, and to detect any deterioration in standards of control. Records of monitoring need to be kept by the employer and should be available to employees or their representatives. Further information is contained in HS(G)173 Monitoring strategies for toxic substances<sup>6</sup>, and the General COSHH ACoP.

### **Information, instruction and training**

32 All workers should be given the appropriate information, instruction and training to enable them to appreciate the hazards and risks from RCF and why it is important for them to observe the correct precautionary measures, eg wearing respirators and maintaining good standards of housekeeping and hygiene.

### **Health surveillance**

33 Unless it is clear that exposure to RCF is not significant (ie the exposure is most unlikely to result in disease or adverse health effect), health records should be kept for workers. This means collecting and maintaining for 40 years the following information for workers:

- 1) name;
- 2) date of birth;
- 3) address;

- 4) national insurance number;
- 5) date of starting current job; and
- 6) historical record of jobs involving work with RCF.

There is no requirement for such workers to have regular medical checks or X-rays.

### References

- 34 1 L5, *General COSHH ACoP and Carcinogens ACoP and Biological Agents ACoP: Control of Substances Hazardous to Health Regulations 1994*, ISBN 0 7176 1362 3.
- 2 GN EH 40 *Occupational exposure limits*, (published annually), ISBN 0 7176 1474 3 (for 1998).
- 3 European Ceramic Fibres Industry Association, 3 Rue de Colonel Moll, 75017 Paris, France, Tel: +33 (0) 1 44055484, Fax: +33 (0) 1 44055494.
- 4 GN EH 46, *Man-made mineral fibres* (1990), ISBN 0 1188 5571 9 (due for revision).
- 5 HS(G)53, *The selection, use and maintenance of respiratory protective equipment: a practical guide*, ISBN 0 7176 1537 5.
- 6 HS(G)173, *Monitoring strategies for toxic substances*, ISBN 0 7176 1411 5.

Note: HSE priced publications can be ordered from HSE Books, PO Box 1999, Sudbury, Suffolk, CO10 6FS, Tel: 01787 881165, Fax: 01787 313995 or good booksellers.

HSE's InfoLine can be contacted on 0541 545500 for general information about workplace health and safety issues.

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### APPENDIX (para 8)

#### TYPICAL WORKPLACE EXPOSURES

During the first 12 months of the European Ceramic Fibres Industry Association's CARE programme, monitoring of a sample of customers activities

has been carried out. Results show the following:

WORK ACTIVITY	Maximum measured concentration in fibres/ml (f/ml)	% of results greater than 2 f/ml (ie the MEL)	% of results less than 0.2 f/ml (ie a tenth the MEL)
Assembly of RCF products (includes encapsulation, stapling, cutting and module formation)	4	5%	40%
Installation of RCF furnace linings (includes fitting, cutting and tamping)	4	12%	15%
Removal activities (includes furnace wrecking, maintenance and clean up/disposal of waste)	Greater than 10 (levels of 20 and above have been recorded)	45%	15%
Auxiliary operations (includes maintenance, general handling and cleaning)	1	0	50%

**Note** that these figures are a guide only. Higher or lower results could be obtained under different operating conditions, dependant on the materials and work methods used. Also the actual exposure of the workers to dust would be less than this because of the use of respirators.

It can be seen that removal activities give rise by far, to the highest results but that assembly and installation can be responsible for creating levels of dust up to twice the maximum exposure limit (MEL).

A full report of the results of the programme is to be published by ECFIA.

