

## INTERNATIONAL MODULE SYLLABUS

### W504 – ASBESTOS AND OTHER FIBRES

**Aim:** This module enhances the student's knowledge of occupational hygiene practice in relation to fibrous dusts. The module concentrates on asbestos, but other fibres, eg. Machine made mineral fibres, aramids, carbon etc., which are increasingly finding uses in industry are also covered. Successful completion of this module will benefit those working in asbestos consultancy as well as in mainstream occupational hygiene, giving an understanding of the health risks associated with asbestos and other fibres as well as the means of evaluation and control.

**Learning** On successful completion of this module the student should be able to:

**Outcomes:**

- describe the composition, nature and properties of asbestos, machine made mineral and other fibres and their historical uses
- describe the health effects of asbestos and other fibrous materials and apply appropriate exposure limits;
- describe the uses of asbestos in buildings and the public health risk that these may pose
- understand the principles of and requirements for asbestos surveys including taking samples and identifying bulk asbestos types by microscopic techniques including relevant safety requirements
- be thoroughly familiar with current good practice in the construction and use of enclosures for asbestos remediation and the use of decontamination units.
- understand all the principles of clearance testing, the requirements for measurement and appropriate techniques for post remediation evaluation;
- conduct air sampling to determine airborne concentrations of asbestos or other fibres in accordance with defined procedures including microscopic counting techniques
- have the ability to advise on all the various techniques for the management of asbestos in buildings in accordance with good practice.

| <b>Content:</b> | <b>Topic</b>   | <b>Time Allocation</b> |
|-----------------|--|------------------------|
|                 | <b>1 Asbestos and other fibrous materials</b>                      | <b>10%</b>             |
|                 | <b>2 Health hazards and exposure limits</b>                        | <b>10%</b>             |
|                 | <b>3 Asbestos in buildings and conducting surveys</b>              | <b>25%</b>             |
|                 | <b>4 Asbestos remediation and assessment prior to reoccupation</b> | <b>20%</b>             |
|                 | <b>5 Air sampling and fibre counting</b>                           | <b>20%</b>             |
|                 | <b>6 Analysis of bulk samples</b>                                  | <b>15%</b>             |

**Note:** Reference is made to standards and good practice documentation. This may not be the most up-to-date relevant publications and is intended as guidance for candidates only.

#### **1 Asbestos and Other Fibrous Materials (10%)**

##### *1.1 Asbestos*

Describe the six regulated forms of asbestos in relation to the serpentine and amphibole groups of minerals. Discuss their characteristic properties, such as flexibility, tensile strength, combustibility, thermal conductivity and resistance to chemical attack. Describe the effects of thermal and other forms degradation on asbestos minerals.

##### *1.2 Uses of Asbestos*

Explain the physical and chemical properties of asbestos which have determined the use to which it has been put by industry. Discuss the three types of asbestos which have found significant commercial use (amosite, chrysotile and crocidolite) and the various categories of

asbestos-containing materials. Describe the use and occurrence of the other types of asbestos particularly as possible contaminants in other minerals.

### 1.3 *Man Made Mineral and other Fibres*

Describe the physical and chemical properties of other fibres such as mineral wools, ceramic fibres, special purpose fibres and continuous filament fibres.

## 2 **Health Hazards and Exposure Limits (10%)**

### 2.1 *Health Effects of Asbestos*

Describe the full range of health effects ranging from the benign (pleural plaques) to the terminal (mesothelioma) in the light of results from epidemiological studies carried out on asbestos workers. Pay particular attention to the report by Doll and Peto, 'Effects on Health of Exposure to Asbestos' (1985), that by Hodgson and Darnton 'The Quantitative Risks of Mesothelioma and Lung Cancer in Relation to Asbestos Exposure' (2000) and IPCS EHC53 Asbestos and other fibres. Review subsequent influential publications. Cover dose response relationships, the effects of smoking whilst working with asbestos and the risks to health from low level exposure.

### 2.2 *Inhalation Studies*

Review research studies of the effects of natural and synthetic fibres on laboratory animals, with particular attention being given to inhalation studies. Draw attention to the differences and similarities between the results of inhalation studies on laboratory animals subjected to various types of fibre. Compare the animal experimental evidence and that derived from known human experience.

### 2.3 *Exposure Limits etc. for Asbestos*

Review exposure limits, and the clearance indicator threshold for asbestos together with the philosophy behind setting them.

### 2.4 *Machine Made Mineral and other Fibres*

Describe the health effects of machine made mineral and other fibres such as skin, eye and upper respiratory tract irritation as well as carcinogenic effects. Review the IARC 2B classification. Review health effects of other fibres including Aramids, carbon etc.

### 2.5 *Typical Exposures to Machine Made Mineral and other Fibres*

Give examples of typical exposures while working with machine made mineral and other fibres in fibres/ml and explain what can be achieved under good working conditions. Operations discussed should include processes which result in a wide range of possible exposure levels.

Comment on the relationship between mass concentrations and fibre counts

### 2.6 *Typical Legislative Approach*

Discuss the WHO guidelines and documentation relating to elimination of asbestos related diseases for control of asbestos exposure. Discuss legislative approach with particular reference to employer's responsibilities for reducing risks.

Review literature and typical guidance documentation.

## 3 **Asbestos in Buildings and Conducting Surveys (25%)**

### 3.1 *Types and Uses of Asbestos in Buildings*

Use the literature as a primary source of information on products and their locations in buildings. Explain the physical and chemical properties of asbestos which have determined the use to which it has been put by industry. Discuss the three types of asbestos which have found significant commercial use (amosite, chrysotile and crocidolite) in relation to sprayed and thermal insulation, insulating boards, coatings, cement products and other reinforced products (eg. vinyl tiles, roofing felts) commonly used in building construction. Discuss the uses and composition of other asbestos products likely to be used or found inside buildings on plant, machinery or domestic appliances (eg. textiles, friction materials, seals, gaskets etc). Describe the use and occurrence of the other types of asbestos particularly as possible contaminants in other minerals.

### 3.2 *Surveys of asbestos containing materials in buildings*

Discuss the types of survey which can be carried out. How to plan, organise and conduct surveys. What parameters need to be assessed and recorded during the survey. Reporting

standards, typical errors and how to present results in meaningful manner and record properly the location of asbestos containing materials.

### 3.3 *Bulk Sampling*

Discuss the reasons for bulk sampling ranging from the collection of one sample through to a complete asbestos audit of a building to compile an asbestos register. The techniques used and precautions required when collecting bulk samples.

### 3.4 *Risk assessment of asbestos containing materials in buildings*

Examine strategies for risk assessment of asbestos containing materials in buildings and the compilation of asbestos registers. Outline the types and sources of information required and discuss the uses to which this information is put.

### 3.5 *Management of asbestos containing materials in buildings*

Examine strategies for management of asbestos containing materials in buildings and the use of asbestos registers and permit to work systems. Outline the types and sources of information required and discuss the uses to which this information is put. Describe the decision making protocols for prioritizing relevant management actions.

## **4 Asbestos Remediation and Assessment prior to reoccupation (20%)**

### 4.1 *Preparation*

Discuss the steps required in a job specification, preparation of a plan of work by the contractor, tender evaluation and the various roles required for proper management of the site. Other health and safety aspects including emergency procedures should be included.

### 4.2 *Enclosures*

Describe with practical examples [photographs etc.] the following:

- Correct principles of construction and implementation of an enclosure for asbestos remediation.
- Methods of enclosure examination and the documentation associated with the enclosure.
- Correct procedures for entry, exit and decontamination.
- The use of negative pressure monitors.
- Use of secondary enclosures.

### 4.3 *Remediation procedures*

Describe the various control measures available to a removal company to ensure that asbestos dust levels are kept as low as is reasonably practicable inside the enclosure.

### 4.4 *Waste Removal*

Describe the requirements for removal, storage and disposal of waste from an enclosure

### 4.5 *Role of Analyst*

Describe the role of the analyst as a competent person/ consultant. Understand the requirements for quality management systems in accordance with ISO17025 and accreditation with National bodies.

### 4.6 *Air monitoring and other techniques*

Identify the various stages where air monitoring should be employed both during and post remediation. Discuss other inspection techniques such as the dust lamp, smoke tubes, negative pressure monitors which are also useful for checking of the effectiveness of the work and the control measures.

### 4.7 *Certification of Reoccupation*

Demonstrate all the essential requirements of the required clearance procedures on completion of asbestos remediation work including the decontamination unit. This must include the certification for reoccupation.

## **5 Air Sampling and Fibre Counting (20%)**

### 5.1 *Types of air sampling*

Detail the types of air sampling that can be carried out. Examine the sampling requirements and their relevance for identification of sources of contamination. Cover assessment of personal exposure and the checking of efficiency and effectiveness of control measures.

### 5.2 *Air Sampling equipment and procedures*

Discuss the requirements of the World Health Organisation method in relation to sampling of airborne asbestos and other fibrous materials. Demonstrate the equipment required and the adjustment, measurement and calibration of sampling rate. Discuss the requirements for

recording calibration and site sampling information etc.

### 5.3 *Clearance Sampling*

Discuss when and how clearance sampling is carried out, what should be looked for and the types and frequency of disturbance which must take place.

### 5.4 *Setting Up Microscopes for Fibre Counting*

Describe use of light microscopy, setting up of Koehler illumination, calibration of stage micrometer, test slides. Describe the theory of phase contrast microscopy, with particular attention being paid to the microscope specifications outlined in guidance material.

Demonstrate and allow students to practise the use of the Walton Beckett graticule, stage micrometer and NPL test slide or equivalent. Students should be given the opportunity to set up various makes of microscope used in this work as well as to count slides of known quality.

### 5.5 *Filter Preparation*

Make students familiar with the preparation of filters and counting of fibres in accordance with the WHO method. Discuss the limitations of the methods together with examination of accuracy, precision and systematic differences.

### 5.6 *Calculation of Results and Quality Control*

Examine the reliability of results in relation to quality control schemes.

### 5.7 *Electron Microscopy*

Give an outline of the basic principles of SEM and TEM.

Discuss the discrimination between asbestos types and other fibres using SEM and TEM together with Energy Dispersive X-Ray analysis (EDXA).

## **6 Analysis of Bulk Samples (15%)**

### 6.1 *Macroscopic examination*

Demonstrate examination by low power stereo microscope, including the recognition of the basic physical properties of the main asbestos types ie. colour, lustre, elasticity, tenacity, morphology and behaviour in water.

### 6.2 *Sample Preparation*

Explain and demonstrate the options for sample preparation to segregate the asbestos for analysis. Demonstrate sample preparation methods to remove matrix materials before Polarised Light Microscopic identification, including acid washing, solvent extraction and combustion.

### 6.3 *Polarised Light Microscopy*

Examine using polarised light microscopy characteristics such as morphology, colour, pleochroism, birefringence (interference colours), sign of elongation and extinction of different asbestos types.

### 6.4 *Dispersion Staining*

Describe and demonstrate dispersion stain microscopy using Refractive Index liquids together with a McCrone dispersion staining objective or phase contrast microscopy with polariser in relation to the assessment of refractive indices of asbestos and other fibres.

### 6.5 *Health and Safety Precautions During Identification*

Discuss the precautions required when working with asbestos and other fibres eg. the use of glove boxes and ventilated cabinets as well as the required precautions when using acids during sample preparation and when handling R.I. liquids.

### 6.6 *Quality Control*

Discuss Quality Control procedures, likely detection limits, problems of cross contamination during sampling and analysis, together with the handling of homogeneous and heterogeneous samples.

### 6.7 *Interfering fibres and products*

Describe other types of fibres and other products which may interfere with asbestos identification eg. leather swarf, skin cells, polyethylene. Cover problems with products such as floor tiles. Describe the effects of heat on asbestos fibres.

## **Overall Assessment Method**

The overall assessment for this module consists of an "open book" written examination and satisfactory results from the formative practical assessment.

### Written Examination

40 short answer questions to be answered in 120 minutes. The questions require candidates to write short answers which will require no more than the box provided but may include multiple answers. Some questions may require calculations.

### Formative Practical Assessment

All candidates must participate in the practical studies and demonstrate the required skills.

The studies should be designed by the course tutor(s) to test the basic skill and knowledge of each of the candidates in the techniques for safely taking samples from bulk materials and also assessing fibre concentration in the atmosphere.

The exercises must, therefore, involve:

- Set up and use of an air sampling system for asbestos fibres in air with suitable high volume pump and the subsequent preparation of slides for counting.
- Sampling of bulk material for asbestos identification including all the required safety precautions. [Surrogate materials to be used]

Full details of the practical requirements and the individual candidate reporting forms etc. are available in document JD.2.

### Relevant Documentation

- i Asbestos for Surveyors. W.J.H Sanderson (2004) ISBN 0 7282 0452 5
- ii Alternative Code of practice 2 Surveying for Asbestos (2007) Asbestos Control and Abatement Division of Thermal Insulation Contractors Association. [DL1 4QB. UK]
- iii International Programme for Chemical Safety EHC53 Asbestos and other fibres ISBN 924154193 8
- iv WHO fibre counting technique described at :  
[http://www.who.int/occupational\\_health/publications/en/oehairbornefibre.pdf](http://www.who.int/occupational_health/publications/en/oehairbornefibre.pdf)
- v Asbestos and Man Made Fibres in Buildings, Practical Guidance. Thomas Telford DETR (1999)
- vi HSE (UK) Guidance HSG 248 [2005] Asbestos: The analysts' guide for sampling, analysis and clearance procedures. ISBN 0 7176 2875 2
- vii Doll, R & Peto, J Asbestos: Effects on Health of Exposure to Asbestos, London, HM Stationery Office 1985
- viii Hodgson JT & Darnton A, Annals of Occupational Hygiene, Volume 44, Number 8, 1 December 2000, pp 565-601(37) Oxford University Press, The Quantitative Risks of Mesothelioma and Lung Cancer in Relation to Asbestos Exposure (2000)
- ix ISO 17025 (2000) General Requirements for the Competence of Testing and Calibration Laboratories
- x HSE (UK) Guidance Note: Methods for determining Hazardous Substances MDHS100 (2001) Surveying, Sampling and Assessment of Asbestos – Containing Materials.
- xi HSE (UK) Guidance HSG 247 (2006) Asbestos: The Licensed Contractor's Guide ISBN 07176 2874 4
- xii HSE (UK) Guidance MDHS 59 (1988). Man Made Mineral Fibre Airborne Number Concentration by Phase Contrast Light Microscopy
- xiii HSE (UK) Guidance HSG 248 (2006) Asbestos: The analysts guide for sampling, analysis and clearance procedures. ISBN 0717628752

*NOTE: This list is indicative only. Students should be encouraged to read as widely as possible on relevant topics.*