OHTA

INTERNATIONAL MODULE SYLLABUS

W501 - MEASUREMENT OF HAZARDOUS SUBSTANCES (Including Risk Assessment)

Aim

To provide the student with a sound understanding of the techniques for assessing exposure to hazardous substances in the workplace and with an understanding of how exposure information can be used to assess risk.

Learning Outcomes

On successful completion of this module the student will be able to:

- describe the general approach to health risk assessment, including the role of atmospheric monitoring;
- select appropriate equipment to measure specific airborne contaminants and devise a suitable sampling strategy;
- present the results in a form useful for health risk assessment purposes to enable management to comply with relevant legislation.

Content

Topic		Time Allocation
1	**Risk Assessment**	**20%**
2	**Air Sampling Theory and Practice**	**20%**
3	**Air Sampling Equipment**	**20%**
4	**Sample Analysis**	**5%**
5	**Hygiene Standards**	**15%**
6	**Biological Monitoring**	**10%**
7	**Calculation, Interpretation and Presentation of Results**	**10%**

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 Risk Assessment (20%)

1.1 Definitions

1.1.1 Hazard

- Define hazard in terms of chemical safety

1.1.2 Risk

- Define risk in terms of chemical safety

1.2 The Risk Assessment Process

1.2.1 Information gathering

- Be aware of the sources of information
- Be able to make judgements about the significance of a hazard from toxicological properties, physiochemical properties and other data

1.2.2 Assessing risk

- Understand the relationship between risk, hazard and exposure
- Be able to make judgements about likely risk based upon the possible health effects, physiochemical properties and use of a hazardous material
- Be able to make judgements about probable risk based upon measurement data

1.2.3 Actions

- Be able to use risk assessments to decide on appropriate actions to protect worker health

1.2.4 Records

- Be able to record risk assessment information in a useful form
- Understand why it is important to record risk assessment information

1.2.5 Management

- Understand the role of risk assessment in occupational health and safety management

2 Air Sampling Theory and Practice (20%)

2.1 Workplace Sampling Strategies

2.1.1 Strategies
- Understand what a sampling strategy is and its importance in gaining representative results
- Be aware of how the choice of a strategy may effect the measurement results

2.1.2 Surveys
- Understand the different types of surveys
- Be aware of how the results from different types of surveys can be used

2.1.3 Routine monitoring
- Understand the role of routine monitoring
- Be able to plan basic routine monitoring programmes

2.1.4 Interpretation of results
- Understand how monitoring strategy and survey type can effect results
- Be able to make judgements about the significance of measurement results

2.1.5 Basic statistical analysis
- Be aware of how basic statistical tools can be used to help with the interpretation of measurement results

2.1.6 Quality assurance
- Understand the importance of quality assurance in surveys

2.2 Survey Design

2.2.1 Non-sampling sampling approaches
- Be able to apply non-sampling approaches such as the ILO Chemical Control Toolkit or COSHH Essentials
- Understand the uses and limitations of such approaches

2.2.2. Survey design
- Understand the effects of survey design on measurement results
- Be able to design basic surveys to produce representative measurements (what, who, where, when, etc)

2.2.3 Sample numbers
- Be able to calculate the appropriate number of samples required to produce representative measurements
- Understand the basis of statistically representative sampling

2.2.4 Grab samples
- Understand use and limitations of grab sampling

2.2.5 Acute and chronic effects
- Be able to design sampling strategies that are appropriate for different types of health effect

2.2.6 8 hour TWA and 15 minute STEL sampling
- Understand the significance of TWA and STEL measurements
- Be able to adjust measurements for different sampling periods
- Be able to calculate TWA results from multiple measurements

2.3 Personal sampling

2.3.1 Breathing zone
- Understand the location of the breathing zone and its significance in personal sampling

2.3.2 Effect of sample head location
- Understand the effect of sample head location on the sample collected

2.3.3 Operator variability
- Understand the reasons for the differences in exposure measurement between operators

2.4 Area sampling

2.4.1 General or background measurements
- Understand the function and limitations of background measurements

2.4.2 Contaminant spread
- Understand the effect of particle size and physiochemical properties on contaminant spread

2.4.3 Breathing air quality
- Be aware of the techniques for assessing the quality of breathing air supplied for use in air-fed respirators and self-contained breathing apparatus

2.5 Surface and other measurements

2.5.1 Surface contamination measurements
- Be aware of the techniques and uses of surface contamination measurements

2.5.2 In-situ XRF metal analysis
- Be aware of the uses of in-situ XRF metal analysis

2.5.3 Settlement of contaminants
- Be aware of how settlement rates of particulates can effect their dispersion

2.5.4 Bulk sampling
- Understand the role of bulk sampling in determining the nature of a contaminant

2.5.5 Skin exposure
- Understand the techniques for assessing skin exposure

2.6 Confined spaces

2.6.1 Identification and the nature of confined spaces hazards
- Be aware of where confined space hazards might exist
- Understand the nature of such hazards

2.6.2 Assessment techniques
- Be aware of the techniques for monitoring confined spaces

3 Air Sampling Equipment (20%)

3.1 Sampling pumps

3.1.1 Common types of pump
- Be aware of the different types of sampling pump and their use

3.1.2 Fixed volume hand pumps for indicator tubes
- Understand the correct use of fixed volume hand pumps

3.1.3 Mechanism of operation
- Be aware of the basic operating systems for sampling pumps

3.1.4 Intrinsic safety of sampling equipment
- Be aware of the need for intrinsically safe sampling pumps in certain environments

3.2 Capture devices

3.2.1 Particulates
- Understand the techniques for sampling of common particulates
- Understand the use of size fractionation techniques for respirable dusts

3.2.2 Sampling heads
- Be aware of the different types of sampling heads and their uses
- Understand the effect of the filter head on the sample collected

3.2.3 Filters
- Be aware of the different types of filters
- Understand the use of filters for trapping particulates
- Be aware of the use of chemically treated filters for sampling for reactive materials

3.2.4 Gases and vapours
- Understand the use of whole air sampling
- Understand the use of solvation for trapping gases and vapours
- Understand the use of chemical derivatisation for sampling for reactive materials
- Understand the use of adsorption

3.2.5 Types of adsorbent and absorbent
- Understand the basic principles of adsorption
- Understand the difference between adsorbents and absorbents
- Be aware of the common types of adsorbents and their uses

3.2.6 Colorimetric tubes
- Be aware of the operating principle of colorimetric tubes
- Understand the correct use of colorimetric tubes
- Be aware of the limitations of colorimetric tubes

3.2.7 Mixed exposure to solid/liquid/aerosol/gases
- Be aware of the techniques available for mixed phase sampling

3.2.8 Sampling trains
- Understand how the different components of a sampling system connect together to form the sampling train
- Understand how the sampling train is attached to the worker

3.2.9 Collection efficiency
- Be aware of the collection efficiency of common sampling devices

3.2.10 Sample stability
- Be aware of how minimise sample loss between sampling and analysis

3.2.11 Diffusive ("passive") samplers
- Understand the basic operating principle of a diffusive sampler
- Be aware of the different types of diffusive sampler
- Be aware of the relative advantages and disadvantages of diffusive samplers

3.3 Direct reading instruments

3.3.1 Portable, fixed-site or personal devices
- Be aware of the operating principles of common direct reading instruments
- Understand the nature of the information provided by such instruments

3.3.2 Intrinsic safety of instruments
- Be aware of the need for the use of intrinsically safety instruments in some environments

3.3.3. Real-time analysis
- Be aware of the uses of real-time measurements for training and other purposes

3.3.4 Uses
- Understand the appropriate use of direct reading instruments and their limitations

3.3.5 Instruments for particulates
- Be aware of the common types of instruments available for direct reading measurements of particulate concentrations

3.3.6 Instruments for gases and vapours
- Be aware of the common types of instruments available for direct reading measurements of gas and vapour concentrations

3.4 Calibration of air sampling equipment

3.4.1 Flow rate

3.4.1.1 Primary standards
- Understand what primary standards are and how they are used in flow rate calibration

3.4.1.2 Secondary standards
- Understand what secondary standards are and how they are used in flow rate calibration

3.4.2 Known concentrations

3.4.2.1 Standard atmosphere generalisation
- Be able to use standard atmospheres to calibrate direct reading equipment

3.4.2.2 Primary and secondary standards
- Understand the difference between primary and secondary standards

4 Sample Analysis (5%)

4.1 Trace level analytical methods

4.1.1 Basic techniques and applications
- Know the analytical techniques used for common hazardous substances

4.1.2 Detection limits, sensitivity, chemical interferences
- Understand how detection limits and sensitivity of such techniques will effect the sample volume required
- Understand how chemical interferences may bias results

4.1.3 Sources of methods
- Be aware of the sources of standard sampling and analysis methods such as the NIOSH NMAM and HSE MDHS methods

4.2 Gravimetric Analysis

4.2.1 Weight variation
- Understand the common causes of weight variation and how they can be minimised

4.2.2. Instrument sensitivity
- Understand the level of sensitivity of the technique and how this may effect the sample size required

4.2.3 Cost of analysis
- Be aware of the relative cost of using this technique

4.2.4 Specificity
- Understand what this type of information this type of measurement provides

4.3 Microscopy

4.3.1 Fibre identification – asbestos

- Be aware of the technique used for the measurement of asbestos fibre concentrations

4.4 Quality assurance of analysis

4.4.1 Internal quality control

- Understand the importance of internal quality control in analysis

4.4.2 External quality assessment

- Be aware of the function of external quality assessment schemes in improving reliability of laboratory measurements

5 Hygiene Standards (10%)

5.1 Principles of calculation / setting of standards

- Be aware of how hygiene standards are set

5.2 Standards used in other countries

- Be aware of commonly used international hygiene standards

5.3 Application of standards

- Understand how exposure measurements relate to hygiene standards
- Understand how hygiene standards are used to protect worker health

5.4 Definitions, terminology, units

- Understand the terminology commonly used in association with standards
- Understand the relationship between ppm and mg m^3 for gases and vapours

5.5 Sk', 'Sen' notations

- Understand the meaning of the skin notation
- Understand the meaning of the sensitiser notation

5.6 Problems

- Be aware of situations that may require different interpretation of standards

5.7 Limitations

- Be aware of the limitations of exposure standards in the light of this background

6 Biological Monitoring (10%)

6.1 Biological monitoring

- Be aware of common methods of biological monitoring

6.2 Biological effect monitoring

- Understand the difference between biological monitoring and biological effect monitoring

6.3 Metabolites

- Be aware of the role of measurement of metabolites in biological monitoring

6.4 Target organs

- Be aware how the target organ may effect the choice of monitoring technique

6.5 Local action

- Understand the difference between local and systemic actions

6.6 Biological half-life

- Understand the significance of biological half-life in biological monitoring

6.7 Sample timing

- Be aware of how to plan the timing of biological sampling

6.8 Biological standards

- Be aware of the sources of biological standards and understand how they are applied

6.9 Confidentiality

- Be aware of the need of confidentiality when dealing with biological sampling data

7 Calculation, Interpretation and Presentation of Results (10%)

7.1 Numerical evaluations

7.1.1 Time-weighted average airborne concentration

- Be able to calculate TWA values

7.1.2 Standardised format

- Be able to present calculations in a standardised format

7.2 Interpretation

7.2.1 Relevance of the calculated result

- Understand the significance of exposure measurements

7.2.2 Overall accuracy

- Be aware of the elements that effect the overall accuracy of measurements

7.3 Presentation of results

7.3.1 Relevant information

- Be able to organise and present data in a relevant format

7.3.2 Interpretation of data

- Be able to provide useful and appropriate interpretation of data

7.3.3 Recommendations

- Be able to make relevant and appropriate recommendations based upon exposure measurements

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 100 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 of personal sampling for the assessment of personal exposure.

The exercises must, therefore, involve:

- The setting up and calibration of sampling pumps for vapour sampling with charcoal tubes. The flow calibration should be carried out using basic equipment such as a soap bubble meter and stop watch rather than the more sophisticated equipment now used by experienced staff in the field.
- The set up and use of both a cyclone sampler for respirable dust and an open faced sampler for inhalable dust. This must include the weighing of filters, preferably GFA, before and after a sampling sequence to demonstrate that the candidates have the requisite manipulative skills needed in this procedure.
- The correct positioning of sampling equipment on the wearer.

Full details of the practical requirements and the individual candidate reporting forms etc. are available in document JA.2 (100408)

Relevant Documentation

i. HSE Guidance HSG Series
ii HSE Guidance MDHS Series
iii NIOSH NMAM Methods
iv NIOSH Sampling Strategy Manual
v BSEN 689:1996 Workplace atmospheres – Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategies, ISBN 0 580 25420 8
vi BOHS Technical Guide No 15 Direct Reading Instruments
vii ILO Chemical Control Toolkit
viii Standard reference textbooks such as:

1. The Occupational Environment – Its Evaluation and Control (the "White Book") published by AIHA Press
2. Air Sampling Instruments for the evaluation of atmospheric contaminants published by ACGIH
3. Occupational Hygiene, Edited by Harrington and Gardiner, Published by Blackwell Science

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

Source: BOHS Faculty of Occupational Hygiene