What are hazardous substances in the workplace?

A substance that is hazardous or harmful to health is any substance or preparation (natural, artificial, solid, liquid, gas, vapour, micro-organism, also mixtures of chemicals) used or produced at work which can cause harmful health effects, injury or ill-health. They can cause injury, ill-health or death of human beings by reason of their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure in certain circumstances. Section 1 (d) of Act No. 15 of 1973 states that Group I, Group II or Group III or Group IV hazardous substance means a substance, mixture of substances, product or material declared in terms of Section 2 (1) of Hazardous Substances Act No. 15 1973 to include Group I, Group II or Group III or Group IV hazardous substance.

What does the MHSA say?

Hazardous substances at work are regulated by the Hazardous Substances Act No. 15 of 1973. Hazardous substances are health hazards and therefore Section 13 MHSA is applicable to them and which requires the owner of the mine to establish a system of medical surveillance of employees exposed to health hazards. If you use chemicals at work you must put in place emergency plan to deal with major disasters such as spills, chemical explosions and serious exposure of workers. If you are using a chemical like cyanide in mining processes, you must develop a code of practice on cyanide management at the mine using published DME Guideline for the compilation of mandatory code of practice.

Classification of hazardous substances

Hazardous substances are classified in several ways. Section 2 (1) of Hazardous Substances Act No. 15 1973 categorizes hazardous substances into Group I, Group II or Group III or Group IV.

Hazardous substances in an approved classification list (ACL) are substances that are:

- Very toxic, harmful, corrosive or irritant.
- Substances with a workplace occupational exposure limit.
- Biological agents capable of causing infection, allergy, toxicity or other human health hazards.
- Substances that are specifically regulated e.g. lead and asbestos.

Classification is based on physic-chemical properties of substances

Examples are presented in table 10 below.

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18 Guideline for a mandatory code of practice for cyanide management.
Table 10: Classification of hazardous substances based on physic-chemical Properties

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Hazard</th>
<th>Description of hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Explosive</td>
<td>Chemicals that explode</td>
</tr>
<tr>
<td>O</td>
<td>Oxidising</td>
<td>Chemicals that react exothermically with other chemicals</td>
</tr>
<tr>
<td>F+</td>
<td>Highly flammable</td>
<td>Chemicals that may catch fire in contact with air, only need a brief contact with an ignition source to catch fire and has a very low flash point</td>
</tr>
<tr>
<td>T+</td>
<td>Very Toxic</td>
<td>Chemicals that at very low levels cause damage to health</td>
</tr>
<tr>
<td>T</td>
<td>Toxic</td>
<td>Chemicals that at low levels cause damage to health</td>
</tr>
</tbody>
</table>

Classification based on health effects

Examples include:

- Classification of substances and preparations toxic for reproduction

  A substance or preparation that is toxic for reproduction has specific properties that impair the male reproductive functions or capacity (fertility) and induce non-heritable harmful effects on the offspring.

How you can identify a hazardous substance?

It is the duty of the employer to identify the hazardous substances intended for use at the mine. There are a few things you can do to identify the type of substance you are introducing in the workplace and what it does to the health of any person who is exposed to it, for example:

(i) Conduct a preliminary risk assessment

Walk through survey to make an inventory of chemicals used

- Identify each potentially hazardous substance.
- Examine the labels and safety data sheets of the substances used in your workplace. Manufacturers and suppliers have a duty under MHSA to provide those documents which show the nature of the substance, how an employee is exposed to its risk (e.g. by inhaling it, body contact or swallowing) e.g. whether it can cause cancer or damage to the hereditary genetic system of an employee exposed to it and the precautions to be taken if a person is exposed to it.
- Check guidance notes.
- Evaluate the likely significance of the hazard.
- Identify the control measures in force
- Monitoring identify the effectiveness of the control measures.
Suitable and sufficient risk assessment of hazardous substances

When conducting a suitable and sufficient risk assessment of hazardous substances such as chemicals in the workplace you should consider the following things:

1. Reference to MHSA and Regulations, COPs, DME/DMR Guidance notes, materials safety data sheets for the danger symbols, risk and safety phases of the chemicals.
2. The physical and chemical properties of the substance e.g. the volatility if it is a solvent.
3. The routes of entry or exposure e.g. by inhalation, skin absorption.
4. The health effects e.g. irritation of skin, eyes, respiratory tract and toxic effects if they enter blood stream.
5. Who are exposed, the number exposed and extent of exposure, susceptible persons e.g. pregnant women and persons with re-existing medical conditions.
6. Whether there is a WEL assigned to the solvent.
7. The need for monitoring controls and health surveillance.
8. The need to assess the additive and synergistic effects of multiple exposures.
   a) The overall monitoring strategy that could be used to assess the actual exposure of workers including:
      • Atmospheric monitoring to establish level of airborne concentrations of solvent vapour.
      • Biological monitoring.

Suitable ways of monitoring exposures to hazardous substances include:

• Personal sampling to measure levels in the breathing zone of the workers; static sampling to measure concentrations in specific areas of the workplace. These data gives possible exposure levels by inhalation.
• Biological monitoring to obtain the total exposure hidden in the body of workers by measuring concentration in body fluids.
• Deciding who is to be monitored and for how long and when monitoring should be carried out.
• The sampling methods (grab sampling, stained tubes or integrated sampling using pump, passive absorption tubes).

Use the results to determine the acceptability of such exposures and whether current controls are working properly:

• By comparing monitoring data against the occupational exposure limits.
• Measurements obtained can be used to evaluate the suitability of work practices and need to review them.
• Results can be used to compare with exposure standards set in-house or by other organisations in the mining industry.
• Data may be used to calculate or estimate additive and synergistic effects of multiple exposures (different solvents).
• Comparison with previous results.
• The measurements can be reviewed against engineering controls such as local exhaust ventilation performance tests or PPE selection and use.
• The data can be reviewed against the results of health surveillance.
• Comparison with biological standards.
Labelling, packaging and material safety data sheets

What is a label?

A label is a written, printed or graphic material that is firmly attached to the container of the substance.

What is the importance of the label?

- The label draws the attention of the person handling or using the chemical to the dangers of the chemical.
- It tells you more about the dangerous substance that is in the chemical and what it can do to your health.
- It will also give you the safety measures you must observe when handling or using the chemical.

When you purchase a dangerous substance, make sure that it label has the following information:

- The name and complete address of the supplier, or manufacturer, the distributor or the importer.
- The name of the substance as listed in the list of dangerous substances.
- The nominal quantity, mass or volume of the contents.
- The batch identification, which can be a bar code.
- The danger symbol including an indication of the danger involved in the handling and use of the substance or preparation for example: E for explosive with a symbol of an exploding bomb.
- Standard phases indicating the special risks that arise from such dangers for example: C for corrosive- danger symbol depicting the damaging effects of acids and alkalis.
- Risk phase R27 very toxic in contact with skin.
- Safety phrases: S28 After contact with skin, wash immediately with plenty of clean water and contact your doctor, etc.
- Standard phases indicating the safety advise with regards to the use of the substance e.g. S28 above.
- Hazard class.
- Any additional information required by law.

Packaging

Packaging is the container that is used to protect, handle, deliver and present goods from the producer to the user or consumer. When you purchase substances for use at the mine, make sure the packaging is well constructed and closed to prevent deformation, leakage or sifting of the content due to vibration, stacking, impact or changes in environmental conditions such as temperature, pressure or humidity.

Substances and preparations that are dangerous or harmful to the aquatic environment are assigned the symbol (N) with the indication “Dangerous to the environment” and the appropriate risk phase- R51 Toxic to aquatic organisms.
R53 May cause long-term adverse effect in the aquatic environment.
R50 Very toxic to aquatic organisms.
• Mutagens categories 1 and 2, danger symbol T and indication of danger “Toxic” Risk phase R46 may cause heritable genetic damage.
• Category 3 mutagen symbol (Xn) with indication of danger “Harmful” Risk phase 40 possible risk of irreversible effects.

Check the material safety data sheet (MSDS)

The MSDS gives information to users of the substance to enable them to take the necessary steps to protect health and safety and the environment. The MSDS provides information that:

- Identifies the substance or preparation and the company or business entity.
- Identifies the hazards of the chemical e.g. Toxic
- Specifies the ingredients of the substance.
- Specifies the physical and chemical properties of the substance and whether it is stable or can react with other chemicals.
- Gives the toxicological information or how it can affect the living organism e.g. Risk phrase R27 very toxic in contact with skin.
- Indicates how it can affect the environment, e.g. toxic to aquatic life e.g. R51 Toxic to aquatic organisms.
- Specifies how to transport and dispose of the substance safely.
- Indicates how to handle and store the substance safely.
- Indicates the first aid measures to take in case of exposure to the substance e.g. in case of contact with face, rinse properly with clean cold water and contact your doctor: S28 After contact with skin, wash immediately with plenty of (specified by the manufacturer).

Harmful and adverse effects of hazardous chemicals

Depending on the toxicity and amount of substance, risk to health can be acute (short-term), chronic (long-term) or both. The effect can also be additive.

- Acute effect occurs from a single contact causing serious effects or death either immediately or after some time.
- Chronic effect occurs from repeated contacts, even at low level, causing harmful effects or even death.
- Both short and long term effects could occur.
- An additive effect results from mixed or consecutive contacts with different substances.

Hazardous substances are a real danger to health and can do damage that cannot be reversed on exposed employees. Such consequences can be:

- Mutagenic by changing the genetic material that determines the heritable characteristics of living cells in the person.
- Carcinogenic by causing human cells to grow uncontrollably resulting in cancer if the growths become malignant.
- Reproductive when they impair fertility or cause damage in the development of the offspring before conception, during pregnancy or after birth.
- Allergenic by causing hypersensitive conditions in humans.
Controlling hazardous substances at work

Control measures include:

The best option is always to avoid a harmful substance altogether, or substitute the substance with a less harmful one. When it is not possible to eliminate a chemical or substitute it with an alternative substance that is less harmful, then your action should be directed towards reducing exposure of employees to the substance to as low as reasonably practicable.

- Try to reduce the quantities of the substance you use.
- Search the market for safer physical form of the substance; for example, buy used pellets or flakes rather than the powder form.
- If this is not possible try to change your processes or use engineering systems to reduce exposure for example:
  - Enclose the system or process to remove it from workers.
  - Automating this system or if not possible, partially enclosing it to reduce the number of workers who get exposed.
  - Providing local exhaust ventilation (LEV) to control exposure at source.
- Use sealed or closed containers to store the chemical and it is good practice to store a larger quantity rather than smaller amounts of the substance so that you can control exposure better.
- Label the materials correctly and restrict the areas you use them by putting signs showing the zones and restricting entry only to authorized persons.
- Manage wastes correctly by labelling them clearly, storing them in secured containers to be removed only by authorized contractors for safe disposal.
- You can use other administrative controls such as reducing the number of workers operating in the exposure area by rotating workers to other jobs as well as limiting access only to authorized persons.
- Take precautions to limit contamination. For example, ban eating, smoking, drinking in the restricted areas and make sure workers are provided sufficient facilities to wash.
- Carry out adequate monitoring of exposure levels and how well your controls are working by checking personal exposure through medical surveillance and checking workplace concentrations.
- Provide sufficient information, instruction and training to workers about the nature of the chemical, the health effects and the controls in place. The MSDS should be made available to employees.
- PPE should be provided in combination with other control measures.

Personal protective clothing and equipment (PPE)

PPE for use when handling chemical substances must be carefully selected. There are some factors that you need to consider when selecting PPE for: Hands, face and eyes and the rest of the body.

Factors to be considered for selecting protective gloves for the hands:

- The resistance to the chemical and the breakthrough time of the chemical.
- The length of time that the gloves had to be worn.
- The level of skill required for the task.
- The length of the gloves to ensure adequate protection.
- The duration of the gloves.
• The need to ensure that a suitable range of sizes is available for various users.
• The need to identify any employee allergies to the glove material or any other skin problems.

Selection of eye protection needs to consider:
• The risk of splashing the face and eyes.
• The provision of instruction on the use of goggles to face shields.
• The level of chemical resistance of goggles and face shields.
• Compatibility of goggles, face shield with other PPE if required.
• The need for fit testing of goggles and face shield.

When selecting body protective equipment such as aprons, overalls and foot wears consider:
• Compatibility with the chemicals.
• Sizes fit and comfort of users.
• Duration of use, workplace environment conditions, etc.

For skin, eye and body protection, factors such as consultation and user trials, conformity to appropriate performance standards and SABS marking; and chemical resistance would have to be considered.

Emergency preparedness and response

The MHSA requires you to put in place an emergency plan for responding to foreseeable emergencies arising from using hazardous substances such as employees’ contamination, spillage and explosions at the mine that may arise during process work, storage, transportation or disposal of wastes. Your emergency plan should include:

• Arrangements for first aid including medical kits and supplies, trained first aiders, appropriate location of first aid facility. For example, if the chemical in use is cyanide, your first aid facility should be able to provide first aid treatment to:
  - Any suspected inhalation or skin contamination.
  - Any suspected swallowing of cyanide.
• Arrangements to provide hospital treatment for suspected exposure to cyanide
• Arrangements for cleaning of spillage to make the work environment safe:
  - Detoxification and decontamination of the spillage area.
  - Disposal of the chemical spillage and packaging which should be carried out by authorized expert contractors.
• Arrangements with local emergency authorities to coordinate activities in case of a major chemical disaster including putting in place a communication system to liaise with them during an emergency. Emergency contact numbers should be brought to the notice of employees.

Provide employees information and training in the use of these procedures.
Summary of what to do to control exposure from hazardous substances at work include:

- Assess the risks.
- Decide what precautions are needed.
- Prevent or adequately control exposure.
- Ensure that control measures are used and maintained.
- Monitor exposure.
- Carry out appropriate health surveillance.
- Prepare plans and procedures to deal with accidents, incidents and emergencies.
- Ensure that employees are properly informed, trained and supervised.

**Purchasing, transportation and delivery of hazardous substances**

It is good practice to develop and implement a purchasing policy which states the procedures for purchasing and bringing in and taking out hazardous substances from the mine. When you purchase chemicals, you import or bring in hazards to the mine and when you take wastes out, you export wastes out of the mine to the community or local environment. A procedure for managing hazardous materials at work will sort out those issues. In general, you should:

- Purchase chemicals, e.g. cyanide used in gold mineral processing from dependable and reputable manufacturers, suppliers and distributors.
- Make sure that the chemicals are supplied with their material data safety sheets (MSDS).
- Substances are transported and delivered safely: in appropriate packaging to prevent spillage and exposure of people and contamination of the environment; packaging clearly labelled including tactile symbols; off-loading and handling by competent persons and using appropriate techniques.
- Substances to be stored in appropriate containers and separated from other chemicals to avoid mixing and the risk of chemical reaction and explosion; container lids to be kept tight to prevent vapour release. Make sure only authorized persons can gain access to the storage area to limit the number of persons that can be exposed.
- Allow only competent persons to use the substance, e.g. cyanide and only competent persons should use the equipment. Make sure that the chemical is used only according to the instructions shown on its material data safety sheet supplied by the manufacturer.
- Appropriate PPE must be selected and provided to persons working with the chemical. The equipment should fit the worker properly and he/she should be thought how to use, store and maintain it and to report damaged PPE and receive fresh ones. A competent person must regularly inspect the equipment and maintain it to prevent people from being exposed.
- Ensure that leakages and spills are detected, reported and action taken in good time.
GUIDELINES FOR OCCUPATIONAL HEALTH SURVEILLANCE

What is health surveillance?

Health surveillance is a process that involves a series of techniques used to detect early signs of ill-health related to work among workers exposed to certain health risks and acting on the results obtained. Occupational health surveillance in mining affords the opportunity to:

- Assess the health status of all mining employees on a regular basis.
- Analyze the information collected to detect adverse health effects at the earliest opportunity.
- Enable appropriate and timely corrective action to be taken to protect the health and safety of mine workers.
- Provide data that can be used to carry out studies about the distribution of diseases, their risk factors and how to control them.

What the MHSA says on Medical surveillance?

Section 13 (1) (2) of the MHSA states that employers must establish a system of medical surveillance for persons who are or may be exposed to an occupational health hazard.

Section 13 (2) (a) of the MHSA states that the medical surveillance programme must be appropriate for the hazards identified.

Section 13 (2) (b) of the MHSA states that the medical surveillance programme should be able to provide the employer with information to eliminate, control or minimise the hazard and its associated risks.

Section 13 (3) states that if you establish or maintain a system of medical surveillance for your employees, you must hire the services of a part-time or full-time occupational medical practitioner and give the practitioner the means to carry out his/her work and keep a record of medical surveillance for each employee at the mine.

This means that only occupational health or occupational medical practitioners should carry out medical surveillance. If you are a small mine owner with financial constraints and you must deal with these experts following your risk assessment, it may be good idea to pool resources as a group of small independent miners to hire the services of one or more experts to assist you.

The MHSA says that your medical surveillance programme should be appropriate to the hazard. This means that it should be able to quantify the effects to health of exposure to the hazard. For example, for noise hazard, the testing of the workers hearing done by audiometric test is the most appropriate form of medical surveillance because it gives the levels of hearing loss which can be related to the worker's exposure to noise as shown also by the personal noise sampling using dosimeter (the occupational hygiene measurements). Audiometric results will help enhance the effectiveness of hearing conservation programme and therefore meets the MHSA medical surveillance requirement. A worker’s medical surveillance record is therefore linked to his/her personal exposure measurements.

If it is not practicable to cover all employees, medical surveillance can be done on the basis of a group of workers representing an occupation, activity and or a workplace known as the homogenous exposure group.
Your medical surveillance programme can cover several hazards for example, for airborne particulates such as dust and diesel fumes, thermal stress (heat and cold), radiation and vibration, chemical and biological agents.

Health surveillance means the monitoring (including biological monitoring and medical examination) of employees in order to identify changes in health status due to occupational exposure to a hazard including chemicals, noise and vibration.

**When is health surveillance required?**

Section 13 of the MHSA requires the employer to establish and maintain a system of medical surveillance of employees exposed to health hazards at the mine such as physical hazards including noise, vibration, radiation, thermal stress, hazardous substances such as dust, fumes, chemicals and biological agents.

- A regulation or notice in the Gazette may require you to establish a system of medical surveillance at the mine.
- Where your risk assessment in terms of Section 11 (1) of the MHSA indicates a need for medical surveillance, for example if it identifies a health hazard with a significant risk to the workers exposed to it.

The MHSA also states that medical surveillance must be appropriate to the nature of the hazard. This means that:

- There should be an identifiable disease that is associated with the hazard or work activity, for example noise-induced hearing loss (NIHL) in workers working in excessively noisy work areas.
- There are appropriate methods, which the occupational health practitioner will use to identify the disease, e.g. audiometric tests to detect hearing loss.
- In the current conditions in the work areas, workers operating in them are likely to suffer from NIHL.
- Medical surveillance is mandatory for all employees exposed to health hazards.

In addition the MHSA Section13 (6) also says that whenever any of your workers is declared by the occupational medical practitioner unfit for work because of an occupational disease, you must carry out an investigation.

**Procedure for Health Surveillance**

It is good practice to develop a health surveillance procedure in consultation with the health and safety representatives, health and safety committee and employees. The procedure should set clearly the roles and responsibilities of management, occupational health practitioner or service and the human resource department. It should specify the following:

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19 Regulations under the mine health and safety Act, chapter 11 occupational medicine (Act No. 29 of 1996).

20 Guidance note on tuberculosis control.
GUIDELINES FOR THE MANAGEMENT OF HAZARDOUS SUBSTANCES AT WORK

- How results of medical surveillance are to be handled, recorded and stored, especially with regard to individual medical information.
- An agreed policy on redeployment of an employee whose continued fitness for work is affected by the outcome of medical surveillance.
- Section 19(2) of the MHSA states that an employee may request, and the employer must then provide, a copy of the record of the exit certificate prepared as a result of medical examination conducted by the OMP conducting in terms of section 17 of the MHSA.
- The consequences if an employee refuses to participate in medical surveillance.

Objectives of conducting Health Surveillance

- To protect the health of employees by detecting early adverse changes that may be attributed to exposure to substances hazardous to their health.
- To assist in the evaluation of measures taken to control exposure.
- To collect, maintain and use data for the detection and evaluation of hazards to health.
- To assess, in relation to specific work activities involving micro-organisms hazardous to health, the immunological status of employees.

Types of health surveillance procedures to achieve the objectives

1. Biological (exposure) monitoring
   - Measurement and evaluation of the levels of hazardous substance e.g. chemical or its metabolites (break-down products) in body tissues, body fluids (urine, blood) or in exhaled breath of an exposed person in order to quantify actual exposure. Examples:
     - Testing for blood lead level in workers who carry out operations in mines containing lead ores.
     - Provision of information to workers about new risks that may make them more susceptible for example cardiovascular disease, asthma.

2. Biological effect monitoring
   - Measures and assesses early biological effects before the health of workers exposed is impaired.

3. Medical examination
   - Use of standard clinical and medical assessments, tests and other techniques to assess the presence of early or long-term disease by a registered occupational medical practitioner (OMP). This is carried out at set intervals and includes:
     - Assessment of medical history of the employee.
     - Occupational work and assessment of previous exposure history.
     - Physical examination.
     - Lung function tests.
     - Radiography (chest X-ray)
   - Make enquiries about symptoms: Inspection or examination by a suitable qualified person e.g. an occupational health nurse (OHN).
Review of records and occupational history during and after exposure: To check correctness of the assessment or risk to health, and to indicate if the assessment needs reviewing.\(^{21}\)

**Aim:** to determine the level of exposure for example to silica or asbestos.

Selecting the monitoring methods or combination of monitoring methods to use for health surveillance depends on the type of substance or activity to which workers are exposed, the way they are exposed (e.g. by inhalation, ingestion (swallowing) or skin contact) and whether it is possible to carry out biological exposure monitoring (whether valid methods exist to detect metabolites) rather than medical examination which is after exposure.

The MHSA is specific, medical surveillance is required for hazards to health including physical hazards, airborne pollutants, and biological agents at the mine. The MHSA requires you to integrate medical surveillance with occupational hygiene programme so that occupational hygiene measurement results are linked with the medical surveillance outcomes of employees.

A health surveillance programme at the mine should include:

1) **Programme for occupational health monitoring:**
   - Pre-employment or initial medical examination
   - Routine medical examinations
   - Fitness for work/disability assessment following long period of illness
   - Exit medical examination

2) **General health screening (as part of general workplace health promotion activities)**

**What are the various forms of health surveillance?**

1) **Pre-employment or initial medical examination**

The pre-employment or initial medical examination is aimed at making sure that the new recruit is fit for his/her job and will not be a danger to himself or others. The examination is conducted on all prospective full-time, part-time and temporary employees, most particularly those who will have to work in the risk areas at the mine to establish before exposure whether the individual already has any defects which could lead to health risks in the job. Initial medical examination is important in:

- Providing baseline information about the health status of the employee against which subsequent checks will be made. For example, lung function or spirometry tests are done on workers who may be exposed to silica and coal dusts and harmful fumes, and audiometric tests on those workers who will be exposed to excessive noise levels that may lead to noise-induced hearing loss (NIHL).
- Promoting employee health by detecting diseases that are not related to their work including hypertension, diabetes, cardiovascular problems and providing them with treatment.

\(^{21}\) Guideline for the compilation of a mandatory code of practice on minimum standards of fitness to perform work at a mine.


_Courtesy: MHSC_