



**INTERNATIONAL ACADEMY**  
Initiative in Education & Lifelong Learning

## **Certificate Programme**

# **Occupational Health and Safety: Legal and Operational Guide**

## **Unit 2**

### **Sector Specific Occupational Health and Safety Issues**

Occupational Health and Safety: Legal and Operational Guide

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## **Units of Certificate in Occupational Health and Safety**

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### **Unit 1: Introduction to Occupational Health and Safety (OHS)**

- Definition and Context of OHS
- Objectives and Principles of OHS
- Workplace and Health
- Occupational Health, Hygiene and Ergonomics

### **Unit 2: Sector Specific Occupational Health and Safety Issues**

- Health and Safety Risks in Mining
- Health Hazards in Electronic Industry
- Health Hazards in Food Processing Industry
- Health Hazards in Other Industries

### **Unit 3: Socio-Economic Aspects of Occupational Health and Safety**

- Women's occupational and health safety
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## Introduction

The most common illnesses in the workplace are cancers from exposure to hazardous substances, musculoskeletal diseases, respiratory diseases, hearing loss, circulatory diseases and communicable diseases caused by exposure to pathogens. The variety of the occupations is so vast that not even experienced specialists, safety engineers, industrial hygienists, industrial physicians, consultants and researchers are familiar with all the hazards that exist in each specific occupation. The present unit elaborates various occupational hazards of some of the occupations like mining, electronics, textile industry, food processing etc.

## Learning Objectives

After completing this Unit, you should be familiar with the following concepts and issues:

- Health hazards of the mining industry
- Occupational hazards related to the electronics industry
- Health hazards of the food processing industry
- Health hazards of the textile industry

## 2.1 Health and Safety Risks in Mining

Mining is the extraction of valuable minerals or other geological materials from the earth, usually from an ore body, vein or seam. Mining in a wider sense can also include the extraction of petroleum and natural gas.

Mining remains one of the most difficult, dirty and hazardous occupations; causing more fatalities than most other occupations. Although accounting for only 0.4 per cent of the global workforce, mining is responsible for over three per cent of fatal accidents at work (about 11,000 per year, about 30 each day) throughout the world.

Workers in mines are among those who have paid and who continue to pay a high price for inappropriate and insufficient occupational safety, health and hygiene measures. While it is true that there has been remarkable progress in occupational safety and health, much remains to be done. The risks to mine workers can be generalised as follows:

- **Environmental hazards** - underground difficulties due to darkness, heat, dampness, cramped conditions, radiation, exposure to gases such as methane, and atmospheric pressure.
- **Work specific hazards** - explosives, physical work, noise, vibration; dust, etc.
- **Poisoning** - due to fumes from explosives, diesel engines, resins, PVC conveyor belts, glues and non-flammable liquids based on polychlorinated biphenyls, phosphate and glycol esters.
- **Biological risks** - in mines with wooden pit-props, or those where draught animals are used.

The unpredictable and constantly changing nature of the work environment are two special features that distinguish mining from other industrial activities. A central problem in mining and quarrying work is the continuous movement, which necessitates special requirements for occupational protection, compared to permanent places of employment.

### **2.1.1 Environmental Hazards**

#### ***Heat and Humidity***

The environment in underground mines is generally hot and humid because of strata temperature, heat generated by machines, heat given off by human beings and heat produced by the oxidation of carbonaceous matter, etc. Moreover, in underground mines, the principal source of heat is from the rock itself. The temperature of the rock goes up about 1° C for every 100 m in depth. With the extension of mining operations going deeper and the deployment of an increasing number of machines, health problems are acquiring greater magnitude, resulting in more accidents and loss of efficiency.

#### ***Illumination***

Poor illumination can cause stress on the visual system resulting in fatigue, which in turn leads to production losses, inferior quality of work, increased mistakes in work, increased accident frequency, and an eye disease known as nystagmus. Prescribed illumination levels range from 0.2 lux to 50 lux depending upon the vulnerability of locations/ operations.

### ***Dust and fibres***

Due to the nature of the work, dust has been one of the main problems in mining. The extraction and transport of coal in mining operations can generate significant amounts of airborne, respirable coal dust. Inhalation of this dust can lead to coal workers' pneumoconiosis, a disabling and potentially fatal lung disease.

In the mining of other commodities (metal, non-metal, stone, sand and gravel) and for select occupations in coal mines, the generation of respirable silica dust is a primary concern. Inhalation of excessive levels of silica dust can lead to silicosis, another disabling and potentially fatal lung disease. Exposure to silica is also associated with an increased risk of tuberculosis and some autoimmune diseases, including scleroderma.

#### **2.1.2 Work Specific Hazards**

### ***Noise and vibration***

The noise level in mining areas is normally between 80 - 110 dB (A), but most frequently it is between 90- 95 dB. The majority of noise comes from machines like loading, drilling and personnel transport machines.

Permissible noise levels have not been laid down in the statute for Indian mines. However based on the ILO Code of Practice, permissible limits have been recommended by DGMS through a technical circular. The recommended noise standards are:

- Warning (Action) level- 85 dB
- Danger limit for unprotected ears – 90 dB
- Entry only with ear protection –115 dB
- Entry to be prohibited - 140 dB

The drilling jumbos and loading machines cause vibrations in the entire body, while hand-held drilling machines cause vibrations of the hand and arm. The spectra of whole body vibrations usually have three different peaks between 1.6 to 2.5 Hz, 6.3 to 12.5 Hz and 20 to 30 Hz. From the point of health risk, the most important frequencies are 2-4 Hz and reducing these frequencies is very difficult in this area of work.

### ***Contact with electric current***

Electrical accidents are the fourth leading cause of death in mining and are disproportionately fatal compared with most other types of mining accidents. Fatalities are caused by burns and electrical shock. Half of all mine electrical injuries and fatalities occur during electrical maintenance work and the electrical components most commonly involved are circuit breakers, conductors, batteries, and meters. The wide variety of electrical injuries on-the-job suggests that no single intervention strategy can eliminate occupational electrical fatalities and injuries. Instead, multi-faceted research approaches that consider not only engineering controls but also organisation of work, training, and personal protective equipment are needed to mitigate electrical hazards.

### ***Explosions***

While a lot of progress has been made in preventing explosions in mines, these still occur, often causing multiple fatalities. Explosions and the resulting fires often kill or trap workers, block avenues of escape and rapidly generate asphyxiating gases, which threaten every worker who is underground. Explosions can be prevented by minimising methane concentrations through methane drainage and ventilation, by eliminating ignition sources and also by adding sufficient rock dust to make the coal dust inert.

### ***Fires***

Fires are a significant hazard to the safety and health of mine workers. A fire in an underground coal mine is especially hazardous due to the unlimited fuel supply and the presence of flammable methane gas. The leading causes of mine fires include flame cutting and welding operations, friction, electrical short circuits, mobile equipment malfunctions, and spontaneous combustion. In the recent past, several large coal-mine fires have resulted in mine evacuations and the temporary sealing of the mines.

### ***Diesel exhaust***

Diesel exhaust, based on a combination of chemical, genotoxicity and carcinogenicity data, is a potential human carcinogen. In addition, overexposure to diesel exhausts has been linked to health problems such as eye and nose irritation, headaches, nausea, and asthma. Currently, underground miners are exposed to over 100 times the typical environmental concentration of diesel exhaust and over 10 times of that measured in other workplaces.

### ***Inundations***

Inundations have also taken a heavy toll in mines. From 1975 till date, there have been four disasters in Indian mines killing 414 persons. Inundations take place from surface, as well as underground sources of water.

### **THINK TANK**

Can you find out more about the following?

- Disasters due to electric sparking in mining areas include the Jitpur incident in 1973 (48 deaths) and Baragolai in 1979 (16 deaths).
- The Chasnala disaster.
- In 1965, a major disaster occurred at the Dhori mines killing 268 mine workers due to explosions.

### ***Radiation/Radon exposure***

Workers employed in uranium, hard-rock and phosphate mining, are potentially exposed to high concentrations of radon and uranium miners are generally believed to have the highest exposures. Radon is formed from the radioactive decay of radium and uranium. Miners constantly exposed to large quantities of radon have a high risk of developing lung cancer. The incidence of lung cancer is enhanced when radon acts in combination with silica dust, diesel fumes, and cigarette smoke. Iron ore, potash, tin, fluor spar, gold, zinc, and lead mines also have significant levels of radon.

### ***Roof/ Rock falls***

Rock-falls account for a large proportion of accidents; in recent times, such accidents have been caused by seismic events. These can be attributed to what is generally termed pillar mining, where support structures are created for the earth wall in the process of mining. Unfortunately, due to the continued process of digging further in the attempt to reach the ore, high stress levels are caused and the pillars come under enormous pressure, thereby leading to rock falls and seismicity.

## 2.2 Health Hazards in the Electronics Industry

More than any other single product, the semiconductor 'chip' symbolises the extraordinary progress in the industry. However, the image of the electronics industry being a clean and trim industry – workers in spanking white gowns and caps, and stylish pants with no smoke-belching stacks, is very misleading. Compared to other industries, electronics manufacturing has an exceptionally high rate of illness among its workforce and has been responsible for devastating cases of environmental pollution.

### 2.2.1 Debunking the Myth of a Clean Industry

Interestingly enough, the electronics industry can also be considered a chemical industry. Electronics production utilises several thousand different kinds of toxic substances. Is it not amazing to know that Hewlett-Packard keeps 'Material Safety Data Sheets' on over 3,000 different chemicals, at its California headquarters!!! Raw materials for electronics and electrical manufacturing are provided almost exclusively by the chemical industry, which in turn relies heavily on mining and the processing of basic metals and minerals such as oil and coal.

The high rate of work-related illness in electronics is still being examined. Evidence of health hazards in electronics has only just begun to emerge, since relatively little is known about chemical toxicology, due to the fact that it takes months or years before an illness manifests itself from the time of the first exposure. For example, it may take anywhere from 2 to 50 years after exposure to a carcinogen before cancer appears and one to five years of using a microscope daily before permanent eye damage occurs. Chemicals can leak slowly into the air, soil and water leading to a host of delayed health problems in the residents of nearby communities.

### Health hazards common in the electronic industry

<b>Hazardous Sources</b>	<b>Job/Condition</b>	<b>Immediate Effects</b>	<b>Long Term Effects</b>
<b>Acids</b>	Electroplating, etching, crystal polishing	Skin burns, eye irritation	Lung disease, bone damage, erosion of teeth
<b>Metals</b>	Electroplating, etching, soldering, tinning, sealing	Breathing problems, skin irritation, headaches, insomnia, stomach pain, miscarriage	Cancer, liver damage, sterilisation, dermatitis
<b>Gases</b>	Doping, crystal growing, cap testing	Dizziness, nausea, vomiting, diarrhoea, coma and death	Anaemia, jaundice, liver damage
<b>Resins (Plastics, Epoxies, Glues, Flux)</b>	Cutting, grinding, encapsulation, laminating, packaging	Breathing problems, skin irritation	Cancer, liver damage, allergies, asthma
<b>Solvents</b>	Nearly every job and process and is used as cleaning, degreasing, and thinning agents	Skin irritation, cough, breathing problems, sore throat, dizziness, headache, nausea	Liver damage, kidney damage, heart damage, paralysis, cancer, allergies, menstrual disorders
<b>Radiation (Non-ionizing)</b>	X-ray equipment, electron beam equipment, high voltage power supplies (unshielded)	Redness of skin	Cancer, sterility
<b>Microscopes and TV monitors</b>	Chip assembly, testing, other jobs	Eye problems, headaches, backaches	Eye damage, tenosynovitis
<b>Stressful work conditions</b>	Work quotas, rotating shifts, repetitive work, many others	Weakness, proneness to injury and illness	Menstrual disorders, pregnancy problems, tension, recurring illness, general poor health
(Gassert, 1985)			

## Health Hazards

The different types of health hazards are discussed below.

### *Chemical hazards*

The electronics industry has developed the clean room, where dust levels are kept very low, as the smallest bit of dust can ruin the manufacture of an expensive semiconductor. To save energy costs and to lower dust levels to near zero, filtered air is re-circulated in the clean rooms. As a result, workers are repeatedly and continually exposed to re-circulated mixtures of chemicals because the fumes and vapours of many hundreds of chemicals cannot be completely removed by air and particulate filters.

In the electronics manufacturing industry, workers are exposed to chemicals mainly by contact and inhalation. All communities are also exposed to a variety of chemicals when electronics factories release toxic waste into the local air, water and soil. The hazardous chemicals can have both acute (quick reaction, usually after exposure to a large amount of a chemical) and chronic (delayed reaction, often worsening gradually over time) effects. The effects can also be classified as local effects (effect develops at the place of contact) and systemic effects (effect develops at places in the body, other than where the chemical has made contact with the body).

Irritation and allergic reactions are some of the more common health problems experienced by workers exposed to chemicals in electronics manufacturing. Some of the common allergens and irritants include organic solvents; solder flux, aldehydes, epoxy resins, curing agents, metal dusts and fumes, acrylates, isocyanates, inorganic acids, plastic resins and additives, waxes, aniline dyes, alkali detergents, etc.

Some of the common allergic reactions prevalent in the electronics industry are conjunctivitis, sinusitis, chronic bronchitis, asthma, alveolitis, dermatitis, and pruritis.

The ability of both male and female workers, in the electronics industry to have a normal sex life and to give birth to healthy children is threatened by three job hazards – chemicals, radiation and stress. Some of the effects are change in sexual behaviour, problems in the reproductive system, abnormal pregnancy, birth defects and accumulation of mutated genes in future generations.

The risk cancer of getting for workers in the electronics industry may be higher than for the general population in urban industrial areas. At least 20 per cent (and perhaps up to 50 %) of electronics and electrical workers or at least one out of every five workers, face the risk of cancer-causing substances on the job. The groups of chemicals that cause higher rates of cancer risk include petroleum and fuel oils, heavy metals and their compounds, chlorinated hydrocarbons and other solvents, vinyl chloride, acrylonitrile, ethylene oxide and other plastic resins, and asbestos.

### ***Radiation hazards***

Many electronic workers are exposed to radiation on the job. The most common forms of low risk radiation in electronics are heat (radio frequency radiation) and artificial light (fluorescent lamps). Evidence suggests that even low amounts of both ionizing x-rays, gamma rays, radioisotopes, neutrons) and non-ionizing radiation (radio frequency, microwaves, infrared and ultraviolet light) can be dangerous to workers.

Most ionizing forms of radiation penetrate the skin and instantly damage or destroy the tiny cells of the human body; the damage is almost irreversible. The amount of

cell damage depends on the dose or strength and duration of the exposure to radiation. Exposure to ionizing radiation is more likely to occur in the wafer fabrication process, in the manufacture of PCBs (printed circuit board) and when using radioisotopes such as krypton-85, to check for leaks after encapsulation, in the process of semiconductor assembly. Results of exposure can include cancer, genetic mutation, aplastic anaemia, and birth defects in children, miscarriages, decreased life expectancy and premature ageing.

Non-ionizing radiation is generally thought to be less dangerous but new evidence about the health effects of exposure to microwaves is causing concern. Laser beams, used for cutting and drilling, can cause instant destruction of human tissue. Non-ionizing forms of radiation usually affect the eyes, skin and male reproductive organs (the testes). Microwaves, ultraviolet light and lasers are among the most dangerous kinds of non-ionizing radiation.

### ***Eye hazards***

One of the saddest stories to emerge so far in the brief history of electronics manufacturing is the permanent loss of eyesight suffered by thousands of young workers solely because of unjust and unhealthy working conditions. Eye problems like chronic conjunctivitis, near sightedness and astigmatism are shocking, considering that for most jobs only applicants with 20/20 vision (perfect eyesight) are hired. The main causes of eye problems in these workers are stress, radiation hazards of using scopes and TV monitors, chemical vapours, fumes, dust and gases that cause irritation.

Eye problems can be grouped as eyestrain, eye irritation, and eye damage. Conjunctivitis, known as 'pink eye' (inflammation of the mucous membrane) is

caused by irritant chemicals. Near sightedness (myopia) is perhaps the most common form of eye damage resulting from repetitive detailed work with scopes or monitors. The toxic effects of chemicals may also result in the loss of normal colour perception, loss of peripheral vision, hallucinations, decreased ability to see in the dark, blurred vision, loss of normal eye-hand coordination, reduced vision and blindness. In addition, eye problems can lead to other complications like headache, dizziness, fatigue, inattention, irritability, nervousness, insomnia, hallucinations, stress, etc.

### **Noise Hazards**

In the electronics industry, machinery such as metal stampers, cutting equipment, motors and packaging machines may emit excessively loud noise. High frequency noise is also emitted from ultrasound equipment used for bonding and testing components and for other purposes. The pain threshold of noise is about 120-140 dB and most work related hearing loss is caused by prolonged exposure to noise over 80 dB. Signs of stress, such as increased heart rate (rapid pulse) have been observed in people exposed to continuous noise at levels between 60 and 70 dB.

### **Stress**

Stress is an important, but often overlooked factor in health and safety hazards at work. In electronics manufacturing, there are three main cause of stress - ergonomic, economic and social.

*Ergonomic causes* of stress are those that involve the worker's biological-mechanical (physical) relationship to the job he/she must perform and the equipment he or she

must use. This includes body-task positioning (position of the work table, height of the chair and its hardness, lighting, etc.), repetitive movements (leading to strain, irritation and also diseases of nerves, tendons and muscles), noise (high volume or frequency contributes to mental, physical, as well as mental stress symptoms), vibration (damage to muscles and bones) and extreme temperatures (higher rates of bronchitis, pneumonia, chances of cold, sore throat, etc.).

*Economic causes* include inadequate wages and benefits to the workers, piece-rate or quota wage systems (leading to unhealthy competitiveness among the workers), lack of job security, lack of health benefits, lack of decent housing, overtime, shift work and work speed-ups.

*Social causes* of stress include the lack of control or decision-making about one's job, or the way the workplace is run. The common factors are sexual, racial, class, religious and intellectual discrimination, besides lack of reward or encouragement for the efforts and achievements of a worker and poor relationship between a worker and his supervisor.

## 2.3 Health Hazards in the Food Processing Industry

The food processing industry covers a series of activities directed at the processing, conversion, preparation, preservation and packaging of foodstuffs. The raw materials used are generally of vegetable or animal origin and produced by agriculture, farming, breeding and fishing. In spite of the extreme diversity of the food industries, the preparation processes can be divided into these activities:

- handling and storage of raw materials
- extraction (extract a specific food product from fruit, cereals or liquids)
- processing (general procedures used are fermentation, cooking, dehydration and distillation), preservation (prevent any deterioration of food products by processes like radiation sterilisation, antibiotic sterilisation, chemical action, dehydration, and refrigeration and
- packaging (by processes like canning, aseptic packaging and frozen packaging).

The food processing industry is one of the world's largest employment sectors. While the industry has a below-average nonfatal injury incidence rate, awareness on the health and safety hazards involved in the sector gains significance, considering the number of people engaged in the industry.

The most common causes of injuries in the food industry are hand tools, especially knives; operating machinery; collisions with moving or stationary objects; falls or slips; and burns. Electrical shocks can occur in electrical installations, especially in wet or damp places. Fires and explosions may occur in gas or oil-fired ovens or cooking processes, if they are not installed, operated or maintained correctly; provided with the essential safety devices; or if proper safety procedures are not followed (especially in open flame operations).

### ***Respiratory Problems***

Common respiratory problems related to food processing industry are rhinitis that affects the nasal passages; broncho-constriction in the major airways; and pneumonitis, which consists of damage to the finer structure of the lung. Exposure to airborne dust from various foodstuffs, as well as chemicals, may lead to emphysema and asthma (organic dust from grain or flour can cause “baker's asthma”). Rhinitis and chronic coughs are common among workers in slaughterhouse and pre-cooked food industries. Respiratory disorders are also caused due to allergens and antigens originating in foodstuffs, such as egg protein and seafood products.

Among the hazards due to microbiological processes involved in the food processing, *Tricoderma* and *Penicillium* are prominent. *Penicillium* is found in dairy and meat processing plants (and various other sectors); during the maturing of cheeses and sausages, there can be abundant surface growth. Occupational asthma cases have been associated with many of these organisms, while some are also suspected of causing infection or carrying mycotoxins. The enzymes trypsin, chymotrypsin and protease are associated with hypersensitivity and respiratory disease.

Inhalation of hazardous chemical substances used as reagents, refrigerants, fumigants and sanitizers may cause respiratory and other disorders. Exposure at or above the recognised limits often results in skin or eye irritation and respiratory disorders. Headaches, salivation, burning of the throat, perspiration, nausea and vomiting are symptoms of intoxication due to overexposure.

### ***Skin Disorders***

The common skin problems found in the food and drink industries are dermatitis and contact allergies (e.g., eczema). Due to sanitation requirements, workers are constantly needed to wash their hands with soap and using hand-dip solutions that contain quaternary ammonium solutions. This constant wetting of the hands can reduce the lipid content of the skin and lead to dermatitis. Working with fats and oils can clog the pores of the skin and lead to acne-like symptoms. These primary irritants account for 80 per cent of all occupational dermatitis seen. Workers may become highly sensitised to microbial proteins and peptides generated by fermentation and extraction, which can lead to eczema and other allergies. Occupational dermatitis is also reported when working with enzymes, such as trypsin, chymotrypsin and protease.

Ionizing radiations sometimes used during the processing of the food or food sterilisation, also pose a health hazard.

### ***Parasitic Infection***

Infectious and parasitic diseases of animal origin are the occupational diseases most specific to the food and drink industries. The diseases are most common among meat-packing and dairy workers, as a result of direct contact with infected animals.

### ***Noise and Hearing Related Problems***

Hearing impairment occurs as a result of continuous and prolonged exposure to noise above recognised threshold levels. There is also an association between exposure to high noise levels and abnormal blood pressure, increased heartbeat,

increased respiration rate/volume, stomach and intestinal spasms and nervous disorders.

It is estimated that more than 60 per cent of the workers in the food industry are facing health hazards because of higher noise levels. Technological progress can be singled out as the chief culprit; the noise hazard faced by workers has increased as a result of mechanised and semi-automated production methods.

### ***Musculoskeletal Disorders***

Work in meat, poultry, fish and food processing plants tends to involve repetitive and monotonous movement and that too at a gruelling pace, particularly in slaughterhouses and in the manufacture of sausages and canned food. Most of the strain is exerted on the upper extremities.

Repetitive strain injuries (RSIs) include inflammation of the tendon (tendinitis) and inflammation of the tendon sheath (tenosynovitis). Tasks that repeatedly combine the bending of the wrist with a gripping, squeezing and twisting motion can cause carpal tunnel syndrome (CTS). Characterised by a tingling sensation in the thumb and first three index fingers, CTS is caused by inflammation in the wrist joint creating pressure on the nerves in the wrist. Misdiagnosis of CTS as arthritis can result in permanent numbness and severe pain in the hands, elbows and shoulders. Vibration disorders also accompany an increased level of mechanisation.

### ***Heat and Cold Related Problems***

Thermal extremes exist in the food work area. People must work in freezers with temperatures of  $-18^{\circ}\text{C}$  or below. Freezer clothing helps insulate the worker from the

cold, but warm break rooms with access to warm liquids must be provided. Meat-processing plants must be kept at 7 to 10 °C but this is below the comfort zone and workers, necessitating them to wear additional layers of clothing. Heat, often combined with high humidity in cooking and sterilising, can produce an equally intolerable physical environment, where heat stroke and heat exhaustion are issues of concern. These conditions are especially found in processing that entails evaporation of solutions, such as tomato paste production; this often takes place in countries where hot conditions already prevail. It is also prevalent on the floors of slaughterhouses. Ovens and steam cookers also emit radiant and moist heat.

**NOTE BANK:****Status of Occupational Health and Safety in Five Star Hotels: A Case Study of Ashoka Hotel****Working Conditions of the Workers (% response)**

Factors	Low	Medium	High	No Response
Temperature	23.3	61.7	10.0	5.0
Noise	5.0	45.0	23.3	26.7
Fumes	3.3	21.7	1.7	73.3
Working posture	1.7	35.0	1.7	61.7
Mental stress	11.7	60.0	8.3	20.0
Constant contact with water	23.3	41.7	20.0	15.0
Constant contact with chemicals	46.7	3.3	3.3	46.7
Frequent changes in temperature	20.0	35.0	18.3	26.7
Customer's rude behaviour	28.3	11.7	10.0	50.0
Waste disposal system	23.3	15.0	5.0	56.7
Injecting fresh air	38.3	20.0	3.3	38.3
Other irritants	5.0	13.3	8.3	73.3

**Health Conditions of the Workers (% response)**

Diseases	Never	Sometimes	Regular	No response
Fever	26.7	65.0	3.3	5.0
Respiratory problems	50.0	15.0	0.0	35.0
Cardiovascular problems	55.0	3.3	0.0	41.7
Skin problems	38.3	3.3	1.6	56.7
Eye problems	45.0	25.0	6.7	23.3
Mental strain	41.7	35.0	5.0	18.3
Orthopaedic problems	43.3	10.0	5.0	41.7
Digestive problems	43.3	18.3	15.0	23.3
Blood pressure problems	40.0	6.7	6.7	46.7
Other illnesses	30.0	1.7	0.0	68.3

(Jaitli &amp; Singh, 1997)

**THINK TANK:****What do you think are the factors that pose a threat to the health of the following professions?**

- Academicians
- Domestic help

## 2.4 Health Hazards in Other Industries

### 2.4.1 The Textile Industry

The term textile (derived from the Latin *texere*, to weave) was originally applied to the weaving of fabrics from fibres, but now it includes a broad range of other processes such as knitting, tufting, felting and so on. It has also been extended to include the making of yarn from natural or synthetic fibres, as well as the finishing and dyeing of fabrics. Textile industries entail diverse operations including fibre synthesis, blow room/ card room operations, weaving, spinning, manufacturing, dyeing and finishing.

The textile manufacturing industry employs over ten million workers throughout the world. Like any other processing industry, the workers face various health hazards. The hazards include chemical poisoning because of exposure to solvents in the cleansing and dyeing processes, lung and skin diseases due to exposure to dust particles and allergy to fabrics, ergonomic problems such as back, neck and shoulder pain, joint diseases in the sewing processes, cuts, injuries and accidents while using various machinery, long working hours and work stress amongst many others.

#### ***Health Hazards in Cotton Units***

##### *Cotton Dust Inhalation (Byssinosis)*

Dust is generated when cotton fibre is converted into yarn and fabric and inhalation of this dust causes an occupational lung disease called byssinosis, affecting about seven to eight per cent of textile workers. It is also known as mill fever, cotton fever (brown lungs) or hemp fever. It usually takes 15 to 20 years of exposure to higher

levels of dust (above 0.5 to 1.0mg/m<sup>3</sup>), for workers to actually start suffering from related diseases.

The dust, an airborne particulate released into the atmosphere when cotton is handled or processed, is a heterogeneous, complex mixture of botanical trash, soil and microbiological material (i.e., bacteria and fungi), which varies in composition and biological activity. The cotton dust enters into the alveoli of the lungs and the continuous accumulation in the lungs, reduces the lung's capacity to retain oxygen and the worker develops a brown lung.

### **Noise**

Noise is often a problem in some processes of yarn manufacturing, but in a few modern textile mills, the levels are below 90 dB, thanks to quieter modern machinery. Normally, the noise levels in the textile industry range between 102-114 dB. Noise can have both auditory (like hearing loss) and non-auditory effects (like sleep disorders, mental fatigue, and irritability and reduced alertness).

### **Heat stress**

Since spinning sometimes requires high temperatures and artificial humidification of the air, the entire set up can cause heat stress.

### **Health Hazards in Wool Units**

Like other sectors of the textile industry, large machines in wool units, with rapidly moving parts pose both noise and mechanical injury hazards. The risk of accidents is increased if sufficient space is not allowed between the machines. Fire is a serious hazard, especially in old multi-storey mills.

### ***Anthrax***

The industrial disease usually associated with woollen textiles is anthrax. Anthrax is caused by bacteria called bacillus anthracis, which can survive for long periods of time in the form of spores. The main cause for anthrax is using wool which has not been disinfected, to kill the spores that cause it. Hence, at one time it posed great danger, particularly to the wool sorters. The wool is disinfected by microwaving the wool bale for a sufficiently long period, at a temperature that will kill any spores. Besides anthrax spores, the spores of the fungus coccidioides immitis can also be found in wool. This fungus can cause the disease known as coccidioidomycosis, which like anthrax usually has a poor prognosis.

### ***Chemical substances***

Various chemicals are used in the wool industry including for degreasing (diethylene dioxide, synthetic detergents, trichloroethylene and, in the past, carbon tetrachloride), disinfection (formaldehyde), bleaching (sulphur dioxide, chlorine) and dyeing (potassium chlorate, anilines). The risks include gassing, poisoning, irritation of the eyes, mucous membranes and lungs, and skin conditions.

### ***Noise***

With all the moving parts in the machinery, particularly the looms, woollen mills are often very noisy places. The noise levels increase, due to the lack of proper lubrication of machine parts, or the non-introduction of sound baffles and other engineering solutions for reducing noise. The symptoms of noise hazards are the same as in other cases.

## Health Hazards in Silk Units

### ***Carbon Monoxide***

The symptoms of carbon monoxide toxicity are usually headache, vertigo and sometimes nausea and vomiting.

### ***Dermatitis (Mal des bassines)***

Dermatitis of the hands of female workers reeling raw silk is quite common, particularly in Japan. The skin lesions, localised mainly on the fingers, wrists and forearms, are characterised by erythema covered with small vesicles, which become chronic, pustular or eczematous and extremely painful. This is usually attributed to the decomposition products of the dead chrysalis and to a parasite in the cocoon.

### ***Respiratory tract problems***

A kind of tonsillitis often occurs among silk spinners due to a bacterial infection from the silk cocoons. Sometimes, workers in the natural silk industry may develop respiratory allergy featuring bronchial asthma, asthmiform bronchitis and/or allergic rhinitis.

### ***Noise***

Noise exposure can reach harmful levels for the workers at the machines spinning and winding the silk threads, and at looms where the fabric is woven.

## **Health Hazards in Viscose Rayon and Synthetic Fibre Units**

### ***Viscose Rayon Units***

The principal hazards in the viscose process are exposure to carbon disulphide and hydrogen sulphide. Both have a variety of toxic effects depending on the intensity and duration of the exposure and the organ(s) affected; they range from fatigue and giddiness, respiratory irritation and gastrointestinal symptoms, to profound neuropsychiatric disturbances, auditory and visual disorders, deep unconsciousness and death.

### ***Synthetic Fibre Units***

Exposure to toxic and inflammable chemicals, accidents and injuries due to machine parts etc., slips and falls due to dirty and slippery floors and passages, and noise are some of the occupational hazards in this industry. Mill fever is also associated with this industry.

## **Health Hazards in Carpet Units**

Largely a cottage industry, carpet weaving is fraught with the hazards because of impoverished homes, with small, crowded rooms that have poor lighting and inadequate ventilation. The equipment and processes are passed along from generation to generation with little or no opportunity for the education and training that might give them opportunity to break away from traditional methods. Carpet weavers are subject to skeletal deformations, eyesight disorders and mechanical and toxic hazards.

***Skeletal deformation***

The squatting position that the weavers must occupy on the old type of looms and the need for them to lean forward and stretch to access the point where they knot the yarn, may, over time, lead to serious skeletal problems. These are often compounded by the nutritional deficiencies associated with poverty.

***Vision disorders***

The constant close focus on the point of weaving or knotting may cause considerable eyestrain, particularly when the lighting is inadequate. It should be noted that electric lighting is not available in many home workplaces and the work, which is often continued into the night, is usually performed by the light of oil lamps. There have been cases of almost total blindness occurring after long years of work.

***Hand and finger disorders***

The constant tying of small knots and the threading of the weft yarn through the warp threads may result in swollen finger joints, arthritis and neuralgia causing permanent disabilities of the fingers.

***Stress***

The high degree of skill and constant attention to detail over long hours are potent psychosocial stressors, which may be compounded by exploitation and harsh discipline. Children are often “robbed of their childhood”, while adults, who often lack the social contacts essential for emotional balance, may develop nervous illnesses manifested by trembling of the hands, which may hamper their work performance and sometimes develop mental disorders.

### ***Chemical hazards***

The dyestuffs that contain potassium or sodium bichromate may cause skin infections or dermatitis. The use of ammonia, strong acids and alkalis also pose a risk. Lead pigments sometimes used by designers, cause lead poisoning due to the practice of smoothing the tip of the paintbrush between the lips.

### ***Biological hazards***

There is a danger of anthrax infection from contaminated raw wool from areas where the bacillus is endemic.

#### **THINK TANK:**

- Briefly describe the health hazards in the textile industry.
- What are the special problems related with carpet units?

### **2.4.2 The Construction Industry**

- The International Labour Organisation (ILO) classifies the construction industry as government and private sector firms erecting buildings for habitation, or for commercial purposes and public works such as roads, bridges, tunnels, dams or airports. The construction industry covers a wide range of activities as it is not only involved in constructing bridges, roads or buildings, but also includes the construction of dams, bridges, tunnels, canals, power plants, industrial structures,

factories, sewerage, laying of railways, tramway, pipelines, cables and ropeways, erection of towers, chimneys etc. The construction industry also includes the demolition and maintenance of structures and services.

Throughout the world, over 90 per cent of the construction workers are male. Although it has been seen that the proportion of women is higher in some developing countries, they are usually concentrated in the unskilled jobs whereas in some countries the work is left to migrant workers. For many unskilled workers, the construction industry is their entry into the paid labour force.

There is little doubt that many developing countries like India and China have seen a dramatic increase in output and employment in the construction industry in the past 30 years. Numerous studies have shown that construction output is growing rapidly, often exceeding the overall economic growth rate. The construction industry plays a major role in combating high levels of unemployment and in absorbing surplus labour from rural areas.

In India the construction sector has been steadily growing since Independence. It is the prime mover for the growth of the nation's infrastructure and produces goods and services worth Rs.2.1 trillion. The industry is also the second largest employer, as it employs 31 million persons round the year (Ministry of Labour and Employment, GoI, 2014).

Construction workers are exposed to a wide variety of health hazards on the job, which can be chemical, physical, and social.

### ***Chemical Hazards***

Chemical hazards are often airborne and can appear as dust, fumes, mists, vapours or gasses; exposure usually occurs by inhalation, although some airborne hazards may settle on and be absorbed through the skin (e.g. pesticides and some organic

solvents). Chemical hazards also occur in liquid or semi liquid state (glues, adhesives, tar) or as powders (dry cement). Skin contact with chemicals in this state can occur in addition to the possible inhalation of the vapour, resulting in systemic poisoning or contact dermatitis. Chemicals might also be ingested with food or water, or might also be inhaled by smoking.

Other hazards include:

**Inhalation of irrespirable dust and fumes:** Various respiratory problems occur due to the inhalation of dust fumes like cement or sand dust, which ultimately blocks the respiratory tract and results in an increase in the breathing rate. Similarly, the constant inhalation of solvent fumes like paints, varnish, glue, etc. also affects the breathing rate and causes various problems.

**Radiation and Light,** workers involved in welding work are constantly exposed to a high wavelength of light and the radiations caused by this, have a detrimental effect on them.

Several illnesses have been linked to the construction trade, among them are:

- Silicosis among sand blasters, tunnel builders and rock drill operators
- Bronchitis among welders
- Skin allergies among masons and others who work with cement
- Neurologic disorders among painters and others exposed to organic solvents and lead.

Elevated death rates from cancer of the lungs and the respiratory tract have been found among insulation workers, roofers, welders and some woodworkers. Lead poisoning occurs among bridge rehabilitation workers and painters, and heat stress among workers who clean hazardous waste and in roofers, from wearing full-body protective suits.

## Physical Hazards

Workers in the construction industry face various types of physical hazards which have been listed below.

**Extreme temperatures** - Workers have to work in extreme hot or cold environments and even in foggy, snowy, rainy, or windy weather and even at night. Hazards from heat and cold are primarily caused, because a large portion of construction work is done while exposed to the weather. Heavy equipment operators may sit beside a hot engine and in an enclosed cab with no roof and without any protection from the sun. Workers in protective gear, such as that needed for the removal of hazardous waste, may generate metabolic heat from hard physical labour and get little relief since the suit is usually airtight. Construction workers, also work in especially cold conditions during the winter, with the danger of frostbite and hypothermia and the risk of slipping on ice.

**Noise**, prolonged exposure to noise that is caused by different machines leads to hearing loss.

**Radiation**, radiation from the machines used to gauge the pipes; welding, etc. has a detrimental effect on the body. The principal sources of non-ionizing ultraviolet (UV) radiation are the sun and electric arc welding.

**Vibration**, the continuous use of drilling machines, adversely affects either the entire body or the parts of the body like hands or arms of the workers. The machines that have today made construction an increasingly mechanised activity have also made it increasingly noisy. Pneumatic hammers, various hand tools, earth moving machines and other large mobile machines also subject workers to segmental and entire body vibrations.

**Barometric pressure** - Divers and others, who work under water, or in pressurised tunnels, are exposed to high barometric pressure. Such workers are at risk of

developing a variety of conditions associated with high pressure, such as decompression sickness, inert gas narcosis, aseptic bone necrosis and other disorders.

**Strains and sprains** are among the most common injuries among construction workers. These, and many chronically disabling musculoskeletal disorders (tendonitis, carpal tunnel syndrome and low-back pain), occur as a result of traumatic injury, repetitive forceful movements, awkward postures or overexertion. Falls due to unstable footing, unguarded holes and falling off scaffoldings and ladders are very common.

### **Biological Hazards**

Diseases and illnesses can occur from biological sources and exposure to biological sources can occur during demolitions, renovations, sewer repairs. Biological sources include:

- Soil
- Water
- Insects and animal bites

### **Psychological Hazards**

There is a lot of instability in the lives of construction workers, which affects their health and psychological conditions, along with their social as well as economic life, as explained below:

#### **a) Social Life**

Construction workers are usually migrants and unorganized workers; due to the fact

that they constantly move from one place to another, or from one site to another, or from one state to another, they are unable to develop a normal social life and are often unable to build relationships with their neighbours, as they have to keep adjusting to new surroundings. In India, the female workforce involved in construction is quite large. They are victims of a dual workload, as well as malnourishment. Most of the women workers involved in heavy jobs and are paid less than their male counterparts.

### **b) Economic Life**

The jobs in the construction are casual, temporary and irregular, which leaves the workers feeling insecure. The majority of the workers are employed on a contract basis through petty contractors; hence there is no direct relationship between the employer and the employee, which leads to lack of welfare facilities and the absence of social security measures. Construction workers lead a hand to mouth existence.

A majority of the workers employed are poor migrants from drought prone villages. As they are usually uneducated, landless and unemployed, they are easily absorbed in the construction industry, as unskilled workers and are given minimum wages.

### **Primary Hazards encountered in Skilled Construction Trades**

Each trade is listed below with an indication of the primary hazards to which a worker in that trade might be exposed. Exposure may occur to either supervisors or to daily wage earners. Hazards that are common to nearly all construction workers i.e., heat, musculoskeletal disorders and stress have not been listed.

The classification of construction trades given here is the same as that used in the United States and includes the construction trades as classified in the Standard Occupational Classification system developed by the US Department of Commerce. This system classifies the trades by the principal skills inherent in the trade.

<b>Occupations</b>	<b>Hazards</b>
Brick masons	Cement dermatitis, awkward postures, heavy loads
Stonemasons	Cement dermatitis, awkward postures, heavy loads
Hard tile setters	Vapour from bonding agents, dermatitis, awkward postures
Carpenters	Wood dust, heavy loads, repetitive motion
Drywall installers	Plaster dust, walking on stilts, heavy loads, awkward postures
Electricians	Heavy metals in solder fumes, awkward posture, heavy loads, asbestos dust.
Electrical power installers and repairers	Heavy metals in solder fumes, heavy loads
Painters	Solvent vapours, toxic metals in pigments, paint additives
Paperhangers	Vapours from glue, awkward postures
Plasterers	Dermatitis, awkward postures
Plumbers	Lead fumes and particles, welding fumes
Pipe fitters	Lead fumes and particles, welding fumes
Steamfitters	Welding fumes, asbestos dust
Carpet layers	Knee trauma, awkward postures, glue and glue vapour
Soft tile installers	Bonding agents
Concrete and terrazzo finishers	Awkward postures
Glaziers	Awkward postures
Insulation workers	Asbestos, synthetic fibres, awkward postures
Paving, surfacing and tamping equipment	Asphalt emissions, gasoline and diesel engine exhaust, heat

operators	
Rail-and track-laying equipment operators	Silica dust, heat
Roofers	Roofing tar, heat, working at heights
Sheet metal duct installers	Awkward postures, heavy loads, noise
Structural metal installers	Awkward postures, heavy loads, working at heights
Welders	Welding emissions
Solderers	Metal fumes, lead, cadmium
Drillers, earth, rock	Silica dust, whole-body vibration, noise
Air hammer operators	Noise, whole-body vibration, silica dust
Pile driving operators	Noise, whole-body vibration
Hoist and winch operators	Noise, lubricating oil
Crane and tower operators	Stress, isolation
Excavating and loading machine operators	Silica dust, histoplasmosis, whole-body vibration, heat stress, noise
Grader, dozer and scraper operators	Silica dust, whole-body vibration, heat noise
Highway and street construction workers	Asphalt emissions, heat, diesel engine exhaust
Truck and tractor equipment operators	Whole-body vibration, diesel engine exhaust.
Demolition workers	Asbestos, lead, dust, noise
Hazardous waste workers	Heat, stress
<b>Source:</b> (L.Weeks, 1998)	

## Health Risks of Underground Construction Work

Underground construction work includes tunnelling for roads, highways and railroads and laying pipelines for sewers, hot water, steam, electrical conduits, and telephone lines. The construction of tunnels requires a great deal of physical effort. The heart rate reaches 150 to 160 per minute, when working with compressed-air drills and pneumatic hammers. Underground machinery generates dust, noise, vibration and diesel exhaust. Respirable silica dust is generated whenever silica-bearing rock is crushed, drilled or ground. Blasting generates flying debris and also nitrogen oxide. In underwater work, when workers in a hyperbaric environment, make too rapid a transition to normal air pressure, they risk decompression sickness and related disorders. Oxygen deficiency may occur in tunnels when other gases displace oxygen and form hazardous gas products.

### 2.4.3 The Pharmaceutical Industry

Another industry which is critical in relation to the exposure to chemicals is the pharmaceutical industry. The irony associated with this sector/ industry is that while drugs are produced for saving the lives of millions of people across the world, the exposure to the same during their manufacture and production could be dangerous and have life threatening consequences.

Health hazards associated with pharmaceuticals or exposure to drugs include: dust, noise, repetitive motion disorders, exposure to ultra violet radiation and exposure to formaldehyde.

**Dust:** During the process of manufacturing pharmaceuticals, dust becomes air borne and creates problems for those who are associated with it, or exposed to the industry. Filling and packaging of the finished product may cause dust related allergies.

In addition to dust, employees are often exposed to *formaldehyde* and ultraviolet radiation, especially when precautions are taken to ensure the sterility of the finished product. Formaldehyde causes lung cancer, Hodgkin's disease, prostate cancer and allergic dermatitis. Also acute exposure could cause pulmonary oedema and pneumonia that can cause death.

## NOTE BANK

### The Harmful Effects of Formaldehyde

**What is Formaldehyde:** Formaldehyde is a colourless, strong smelling gas often found in aqueous (water-based) solutions. Commonly used as a preservative in medical laboratories and mortuaries, formaldehyde is also found in many products such as chemicals, particle board, household products, glues, permanent press fabrics, paper product coatings, fibreboard, and plywood. It is also widely used as an industrial fungicide, germicide and disinfectant.

**Exposure to Formaldehyde:** Workers can inhale formaldehyde as a gas or vapour, or absorb it through the skin as a liquid. They can be exposed during the treatment of textiles and the production of resins. Healthcare professionals and medical lab technicians, including mortuary workers, as well as teachers and students are groups at potentially high risk.

**Impact on Workers:** Formaldehyde is a sensitising agent that can cause an immune system response upon initial exposure. It is also a cancer hazard. Acute exposure is highly irritating to the eyes, nose, and throat and can make anyone exposed cough and wheeze. Subsequent exposure may cause severe allergic reactions of the skin, eyes and respiratory tract. Ingestion of formaldehyde can be fatal, and long-term exposure to low levels in the air or on the skin can cause asthma-like respiratory problems and skin irritation such as dermatitis and itching. Concentrations of 100 ppm are immediately dangerous to life and health (IDLH).

(Occupational Health and Safety Administration, 2011)

**Ultraviolet Lamps:** Used to ensure sterility causes skin cancer.

**Repetitive Motion:** The process of packaging and filling of the finished product could result in carpal tunnel syndrome or tendinitis, which is caused as a result of repetitive and twisting hand motions. Some of its symptoms are pain and tenderness in the affected area such as the hand, wrist or the forearm.

## Specific Hazards

Within the pharmaceutical industry, health hazards are caused because of the exposure to drugs. This mainly occurs during the last stage of the production process.

**Hormonal Disorders:** Increased exposure to drugs could impact the *oestrogen* levels, which may cause the growth of breasts in men, menstrual problems in women, abnormal growth of the endometrium and excessive bleeding or blood loss during menopause. Further, excessive exposure of *progestogen* among male workers, may cause a reduction in their sexual drive and lead to testicular pain. Among female workers exposure to *androgens* could result in disorders of the menstrual and ovarian functions, reduction in fertility, increased frequency of spontaneous abortions and physical symptoms of masculinity.

**Antibiotics:** Antibiotics are chemical substances that destroy micro-organisms such as bacteria, which cause infection in humans and animals. The effects of occupational exposure to antibiotics could include:

- **Allergic reactions:** itching and redness of the eyes, running nose, skin rashes, asthma, and occasional shock due to an allergic reaction (anaphylaxis).
- **Vitamin deficiency:** An excessive intake of antibiotics leads to a decrease in the bacterial growth in the intestines, which break down and absorb vitamins in the intestines.
- **Fungal infections:** Daily exposure to antibiotic dust could result in fungal infections of the skin and nails. Female workers exposed to antibiotics may develop vaginal yeast infections.

- **Toxic effects:** Exposure to certain antibiotics may lead to the development of some toxic side effects that occur when that drug is given as a medicine.
- **Penicillin:** Because of the highly allergenic nature of penicillin and its extensive use, many people have developed an allergy to them. The most acute reaction is “shock” which usually occurs minutes after exposure to the substance. Symptoms are tightness in the chest; asthmatic breathing; dizziness; swelling of the lips, tongue, or face, oedema of the lungs; heart failure and in some cases, also death. Other reactions are hives, "black hairy tongue," fungal infection, and rectal itch.
- **Tetracycline:** Modification of the bacteria of the intestines and other organs has been reported following occupational exposure to *tetracycline* (as well as to *streptomycin* and *penicillin*). In workers exposed to tetracycline and to streptomycin, modification of the bacteria led to a drop in the body's vitamin content, especially the B vitamins. Another problem associated with occupational exposure to tetracycline is drug resistance. Workers may develop infections that are resistant to treatment with tetracycline.
- **Drugs for Heart Disease:** Nitro-glycerine, commonly used in dynamite, is also the basis of several medicines for heart patients - *isosorbide dinitrate*, *pentaerythritol tetranitrate*, and *mannitol hexanitrate*. Nitrates act on the blood vessels of the body and their effects are felt in several ways. Almost everyone exposed to nitro dust, experiences a severe pounding headache, which is caused by the relaxation of the blood vessels within the skull and may be accompanied by a rapid heartbeat and a flushed face.
- **Nitrates** dilate the blood vessels and make the blood pressure fall. As a result, dizziness and even fainting may occur. Other more serious effects are pain in the heart, heart attacks, and sudden death following "withdrawal" from exposure.

- **Tranquilizers:** Both *chlordiazepoxide* and *meprobamate* are prescribed as sedatives and are addictive. In combination with alcohol, they may cause a person to lose consciousness and in high doses, can lead to coma and death. Workers producing tranquilizers are at the risk of these adverse effects and have found that they pass out over a beer after work. There is a real danger of accidents, both in the plant and on the way home, when workers become drowsy as a result of exposure to tranquilizers and barbiturates.
- **Antidepressants:** Tricyclic antidepressants like *amitriptyline*, *nortriptyline*, and *imipramine* can cause irregular heartbeat (*cardiac arrhythmias*), posing a particular problem for production workers with heart conditions.

(Turshen, 1993)

#### 2.4.4 The Steel Industry

Steel making began in the 20<sup>th</sup> century with the invention of melting processes; the Bessemer (1855), the open hearth, usually fired by producer gas (1864); and the electric furnace (1900). Towards the middle of the 20<sup>th</sup> century, the oxygen conversion, mainly the Linz-Donowitz (LD) process by oxygen lance, made it possible to manufacture high quality steel with relatively low production costs. At present, steel production is an index of national prosperity and the basis of mass production in many other industries such as ship building, automobiles, construction, machinery, tools, and industrial and domestic equipment. Moreover, the development of transport, in particular by sea has made the international exchange of the raw materials required (iron ores, coal, fuel oil, scrap and additives) economically profitable (Kant, P (ed.) 2006)

#### Hazards in Steel Industry

It has been observed that the discharges from the steel industry cause contamination in various ways. The emission of toxic gases, liquids, solids or a

combination of these, results in psychological, toxic and allergic reactions. Dust, which gets absorbed into the blood stream of human beings and other living organisms, is one of the major sources of contamination. (Bhatia, 2006)

The following gases, which are injurious to health, are produced within the iron and steel industry.

- **Sulphur Dioxide (SO<sub>2</sub>):** A poisonous gas that causes the destruction of tissues of the respiratory system and oedema of the lungs; headache, dizziness, arterial dilation, fall in the blood pressure, and the corrosion of teeth.
- **Carbon Dioxide (CO<sub>2</sub>):** Prolonged exposure to carbon dioxide causes giddiness and can lead to unconsciousness.
- **Nitrogen Oxides:** Could lead to a problem in the lungs and in breathing.
- **Carbon Monoxide (CO):** It is a poisonous and asphyxiating gas. The presence of substantial quantities of carbon monoxide gas could lead to an explosion. Its inhalation causes headache and unconsciousness.
- **Hydrogen Sulphide (H<sub>2</sub>S):** Causes irritation and nausea. It affects the eyes, lungs and breathing.
- **Ammonia (NH<sub>3</sub>):** It is pungent and asphyxiating and causes pain in the eyes, giddiness, nausea and oedema of the lungs.
- **Benzol:** It is a poisonous vapour that affects the blood and the nervous system.
- **Carbon Disulphide (CS<sub>2</sub>):** Inhalation of its fumes causes headache, nausea, giddiness, slight intoxication and irregular breathing.

- **Phenolic Acid:** Results in heaviness in the head, weakness, difficulty in breathing, giddiness, hoarseness, nausea, insomnia and respiratory irritation.
- **Pyride:** A poisonous and toxic fume. It causes problems in the nervous system and digestive imbalance.
- **Sulphuric Acid (H<sub>2</sub>SO<sub>4</sub>):** Another poisonous gas that affects the respiratory organs and the lungs.
- **Naphthalene:** Inhalation of naphthalene gas causes headache, nausea, retching, and coughing, irritation in the mucous membrane, eyes and the respiratory organs.

Besides, hazards due to the above gases that are released into the work environment, the steel industry faces other hazards such as:

**High Temperatures and Molten Metals:** High temperatures could be harmful for the body tissue and could cause blindness. The splashing of molten metals could lead to severe burns.

**Electricity:** In a steel plant, workers are often exposed to electrocution. The main reason could be the lack of knowledge about electrical safety measures and handling equipment.

**Steam:** Workers are exposed to high temperature and pressure, and the operations are hazardous in nature.

**Liquid Oxygen:** In steel plants, liquid oxygen at very low temperatures is used, which could be hazardous and cause fires.

**Chemical and Radioactive Substances:** In steel plants workers are also exposed to chemical and radioactive substances, which could have an adverse effect on their health. Radiation could cause the water inside the human body to become iodized and result in deformity of the limbs.

**Moving Machinery and Material Handling:** Moving machinery could be dangerous and workers have to be alert to keep themselves safe and secure.

**Dust, Noise and Vibration:** As cited above large quantities of dust are produced in iron and steel plants. One of the most dangerous forms is silica dust, which causes silicosis. Prolonged inhalation of carbon could result in the workers absorbing it, which may further cause it to mix with the body fluid. This in turn results in the formation of fibrous growths around the lungs. Noise as well vibrations result in uneasiness and adversely affects normal hearing (Bhatia, 2006, pp. 202-204)

In the iron and steel industry, large amounts of material are processed, transported and conveyed by huge, fast moving equipment. Steel works typically have sophisticated safety and health programmes to address hazards in an environment that can be unforgiving. An integrated approach combining good engineering and maintenance practices, safe job procedures, worker training and use of personal protective equipment (PPE) is usually required to control hazards. Maintenance is particularly important for accident prevention. Its purpose is to ensure the efficiency of the equipment and maintain fully operative guards, because failure may cause accidents. Adhering to safe operating practices and safety rules is also very important because of the complexity, size and speed of process equipment and machinery. (Kant, P (ed.) 2006)

## Glossary of Terms

- **Allergy:** An allergy or Type I hypersensitivity is an immune malfunction whereby a person's body is hypersensitised to react immunologically to typically nonimmunogenic substances. When a person is hypersensitised, these substances are known as allergens. The word allergy derives from the Greek words *allos* meaning "other" and *ergon* meaning "reaction" or "reactivity". Type I hypersensitivity is characterised by excessive activation of mast cells by immunoglobulin E resulting in a systemic inflammatory response that can result in symptoms as benign as a runny nose, to life-threatening anaphylactic shock and death.. Mild symptoms include swelling of the nasal mucosa (allergic rhinitis), redness and itching of the eyes-conjunctiva (allergic conjunctivitis), in airways-broncho-constriction, wheezing and dyspnoea, sometimes outright attacks of asthma, skin - various rashes, such as eczema, hives (urticaria) and contact dermatitis etc. Depending on the severity, it may also cause cutaneous reactions.
- **Anaemia** - A condition in which there is reduced oxygen delivery to the tissues due to a reduction in the number of circulating red cells. It may result from increased destruction of red cells, excessive blood loss or decreased production of red cells. Weakness, fatigue, and paleness resulting from a deficiency of red blood cells or insufficient amounts of haemoglobin molecules within the red cells are some of the other symptoms.
- **Anthrax:** Also referred to as splenic fever, is an acute infectious disease caused by the bacteria *Bacillus anthracis* and is highly lethal in its most virulent form. Anthrax most commonly occurs in wild and domestic herbivores, but it can also occur in humans when they are exposed to infected animals, tissue from infected animals, or high concentrations of anthrax spores. The word anthrax is derived from the Greek word *anthrakis*, which means "coal", and is used because victims develop black skin lesions. The symptoms in human beings are boils which are large and very painful. Also called Wool Sorter's Disease.

- **Asbestosis:** A chronic, progressive condition of scar tissue build-up in the lungs resulting from the inhalation of asbestos fibres. Shortness of breath, increased risk of lung infection and permanent lung damage are common symptoms of asbestosis. (Over time, exposure to asbestos may lead to asbestosis, mesothelioma and lung cancer.)
- **Asthma:** Asthma is a disease of the human respiratory system in which the airways narrow, often in response to a “trigger” such as exposure to an allergen, cold air, exercise, or emotional stress. This narrowing causes symptoms such as wheezing, shortness of breath, chest tightness, and coughing, which are the hallmarks of asthma. Between episodes, most patients feel fine. The disorder is a chronic inflammatory condition in which the airways develop increased responsiveness to various stimuli, characterised by bronchial hyper-responsiveness, inflammation, increased mucus production, and intermittent airway obstruction. The symptoms of asthma, which can range from mild to life threatening, can be controlled with a combination of drugs and lifestyle changes.
- **Astigmatism:** An optical aberration resulting from unequal magnification across different diameters. Astigmatism blurs vision at all distances because the optical parts of the eye (cornea and lens) do not focus light onto the retina clearly. This condition is quite common, and results from an unequal curve of the cornea when comparing the horizontal and vertical planes. For descriptive purposes, imagine half of a tennis ball, squeezed at the top and bottom; the ball is now curved unequally. In the eye, this results in inaccurate focus on the retina. Lenses are often used to help focus the light to eliminate blurriness from astigmatism.
- **Byssinosis:** Obstructive airway disease in people who work with unprocessed cotton, flax, or hemp; caused by reaction to material in the dust and thought to include endotoxins from bacterial contamination. Sometimes called "Monday morning asthma" since patients improve when away from work on the weekend.

- **Carcinogenicity:** A carcinogen is a substance, which can cause cancer. Carcinogenic means able to cause cancer. Carcinogenicity is the ability of a substance to cause cancer.
- **Carpal tunnel syndrome:** This is a condition characterised by pain and numbing or tingling sensations in the hand, caused by a compression of a nerve in the carpal tunnel at the wrist. In this condition the median nerve is compressed as it passes through the carpal tunnel in the wrist, a narrow confined space. Since the median nerve provides sensory and motor functions to the thumb and three middle fingers, many different symptoms may manifest themselves.
- **Chronic bronchitis:** A disease of the lungs, characterised by changes in the structure of the airways of the lungs, inflammation, and enlargement of the mucous glands. Coughing and sputum (phlegm) production are common symptoms. Chronic bronchitis often develops simultaneously with emphysema. This is often the result of many years of cigarette smoking. This is a serious medical condition, also called chronic obstructive pulmonary disease.
- **Coal worker's pneumoconiosis:** Coal worker's pneumoconiosis is a respiratory disease caused by inhaling coal dust for prolonged periods. Coal worker's pneumoconiosis (CWP) can be defined as the accumulation of coal dust in the lungs and the tissue's reaction to its presence. The disease is divided into two categories: simple CWP (SCWP) and complicated CWP (CCWP), or pulmonary massive fibrosis (PMF), depending on the extent of the disease. The simple form is usually not disabling, but the complicated form often is. Smoking does not increase the prevalence of this disease, but may have an additive detrimental effect on lung function. Main symptoms include shortness of breath and chronic cough.
- **Conjunctivitis:** Inflammation of the conjunctiva, the membrane that lines the inner surface of the eyelids, characterised by a pink eye. The cause is either infectious or allergic; the term "pink eye" really refers to the viral variety, but is

commonly used for any type of conjunctivitis. Other symptoms include burning, discharge, dryness, itching, light sensitivity, pain in the eye or discomfort, stickiness, tearing and chemosis.

- ***Dermatitis:*** An inflammation of the skin caused by an allergic reaction or contact with an irritant. Typical symptoms of dermatitis include redness and itching. Other symptoms include dry, flaky, itchy skin related to changes caused by venous insufficiency; severe cases may weep clear fluid and resemble a skin infection. Specific forms of dermatitis include contact dermatitis, eczema and hand eczema.
- ***Eczema:*** An inflammation of the skin, usually causing itching and sometimes accompanied by crusting, scaling or blisters. A type of eczema often made worse by allergen exposure is termed "atopic dermatitis."
- ***Emphysema:*** It is a chronic lung disease, often caused by exposure to toxic chemicals or long-term exposure to tobacco smoke. It is a disorder affecting the alveoli (tiny air sacs) of the lungs. The transfer of oxygen and carbon dioxide in the lungs takes place in the walls of the alveoli. In emphysema, the alveoli become abnormally inflated, damaging their walls and making it harder to breathe. People who smoke or have chronic bronchitis have an increased risk of emphysema.
- ***Genotoxicity:*** Any substance that leads to chromosomal damage.
- ***Hallucinations:*** A hallucination is a false sensory perception that the sufferer experiences as real. This can affect any of the five senses though hearing and sight are the most common. There is no outside source for the sensory experience yet to the person it seems real. The experience interferes with the person's ability to function normally in day to day life.
- ***Insomnia:*** Sleep problems characterised by difficulty in falling asleep, frequent waking during the night, or waking up earlier than desired. As a result of insomnia the person gets up in the morning with feeling of not being rested and experiences drowsiness during the day.

- **Mesothelioma:** A tumour of the mesothelium, that can be benign (localized) or malignant (diffusely spread), and that is most commonly caused by the ingestion of asbestos particles. Malignant mesothelioma is a very rare form of cancer linked to asbestos exposure that occurs in the sac lining of the chest (pleural mesothelioma) or abdomen (peritoneal mesothelioma), or the lining of the heart (pericardial mesothelioma).
- **Microwaves:** Microwaves are electromagnetic waves with wavelengths longer than those of infrared light, but shorter than those of radio waves. Microwaves have wavelengths approximately in the range of 30 cm (frequency = 1 GHz) to 1 mm (300 GHz).
- **Mining:** Mining is the extraction of valuable minerals or other geological materials from the earth, usually (but not always) from an ore body, vein, or (coal) seam. Materials recovered by mining include bauxite, coal, diamonds, iron, precious metals, lead, limestone, nickel, phosphate, rock salt, tin, and uranium. Any material that cannot be grown from agricultural processes must be mined. Mining in a wider sense can also include extraction of petroleum, natural gas, and even water.
- **Mycotoxins:** Naturally occurring toxic substances produced by fungi or moulds on agricultural crops that may cause sickness in animals or humans that eat feed or food made from contaminated crops. There are between 300 and 400 known mycotoxins. More proof that “natural” does not always mean “safe.” Mycotoxin is a toxin produced by a fungus under special conditions of moisture and temperature. Not all fungi can produce mycotoxins. Even those with the ability to produce mycotoxins, may not be producing them at all times.
- **Myopia:** Near-sightedness; a condition in which light rays from distant objects are focused in front of the retina instead of on it, so that distant objects are not seen clearly. The opposite of myopia is farsightedness or hyperopia.
- **Neuralgia:** A sharp pain along the course of a nerve. This severe nerve pain is caused by nerve compression or the breakdown of the protective myelin

sheath surrounding a nerve. This disrupts the normal signal of the nerve and causes pain that begins as "pins and needles" followed by an electrical shock sensation.

- ***Pneumonitis:*** Also called extrinsic allergic alveolitis/farmer's lung/mushroom picker's disease/humidifier or air-conditioner lung/bird breeder's lung. Hypersensitivity pneumonitis is an inflammation in the lungs caused by exposure to an allergen (foreign substance), usually organic dust. This dust may come from animal dander, moulds, or plants. It is usually an occupational disease. Over time, this acute condition may turn into chronic lung disease. Exposure may also occur in the home from fungus present in humidifiers, heating systems, and air conditioners. Symptoms include cough, fever, chills, shortness of breath, malaise (feeling ill). Chronic hypersensitivity pneumonitis may have symptoms like breathlessness, especially with exertion, cough, often dry, loss of appetite, unintentional weight loss.
- ***Pruritis:*** Causes severe itching. An itch (Latin: pruritus) is a sensation felt on an area of skin that makes a person or animal want to scratch it. It is a distressing symptom that can cause discomfort. Scratching may cause breaks in the skin that may result in infection. Pruritus can be related to anything from dry skin to undiagnosed cancer.
- ***Radiation:*** Energy that is radiated or transmitted in the form of rays or waves or particles. Radiation sickness is a syndrome resulting from exposure to ionizing radiation (e.g., exposure to radioactive chemicals or to nuclear explosions); low doses cause diarrhoea and nausea and vomiting and sometimes loss of hair; greater exposure can cause sterility and cataracts and some forms of cancer and other diseases; severe exposure can cause death within hours.
- ***Repetitive strain injury:*** Also called repetitive stress injury or typing injury, is an occupational overuse syndrome affecting muscles, tendons and nerves in the arms and upper back. It occurs when muscles in these areas are kept tense for very long periods of time, due to poor posture and/or repetitive

motions. It is most common among assembly line and computer workers. Good posture and ergonomic working conditions can help prevent or halt the progress of the disorder; stretches, strengthening exercises and massages can help heal existing disorders.

- **Rhinitis:** It is an inflammation of the mucous membrane that lines the nose, often due to an allergy to pollen, dust or other airborne substances. Seasonal allergic rhinitis also is known as "hay fever," a disorder which causes sneezing, itching, a runny nose and nasal congestion. Symptoms also include irritation in the nose, eyes, throat and ears. It is related to and often occurs together with other disorders such as asthma and sinusitis.
- **Scleroderma:** Also called 'systemic sclerosis'. Scleroderma means 'hard skin'. It is a disease of the skin and connective tissue that causes the skin to become hard and can result in hair loss. However many people with this condition have problems in other parts of their bodies as well, hence the second explanatory name, 'systemic sclerosis'. Scleroderma is an uncommon, chronic (persistent) disease affecting the 'connective tissues' which surround the joints, blood vessels and sometimes internal organs beneath the affected areas of skin.
- **Silicosis:** This ancient lung disease - workers who built the pyramids in Egypt are believed to have suffered from silicosis - was a major cause of sickness and death among workers worldwide earlier in this century. Silicosis derives from inhalation of silicon dioxide, commonly known as silica, in crystalline form. Despite the knowledge of the cause of this disorder, workers worldwide still face exposure in mining, quarrying, tunnelling, abrasive blasting and foundry work. Epidemics of silicosis continue to occur, even in developed nations.
- **Sinusitis:** - An inflammation of the sinuses (hollow spaces in the bone of the cheeks and forehead) due to infection. Common symptoms of sinusitis include pain in the face, coloured (not white or clear) secretions from the nose, and headache. A lot of people who have asthma also have problems with

recurrent sinusitis. There is some evidence that a flare-up of sinusitis can trigger a worsening of asthma symptoms, but this is still not certain.

- **Tendonitis:** Tendons connect muscles to bones. Tendonitis is the result of the inflammation of tendons of a particular part of the body. Inflammation is a healing response to injury, and is usually accompanied by swelling, heat, redness and pain. What usually causes tendonitis is not just a single injury but a series of small stresses that repeatedly aggravate the tendon.
- **Tenosynovitis:** Inflammation and swelling of the tendon sheaths, usually of the wrist or hand, potentially caused by repetitive movements such as very high-speed typing rates. The sheath produces a lubricating fluid for the tendon; tenosynovitis results from a decreased capacity to produce this lubricating fluid.
- **Tonsillitis:** The tonsils are areas of lymphoid tissue on either side of the throat. A viral or bacterial infection of the tonsils causes inflammation or swelling of the tonsils called tonsillitis.
- **Ultraviolet (UV) radiation:** UV is electromagnetic radiation of a wavelength shorter than that of the visible region, but longer than that of soft X-rays. It can be subdivided into near UV (380–200 nm wavelength), far or vacuum UV (200–10 nm; abbrev. FUV or VUV), and extreme UV (1–31 nm; abbrev. EUV or XUV). When considering the effect of UV radiation on human health and the environment, the range of UV wavelengths is often subdivided into UVA (380–315 nm), also called Long Wave or "black light"; UVB (315–280 nm), also called Medium Wave; and UVC (< 280 nm), also called Short Wave or "germicidal". In humans, prolonged exposure to solar UV radiation may result in acute and chronic health effects on the skin, eye, and immune system.
- **Vertigo:** Sense of spinning or feeling of disequilibrium. It is often accompanied by nausea and occasionally vomiting and is generally worsened by motion. Sometimes caused by blood vessel compression of the nerves related to balance.

## Summary

A quick summary of what has been covered in the unit:

- We were oriented to occupational health hazards across different industries
- We analysed the hazards within the mining, electronics, food processing industries
- We also developed insights on health hazards within the textiles, construction, pharmaceutical, steel and metallurgical industries.

## Recommended for Further Reading

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