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Occupational Health Hazards and Environmental Effects in Mining – An Overview

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Abstract: Mining is the extraction ofvaluableminerals or other geological materials from the earth. Life cycle of mining involves exploration, design, construction, operation/extraction, processing, engineering services and maintenance, closure and rehabilitation / remediation. This series of stages of extraction in the mining and metals sector will pose a potential risk to health and wellbeing.The aim of this study is to illustrate actively the range of health problems/hazards that can occur in relation to the various types of exposures in mining and metals workplace, assess their potential risks to health and determine appropriate control measures to protect the health and wellbeing of workers.

Keywords: Mining. Heavy metals, Hazards, Health Risk

Introduction

Mining of stone and metal has been done since pre-historic times. Mining is Associate in Nursing ancient occupation, long recognized as being arduous and prone to injury and illness. The lifecycle of mining consists of exploration, mine development, mine operation, decommissioning and land rehabilitation. the character of mining creates a possible negative impact on the human health each throughout the mining operations and when the mining.. activity Health Hazards in Mining ar classified into 5 classes and ar explained thoroughly.

Physical hazards

Traumatic injury remains a major drawback and ranges from the trivial to the fatal. Common causes of fatal injury embrace rock fall, fires, explosions, mobile instrumentation accidents, falls from height, demurrer and electrocution The physical setting wherever exploration, mining, ore extraction and process takes place will cause health impacts like Physical injuries from accidents involving moving machinery, movement of mining product and from operating with explosives and exploding devices, contractor disorders related to numerous work activities wherever manual handling could be a feature or repetitive motion ar needed and whole-body vibration, Noise-induced hearing disorder related to occupationally connected excessive noise exposure, Hand arm vibration syndrome and different contractor consequences from hand-arm transmitted vibration, carcinoma from working outdoors in direct sunlight, Effects from both ionising and non-ionising radiation like cataracts, Heat exhaustion, hypothermia and various other health effects from exposure to extremes of temperature. Exposure to some of the major hazardous substances encountered in the mining and metals sector can result in a number of important health effects. Skin disorders (burns, contact dermatitis, cancer) from contact with a wide range of chemicals including acids, alkalis, solvents, fuels, lubricants and resins. Allergic contact dermatitis from epoxy resins used in adhesives and the salts of some metals including nickel and chromium (e.g. in cement) Intoxication, through to asphyxiation and death can result from the inhalation of some gases and vapours including the toxic gases hydrogen sulphide, carbon monoxide and sulphur dioxide Acute pneumonia may result from exposure to blasting fumes Damage to the respiratory tract from exposure to airborne chemicals (dusts, gases and aerosols) eg. Silicosis, coal worker's pneumoconiosis and asbestosis arising from exposure to crystalline silica, coal dust and asbestos respectively, lung cancer and mesothelioma from exposure to asbestos and nasal sinus cancer from exposure to nickel subsulphide and acid mists. Damage to internal organ systems such as the lung, kidney, liver, bone marrow and brain from the absorption of chemicals and metals through the skin, respiratory and digestive tracts. different activity hazards to health in the mining and metals sector, like all employment sectors can encounter cases of ‘stress’ and different adverse psychological state and prosperity effects that ar due to, or contributed to by, activity factors, together with shift work.

Noise is sort of omnipresent in mining. it's generated by drilling, blasting, cutting, handling, ventilation, crushing, conveyance and extraction. dominant noise has established tough in mining and noise-induced hearing disorder remains common. Heat and humidness ar encountered in tropical locations and in deep underground mines, wherever Jewess rock temperatures and air temperatures increase with depth, due mainly to the energy gradient and auto-compression of the air column. Fatal heat stroke has been a major drawback at deep underground gold mines and warmth exhaustion remains a recent drawback in deep underground mining. Whole body vibration is often knowledgeable about while operational mobile instrumentation, like load–haul–dump units, trucks, scrapers and diggers. this may cause or exacerbate pre-existing spinal disorders. Poorly maintained roads and vehicles contribute to the matter. Hand–arm vibration syndrome is additionally encountered with the employment of vibratory tools like air leg rock drills. star ultraviolet exposures in surface mining operations ar possible to contribute to the prevalence of basal cell carcinomas, though this is often associate abstract thought drawn from studies of out of doors staff in different industries. Occupations involving substantial outside work seem to not be related to associate exaggerated risk of skin cancer. Infra-red exposures in pyrometallurgical processes contribute to heat stress and should induce cataracts. magnetic attraction fields ar encountered in electrolytic smelting and processing processes. atmospheric pressure is elevated in deep underground mines and reduced at high altitude mines in South America. Chronic intermittent drive at altitude has been according to induce physiological diversifications and symptoms of benign acute altitude sickness (AMS) in mine staff. exaggerated measuring device pressures in deep mines increase air temperatures, increase convective heat exchange and cut back sweat evaporation rates.

Chemical hazards

Crystalline silicon oxide has long been a significant hazard in mining, with the chance of pneumonoconiosis at its worst throughout dry drilling late within the nineteenth century. pneumonoconiosis remains a tangle in developing nations and silico-tuberculosis is vital in continent, wherever the high prevalence of HIV infection among miners will increase the chance. Prolonged exposure to crystalline silicon oxide may also cause chronic hindering pneumonic illness. The prolonged exposure to crystalline silicon oxide will increase the chance of carcinoma. Coal dirt has additionally been a significant hazard in mining, inflicting coal workers' {pneumoconiosis|pneumonoconiosis|respiratory illness|respiratory illness|respiratory disorder} or 'black lung' and chronic hindering pneumonic disease.

The risks have currently been for the most part controlled in developed nations by dirt suppression, ventilation and metabolism protection. Diesel particulate exposures occur in underground mines as a result of diesel supercharged mobile instrumentation, used primarily for drilling and pulling. Diesel particulate is AN human substance alternative|and several other} epidemiologic studies from other industries recommend there's AN excess risk of carcinoma. management measures embrace the employment of low sulphur fuel, engine maintenance and mine ventilation. Arsenic is usually a contamination of metal ores ANd has been commercially extracted throughout copper smelting with an related risk of carcinoma. Exposures to nickel compounds in some nickel refineries are rumored to extend the chance of carcinoma and sinus paranasales cancer. However, these risks have declined considerably with up hygiene. many different metal ores, as well as those of lead, cadmium, manganese, Pt and metallic element, gift health hazards. activity asthma attack has additionally been a tangle within the pot rooms of atomic number 13 smelters. Coal dirt and alkane series gas explosions in underground coal mines stay a significant risk requiring comprehensive observance and management. Some underground coal mines even have issues with greenhouse gas and atomic number 1 compound gas. Cyanide is employed as a solvent for metals like copper and gold in hydrometallurgical processes. Exposure to compound gas will occur throughout cyanide resolution preparation. Skin splashes with cyanide solutions area unit dangerous , though the chance is decreased by the employment of low concentration solutions. Xanthates area unit reagents ordinarily employed in hydrometallurgical processes. They evolve carbon disulphide gas on combustion or on admixture with water.

Suspected acute carbon disulphide toxicity has been rumored throughout salt chemical agent preparation at a gold mine. Mercury continues to be employed in some gold mining operations, particularly in developing nations, to extract gold through the formation of mercury–gold amalgams. Toxicity may result from inhalation of mercury vapour throughout preparation of amalgam, retorting or smelting. acid is employed within the analysis of core samples taken throughout exploration drilling Smelting of compound ores produces sulfur dioxide gas, which might cause acute spasm. pain in the neck dermal exposures area unit common in mining and sometimes lead to eczema.

Biological hazards

The risk of tropical diseases like protozoal infection and breakbone fever is substantial at some remote mining locations. zoonotic disease and ankylostomiasis were common in mines, however obliteration of rats and improved sanitation management the hazards effectively within the world. Cooling towers square measure usually found on mine sites. Regular microbiological analysis of the water is important to observe bacteria contamination or high concentrations of different heterotrophic microorganisms.

Ergonomic hazards

Although mining has become progressively mechanized, there's still a considerable quantity of manual handling. additive trauma disorders still represent the biggest class of industrial disease in mining and sometimes lead to prolonged incapacity. Broken ground is commonly encountered and cause ankle joint and knee injuries. Most mines operate twenty four h per day, seven days per week, therefore shiftwork is extremely common. There has usually been a trend towards twelve h shifts in recent years. Fatigue in respect to shiftwork has been subject to extensive investigation within the business. Sleep deficits, which could be expected in hot locations, are cause impairments of psychological feature and motor performance among drivers.

Psychosocial hazards

Drug and habit has been a tough issue to modify in mining, however policies and procedures square measure currently in situ in most massive mining operations. Mining operations usually need the measure of urinary drug metabolites and breath or blood alcohol on pre-employment. Remote locations square measure common in mining, fatal and severe traumatic injuries still occur in mining and sometimes have a profound impact on morale. Post-traumatic stress disorders typically develop in witnesses, colleagues and managers. Registered managers typically feel in person accountable for such injuries, even within the absence of negligence, and face the ordeal of state inquiries and legal proceedings.

Identifying Health Hazards

Mines are complex workplaces involving the entire spectrum of extraction, crushing, milling, flotation, smelting and refining as well as engineering processes from the operation of chemical processes, heavy equipment and electrical maintenance to electronics. Operations are often located in remote environments and it will be important to consider issues around security, travel risks, medical evacuation capability, standards of local health facilities etc. The range of potential exposures is therefore extensive. Figure 1 illustrates the main elements of the mining and mineral process and how theyinfluence the types of hazards found.

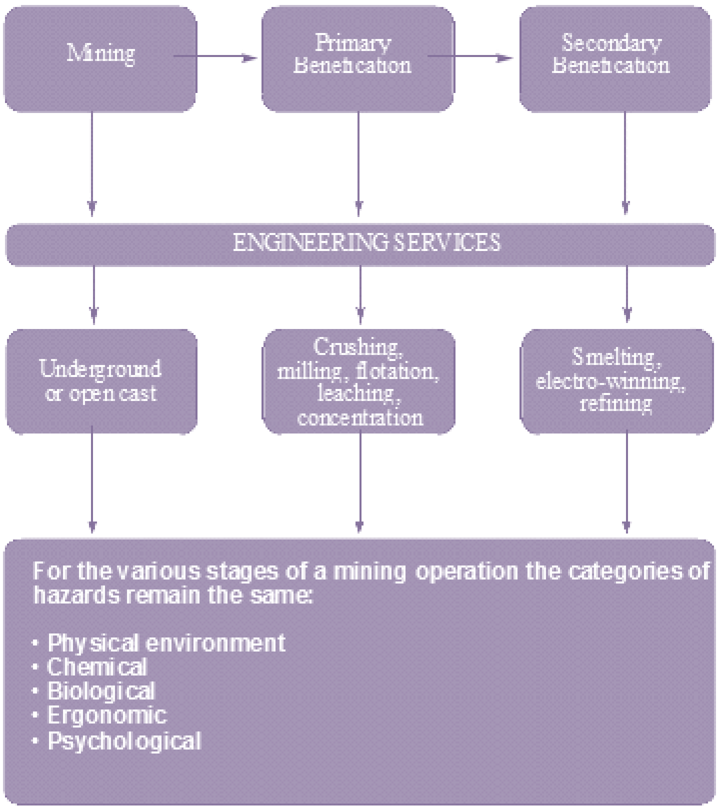

Figure 1: Illustrative flowchart for a mining operation

STEP 1: DESK-TOP ANALYSIS

The first step in identifying health hazards is a desktop analysis. This is particularlyuseful where records of previous Health Risk Assessments (HRAs) and other employment records are available.Some examples of the types of records that might be available areIncident reports, Audit reports, Previous HRAs, Occupational illness and injury reports, Equipment maintenance and fault reports, Health surveillance records, Sickness absence reports, Previous occupational hygiene surveys, Site inspections, Minutes of health and safety meetings, Material Safety Data Sheets (MSDS). A review of the design of the facility, together with blueprints and schematics of theindividual area or process, and related health records will help to systematicallyidentify the potential health hazards that are present or might occur.

STEP 2: WALK THROUGH SURVEY

The survey of the process, area and the task enables to know the health hazards, exposure level, workers health, physical and mental functioning of workers sensing the vision, hearing and feel. The key concepts which may be considered for the study include the follwing;

Environmental Issues (Physical)

1. What are the task involved in whole body vibration or the exposure to hand?
2. Are the working areas have extreme heat wave, cold, humidity at present or there is any possibility of its occurrence?
3. Is the equipments used emits ionising radiation?
4. Is there any special tasks which involveschange in atmospheric pressure?
5. Is the ventilation provided inside is adequate for the workers?

Chemical Agents

1. Are workers exposed to various chemicals that would affect workers physically or mentally over a period of time?
2. The products produced by the company, by products and any other wastes produced by the company is to be considered
3. What are the various hazardous construction materials that may be used which may potentially harm?
4. What are the various chemicals used and reviewing the chemicals which are hazardous and is registered to be available in the site
5. Does the process allow to mix chemicals and raise the hazard?

Biological Issues

1. The existing system installed for drinking water, effluent, sanitation and sewage being maintained
2. The potential for pathogenic micro organisms
3. Is there a adequate number of employees present and the facilities being cleaned regularly?
4. Are the restaurants, canteens and eating place maintained cleanly? What are the measures taken to control insects, rodents etc
5. Is the air conditioners installed in the work place working? Is there a provision for pathogenic micro organisms?

Ergonomic Issues

1. Are the workers involved in carrying out manual tasks which are heavy in nature?
2. Are the workers remain static for longer time periods? Are they involved in repetitive tasks which are awkward and unnatural movements?
3. Are the workers wearing protective clothing that restricts free movement for exertion?
4. Is the type of job requires mental alertness and agility?

Psychological Issues

1. Is the job in terms of shift, employee rotations, resources and work loan lead to disturbance or mental stress?
2. Are the working class isolated from family, friends or working alone?
3. Is there a culture, faith and language issues in the company?
4. Is there a availability of leisure time and recreation facilities?
5. Is the system has the facility to receive issues and complaints?

STEP 3: RATING HAZARDS

Hazards caused may be numerically rated in the aspects of how it affects the health. The same is exhibited in Table No. 1. The table extends the knowledge of accurately assessing and setting priorities of risk that would harm workers significantly.

Table 2: Hazard Rating

HAZARD RATING		**DEFINITION**
1	Minor health effects	Exposure at this level is unlikely to harm much
2		Life Won't be threatened but reversible health will be affected
3		Adverse health effects that may be permanent but may not significantly affect quality of life. Health effects may be limiting/disabling and therefore could lead toa change of occupation and lifestyle.
4		
5	**Significant and severe health effects**	Adverse health effects are usuallypermanent and could lead to reduction in quality of life and/or Continued exposure is generally likely to lead topermanent physical or mental disability or along term limiting illness.

Occupational HealthRisk Assessment

An Occupational Health Risk Assessment (HRA) is a method which is a structured and systematically identifies and analyzes hazards that occur in workplace and aims in reduction of risk and the exposure to the hazards by developing and implementing a methodology to avoid, regulate and control the hazards. The occupational setting is the preliminary component to health risk management. It is a decision making process which involves the consideration of the following factors;

1. Political factors
2. Social factors
3. Economic factors
4. Engineering factors.

The combination of all these factors will help to develop, analyze and compare the risk assessment information. The below figure shows the flow chart of HRA and how it works and below are the four key elements of health risk assessment

1. Hazards identification
2. Analysis and examination that may potentially affect the health
3. Exposures measurement
4. Risk characterization

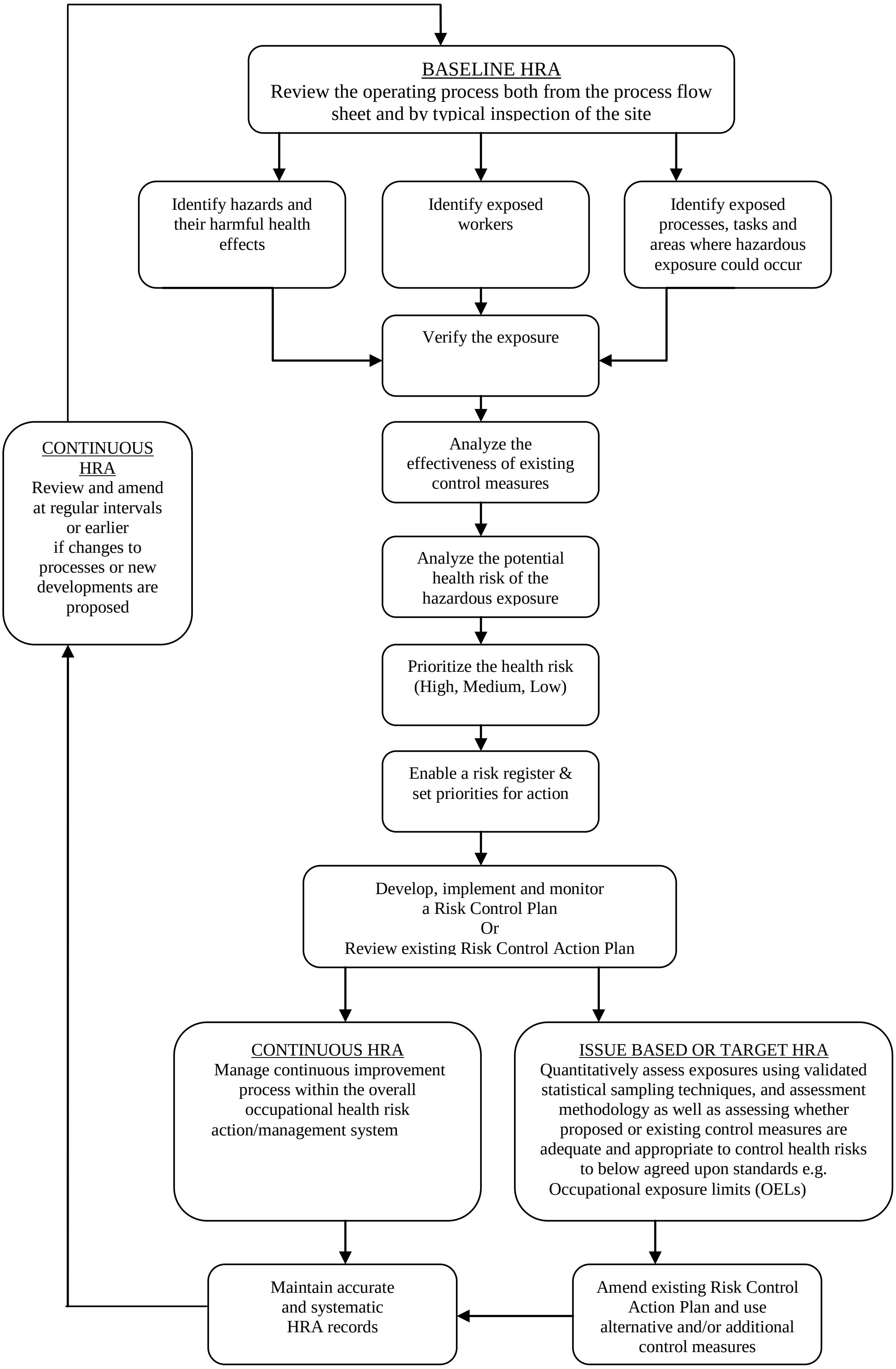

Figure 2: The health risk assessment cycle for new and existing operations

The procedure includes the following;

- Identify the processes, tasks and areas where hazardous exposures could occur
- Assess, measure or verify the exposures
- Analyze the effectiveness of existing control measures
- Analyze the potential health risks of the hazardous exposures
- Prioritize the health risks (high, medium and low)
- Anticipate potential new and emerging health risks
- Establish a risk register
- Set priorities for action
- Develop, implement and monitor a risk control action plan or review existingrisk control action plan
- Maintain accurate and systematic records of the HRA or amend existing RiskControl Action Plan and use alternative and/or additional control measures
- Review and amend at regular intervals or earlier if changes to processes ornew developments are proposed

Assessing the Effectivenessof Control Measures

For the actions, techniques, process, protocols and education should have control measure as interventions and will help to eliminate and reduce the hazardous exposure. Several control measure can be used to control the adverse exposure and are generally termed as Hierarchy of Control. In order to sustain the reliability, effectiveness, likelihood of reducing exposures are through the elimination, administration, engineering and personnel protection equipments. Usually all hazards would be eliminated from the workplace using different methods but in reality lower levels of hierarchy of controls will be employed. For example, whilst education and training methods cannot be able to achieve proper control will be an essential element and other measures are applied and used correctly. The HOC will be implementable to all types of health hazards and one or more methods will be used at different levels to control the health hazards and it is called as multi level controls. Sometimes the levels of control are not applicable at all levels of potential health hazards. An iterative process of hazards reviewing and controls be used to ensure a continuous drive of HOC is embedded operational cultural structure. Personnel protective equipment shall be used as a last resort can be a value addition to the control program. When the control measure are used associating the well defined and well planned program of training with a routines replacement and maintenance would yield good results. Elimination of hazards will help in removal of emission particulates and gases being replaced with diesel powered or electrically powered equipments. Enclosures should be created around the plant so that it can help reducing the noise levels caused by noisy equipments. Mountings for reducing vibration can help in reduction of vibration and noise levels. The changes in administration and work procedures like number of working hours, rotation of tasks, work permits that may result in reduction of exposure to hazards. Education and training is needed to understand and combat the hazards if they are linked to use of equipment or a task. The use of hearing protection devices, face masks, body suits will protect the workers from noise, dust and chemical exposures.

Conclusion

The present study has explained differentrange of health problems/hazards that can occur in relation to the various types of exposures in mining and metals workplace. The study briefed out about assessment towards the potential risks to health and illustrated in determining the appropriate control measures to protect the health and wellbeing of workers.

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