

## Coal basically a hazardous Industry and source for numerous occupational diseases for workers

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### Abstract

*For the purpose of steady and faster economic growth, plans for development in all front including industrial units appear to be important. Coal plays major role in the industrial front and building economy. Coal, the prime energy source will dominate for a few decades to come in India and therefore, attaching importance to existing and new Coal Projects will gain priority*

*Coal mining is a constant struggle with nature. The people attached to this industry face challenges in working against odds as the industry is known for its highly risky and hazardous working environment. Technological advancement in coal extraction techniques for proliferation of production levels has caused further concern for safety in this industry. .*

*A large number of mobile mining equipment such as haul trucks, dumpers, tractors, tankers are used for different operation and such operations contribute significantly in causation of fatal and serious accidents. Fire, flood, collapse, toxic atmospheric contaminant, and dust or gas explosion are the most critical hazards specifically linked to underground mining. Besides coal combustion releases mercury, nitrogen oxides, sulfur dioxide and other substances known to be hazardous to human health causing chronic diseases and even permanent disablement.*

**Key Words:** *Critical Hazards, Accidents Fatal & Serious Injuries, Occupational Diseases, Safety Policies*

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### Introduction:

Coal is the key source of energy for industrial growth in India. It is the fossil fuel resource which is abundantly available in the country. Coal dominates energy production in India contributing about 70% of the total energy production. India has total coal reserves of over 194 billion tones. Current coal production of India is about 600 million tones. There are about 612 working coal mines under Coal India (CIL), Indian Iron Steel Company (IISCO), Tata Steel Company (TISCO), Singhereni Coal Company (SCCL) providing employment to about 4,50,000- persons in public sector and other coal companies and captive mines under steel- Power companies. Practically coal of all ranks occurs in India except peat and anthracite. The share of lignite is however insignificant compared to sub-bituminous and bituminous coal. In India bituminous coal is divided broadly into two categories, coking and non-coking.

Mining is one of the most hazardous sectors due to its complex work environment. Workers of underground coal mines are prone to several risk conditions during their work which may cause loss of life or serious injury which has a direct and indirect cost for employees and employers. The coal mining also has a major impact on the health of employees engaged in unhygienic working conditions which is tough due to, high temperature, humidity and uneven travelling roads. Darkness persists in working places with insufficient light. Some times the occupational diseases become so severe that workers face total disablement or inherit ailments specially of lungs due to inhalation of coal dust. This causes serious health problems both during their tenure of service or after retirement.

**History:**

Coal mining was first started in 1775 in Raniganj coalfield. Since coal was not commercially viable due to its low quality, mining was suspended for many years. Later coal mining started in Raniganj Coalfields again during 1818. However actual shape was given to coal as industry by Dwarkanath Tagore in 1837 when coal mining became profitable. The industry became important and vital after introduction of steam engine and starting of rail where coal was essential. (1)

The industry is known for its highly risky and hazardous working environment which can be seen from the incidences of accidents (from 1901 with interval of 5 years) resulting to fatal and serious injuries of coal mining workers in India. During this period coal mines were run by private coal mine owners. At that time coal industry was highly labour intensive and they were largely seasonal, casual, temporary besides some permanent workers and supervisors. Coal mines were mostly having primitive working methods and in some mines intermediary technologies were introduced. The mines were of various sizes, depth, age and mostly under Indian owners. A few European coal companies were operating since earlier period. From the table below it would be seen that up to 1915, nearly 90 people in average were involved in fatal accidents and were killed every year. In the later period, the rate of fatality and serious injuries registered higher trend.

**Table 1 (from 1901 with interval of 5 years) Source: Office of the chief Inspector of Mines (2)**

**Accident position of Coal Mines of India**

<b>Year</b>	<b>No. of persons killed</b>	<b>Serious Injuries</b>
1901	70	N.A
1905	58	58
1910	160	74
1915	106	239 *

\* During World war I Coal demand increased and it appears that to meet up such demand coal production was increased which might have caused higher accidents in mines. At that time

principle of "More hole More coal" was adopted by small mine owners in Raniganj coalfields.

1920	172	240
1925	186	373
1930	211	499
1935	264	628
1940	248	1220

After independence, the administration of the European run coal companies gradually passed on to the Indians experts in mining and more number of small coal mines under private owners came up. During the period till takeover of mines there were heavy toll in accidents.

**Table 2 Source: Annual Report of Chief Inspector of Mines (3)**

<b>Year</b>	<b>Killed</b>	<b>Serious Injuries</b>
1947	239	1302
1950	241	1742
1955	309	2880
1958	420	2885

**Hazards in Coal Mining Industry:**

A mining accident that occurs during the process of mining minerals brings tragedy in the life of coal workers and in their family. It can often have serious catastrophic consequences in underground mines.

In this period hundreds of miners used to die from mining accidents each year, especially from underground coal mining. Over the years, the Directorate General of Mines Safety (DGMS), mining companies, research institutes and academics have made constant efforts to prevent accidents in Indian mines by proposing solutions, such as additional regulations, improved training, advanced technology and reliable equipment.

Though there has been a decreasing trend in the fatal accident frequency rate per lakh man shifts; the death rate per 1000 persons employed and the death rate per million tones of coal production in Indian coal mines, the current rates are still unsatisfactory. The fact is that underground coal mining is associated with hazards and therefore complete elimination of risks is unavoidable.

Currently coal mining in India is at a very critical juncture (like many other public sector companies). Workers and their organisations are facing an uphill task of preventing entry of private operators in the coal sectors and apprehension of privatisation, in order to save their jobs and union membership. There has been a steady decline in the employment in the coal sector due to mechanisation and other cost-cutting measures. There is no doubt that safety has taken a back seat and people are faced with a Hobson's choice - "No Jobs versus Hazardous Jobs".

The accident figures which appear in government statistics may not reveal the actual situation as many accident that takes place in illegal mines remains unreported.

Due to difficult working environment, there are many hindrances come across during mining. Explosion and mine fire are the most dreadful hazards in underground coal mines and major causes of accidents claiming significant number of fatalities..

Disasters in Indian coal mines have caused havoc in the past. In recent times also, there had been 7 disasters since the year 2000 killing 144 persons. The worst disaster ever in Indian mining history is the Chasnala disaster due to inundation killing 375 persons in 1975, But unfortunately very little has been learn from these past disasters ( *Source: DGMS Report (4-)*).

Up to 1909 the general idea was that coal mines in Bengal were free from explosion of fire damp excepting of a minor scale. However on 7 th February 1910, due to explosion in Dishergarh mine of M/S Equitable coal company 11 persons lost their lives. In the later period there were several such accidents due to explosion. In same Dishergarh Mine 14 persons died and 4 persons severely burnt on 20<sup>th</sup> July 1916. On 18 th November 2018, ten (10) lives were lost.

On 17th February 1931 as high as 13 persons were killed due to explosion in Nigha coal mine .In a major explosion in poidhi colliery 209 persons died instantly out of which 63 were women employees (at that time female workers used to work in underground mines Explosion in Chinakuri coal mine on 19 th February 1958 turned into a disaster when a number of persons died which involved 173 workers. *Source: DGMS (5)*).

The accident which sometime turnas dreadful disaster are due to the following reasons:

Flood:- Floods are big risk for both underground and above-ground mining sites.

Gas explosions:- A methane gas buildup can lead to an explosion in a coal mine.

Chemical leakage: - Chemicals are used in mines to transform ores from a natural state into usable commodities

From the accident statistics mentioned in the tables it is essential to identify all the potential hazards that may probably lead to accidents of different nature including loss of limbs and even fatal. Mine disaster though undesirable yet it takes place involving heavy casualty.

Statistics of accident immediately after takeover of mines in Raniganj coalfields where coal is mined mostly from underground is shown below.

**Table I Source:Annual Report of Director General Mine Safety –(6)**

Year	1973 -74	74 -75	75 -76	76 -77	77-78	78 -79	79-80	81- 80	81-82
Production	21.06	23.16	26.18	26.46	25.23	22.05	20.52	22.61	23.55
Manpower	179635	180943	185325	186673	186540	186243	186673	185230	188156
No. of Fatal Accident	36	48	48	49	43	27	36	25	35
Fatalities	38	56	56	54	46	33	44	29	41
No. of serious Accidents	209	260	318	294	326	324	244	353	409
No. of serious Injuries	308	272	336	310	336	326	272	382	424

On examination of the accident statistics the reasons that could be ascertained and identified as follows:-

- 1) Collapse of Pillars
- 2)Blasting
- 3)Roof fall
- 4)Side fall
- 5)Firedamp and Coal Dust Explosion
- 6) Mine Fires
- 7)RockBursts
- and 8)Bumps.

Further underground mining hazards include suffocation, gas poisoning, roof collapse, outbursts and gas explosions. Firedamp explosions can trigger the much-more-dangerous coal dust explosions, which can engulf an entire pit. Another danger that miners face every time they venture underground is that of gas explosions. Companies spend a lot of time, money and effort ensuring that there is adequate ventilation but a methane gas buildup can and does lead to explosions

There are still many accidents that can and do occur on mine sites worldwide. One of them being cave-ins. This is tragically one of the most common underground mining accidents that happen. Flooding is also a big danger and can occur due to uncontrolled surface runoffs such as flash flooding caused by heavy rain. These floods can also damage the pit walls of underground mines which may cause a collapse which can be extremely dangerous and in many cases cause fatalities. Mine accidents also take place due to Electrocutation and Radon.

Hazards also occur from machines, rope haulage, conveyors, ventilation fans, dewatering pumps, shuttle cars and locomotives.

The causes of Hazards at the Coal Face can be grouped in two categories

GR I - Hazards at the Coal Face: • Noise • Dust • Explosive gas • Heat • Low oxygen • Roof Fall • Side Fall • Uncomfortable working posture Haulage Hazards • Rope breaking • Run over by coal tubs • little or no illumination Cage Hazards • Brake failure • Operator error.

GR II- Sound • Air pollution • Slippery mud due to oozing water • Poor light • Electrical hazards • Loading and unloading of tubs • Gas • Explosion due to methane.

Over the past 30 years, there has been reduction in fatal accidents and it is because of the fact that coal production has shifted above ground to strip and mountain-top-removal mining. Open cut hazards are principally mine wall failures and vehicle collisions, Coal is inherently more dangerous than metal mining, The reality is that miners are still dying from explosions, cave ins and equipment accidents, and they are also still being exposed to fatal and chronic conditions that are linked to their toxic work environment.

### **Current position of Hazards In Ranganj Coal fields**

The study on coal mine hazards has been carried out in the area of Raniganj Coalfield the oldest coal mining areas. In this coalfield there are large number of underground mines having low unit production and dismal productivity. b. Difficult geo-mining conditions like high degree of gassiness, seams susceptible to spontaneous heating, presence of water-logged workings in the upper seams etc. Profile of Eastern Coalfields Limited

Extensive manual loading of coal at UG mines led to low production and productivity due to presence of adverse geo-mining conditions Hydraulic sand stowing had to be done in many mines which led to increase in operational cost.

Presently in Ranganj Coal fields there are- 77 underground mines and 21 open cast Projects. The rate of fatal accident shows a significant reduction from 1980 to 2000 but it becomes almost flat for the last 13 years since 2000. Though all the accidents were investigated and recommendation were made for preventing recurrence, there is no further reduction in the rate in last 13 years. Accident Statistics for the year of 2016-17 & 18 (upto July) in Raniganj Coalfields are: -

**Table 4 Accident Source: Ministry of Coal Govt. of India (7)**

	2016 -2017*	2015-2016
Fatal Accidents	7	8
Fatalities	24	8
Serious Injuries	41	38
Fatalities /Million Tone Output	0.592	0.199
Fatality /3 Lakh Man shift	0.475	0.153

(\* subject to reconciliation with DGMS)

Fatal Accident ( FA) Fatalities (FI) Serious Accident(SA) serious Injuries (SI)

2017 2018 ( Up to July 2018)

(F A) ( FI ) (SA )( SI ) ( F A) ( FI ) (SA )( SI )

40 44 20 19 40 44 20 20

Source: From Records of Eastern Coalfields Ltd. (8)

The trend of accident during last few years were considerably high.

**• Health Risks-Coal's Assault on Human Health**

Besides mine accidents of both Fatal, Serious and Minor injuries, the workers in coal mines face health problems like chronic diseases. These are mainly arising out of dust and coal particles. Also workers suffer disorder in heap, knee, Spine. Shoulder, as well as loss of hearing, loss of eye sight partially and skin diseases.

Some occupational diseases/injuries common in mine workers are: • Noise Induced Hearing loss. • Tremors due to drilling. • Chest Infection/Bronchitis. • Occupational Skin Diseases. • Gas poisoning. • Multiple injuries, head injuries and spinal injuries due to roof fall (which is the most common case handled in hospital).

**Dust Problem:** Coal mine dust causes a spectrum of lung diseases collectively termed coal mine dust lung disease (CMDLD). These include Coal Workers' Pneumoconiosis, silicosis, mixed dust pneumoconiosis, dust-related diffuse fibrosis (which can be mistaken for

idiopathic pulmonary fibrosis), and chronic obstructive pulmonary disease. Miners run the risk of respiratory damage through the high levels of dust and other chemical particulates present in deep coal mining. Some of the disorders caused by these particulates include COPD, coal worker's pneumoconiosis (CWP) and progressive massive fibrosis (PMF). Black lung disease, which can strike coal miners, is another form. Pneumoconiosis can cause scarring of the lungs called fibrosis

Coal Workers' Pneumoconiosis (CWP), commonly referred to as black lung, is a type of pneumoconiosis caused by inhaling respirable coal mine dust. Chest x-rays can show shadows in the lungs called opacities.

An irreversible, disabling form of this disease called silicosis can occur when a miner inhales excessive amounts of crystalline silica, or quartz. (Source <https://www.miningreview.com>). Silicosis is the disease most familiar to many. They have similar radiographic findings, with milder forms characterized by small (<1 cm) rounded opacities found more in the upper lung zones. A more severe form called progressive massive fibrosis (PMF) is characterized by coalescence of small opacities into large ( $\geq 1$  cm) opacities. These diseases can be distinguished by pathology; their pathogenesis and pathology are reviewed elsewhere. Miners with combined exposures to coal and crystalline silica (quartz) dusts can also get mixed dust pneumoconiosis. Coal miners with rheumatoid arthritis and a background of pneumoconiosis are also at risk for rheumatoid pneumoconiosis. In this condition, multiple well-defined rounded nodules, classically resembling rheumatoid nodules in other locations, may occur in crops. They range in diameter from about 0.5 to several centimeters and are found predominantly at the lung periphery.

Coal combustion releases nitrogen oxides, sulfur dioxide, particulate matter (PM), mercury, and dozens of other substances known to be hazardous to human health. Sulfur dioxide (SO<sub>2</sub>), which causes acid rain and forms small airborne particles that, can cause lung damage, heart disease, and other illnesses.

*In a joint study by the Indian Council of Medical Research and the International Development Research Centre, Canada (ICMR & IDRC, 1993) in the Raniganj coalfield area of West Bengal- (9 )*

the following facts were observed:

- (a) The dust levels in all underground coal mines included in the study were higher than the suggested threshold limit value (TLV).
- (b) The prevalence of pneumoconiosis in underground coal miners was 2.84% while in the case of surface coal workers it was 2.10%.
- (c) About 40% of the cases of pneumoconiosis in underground coal miners and 20% in surface coal workers showed irregular (linear) opacities on chest X-rays.
- (d) The prevalence of chronic respiratory symptoms amongst the underground miners was 31.3%, which was significantly higher than that amongst the surface coal workers (17.0%).



(e) The overall prevalence of functional abnormalities of lung in underground coalminers and surface coal workers was 45.4% and 42.2% respectively.

(f) In underground coal mines the noise levels were higher than the standards prescribed by Director General of Mines Safety (DGMS). This can create ENT related problems.

(g) The thermal environment in the underground mines was found to be non conducive for heavy and moderate physical work as evidenced from Wet-Bulb-Globe-Temperature (WBGT) index.

(h) The wind velocities at the working faces in underground coal mines were found to be either low or stagnant

### **Disorder of Knee, Heap joint, shoulder, ear causing hearing problem and eye sight problems etc**

Employees often face disorder of Knee, Heap, and shoulder joint also Ear causing hearing problems and low eye sight etc which they develop during the course of employment.. The possible reasons as identified for all such ailments are:

i) Heap Joint and Knee pain:- problems occur due to regular walking underground mines through uneven travelling road

ii) Shoulder problems: crop up mainly with the coal loaders for carrying coal loaded baskets over head or Shoulder.

Osteoarthritis is almost a common problem to mine workers who are engaged mainly for underground work Osteoarthritis in any of these locations stated above can cause pain, muscle spasms, and diminished mobility. In some cases, the nerves may become pinched, which produces radiating pain. Advanced disease may result in numbness and muscle weakness. The condition can cause bone spurs to grow on the edges of the joint. Bits of bone or cartilage can break off and float inside the joint space, which causes more pain and damage.

Osteoarthritis often affects the spine. Usually, damaged disks or joints in the spine cause only mild pain and stiffness. However, osteoarthritis in the neck or lower back can cause numbness, pain, and weakness in an arm or leg if the overgrowth of bone presses on nerve.

Osteoarthritis, the most common joint disorder, often begins in the age group of 40s and 50s. Many people have some evidence of osteoarthritis on x-rays (often by age 40), but only half of these people have symptoms. Internal derangements of the knee joint appear to be prevalent among coal-miners.

A large proportion of miners suffering from acute orthopedic disabilities are treated in the hospital, as well as some of those suffering from the more chronic orthopedic conditions.

However according to Medical Specialists osteoarthritis affects only joints and not internal organs (10)

Different body parts pain in coalminers performing strenuous jobs withPercentage have been ascertained ( Personal survey -June 17 to December 17) .

**Table -5 Disorders(Source:-Regional Hospitals of ECL)**

Type of Workers	Disorder	%
1. Coal Loaders	Neck trouble	18.18 %
2. Coal Loaders& Wagon Loaders	Shoulder trouble	14.54 %
3. Timber/ Rail carrying Workers, Miners Low	back trouble	54.13 %
4. Trammer who pushes Loaded Tubs	Wrist trouble	12.72 %
5. Driller and Underground Workers in general	Leg trouble	29.09 %

The disorder often seen among the workers engaged in pushing coal loaded tubs (Trammer), lifting heavy wooden props ( Timber Majdoor & Mistry) Carrying heavy Drill Machines ( Driller).

In this study 34 out of 55 miners (65.45%) complained about the development of musculoskeletal disorders at different body parts. The maximum pain was identified at lower back. The presence of lower back pain was observed among 54.13% of miners. The prevalence of pain in different body sites of the miners increased significantly with their ages. According to the present study, the repetitive operations and awkward postures were the risk factors for the development of work related musculoskeletal disorders in neck, shoulder and upper limbs; moreover, the repetitive operation of moving heavy substances and stooping postures continuously were related significantly with the development of lower back pain at lower limbs due to the long standing awkward posture. It may be concluded from the above study that Eastern Coalfield miners are suffering from work related musculoskeletal disorders. This condition may be rectified by changing working postures or by implementation of ergonomically designed tools and machineries.

A group of conditions that involve the nerves, tendons, muscles, and supporting structures such as inter vertebral disks. They represent a wide range of disorders that can differ in severity from mild, periodic symptoms to severe, chronic, and debilitating conditions. Work-related musculoskeletal disorders (WMSDs) arise from such risk factors as frequent or heavy lifting; pushing or pulling heavy objects; prolonged awkward postures; vibrations; and repetitive, forceful, or prolonged exertion of the hands

Apart from orthopedic disabilities, problems often found with ear , eyes. nose and throats of mine workers.

iii) Hearing trouble or defect in ears causes due to heavy sound underground during blasting of coal seam. The underground tunnel create huge sound during drilling and blasting . Because of the incessant drilling and usage of heavy machinery, mines are notoriously noisy places; the constant exposure that miners have to the mining equipment can damage their hearing, and even rupture eardrums. Unfortunately many miners do not notice the damage to their hearing until it's often too late. There are other dangers lurking on mine sites, including injury or death caused by falls, and accidents

iv) Occasionally problems do develop in eye and eye sight due to working inthe coal face with the aid of safety lamp. In the darknessthe workers cannot use googols to protect the eyes from coal dust and minor coal particles.

v) Coal dust creates problems in thethroat and nose of coal mine workers. There are also a number of known health risks that miners are exposed to during their careers. Miners in underground mines are at a risk of developing occupational disease or respiratory related issues caused by ventilation hazards and exposure to harmful substances.

Radon is an odorless radioactive gas that can lead to lung cancer from long term exposure. Dust is also a major danger that miners face on a day to day basis. Blasting and drilling creates very fine dust particles in the air which can accumulate in and damage the miner's lungs. This buildup can lead to pneumoconiosis, Silicosis

The unhygienic working conditions in underground mines create healthhazards for the mineworkers and have a major effect on their health. The problem isespecially serious in view of the economic importance of coal mining in India – as asource of energy, in terms of its contribution to GDP, and as a major provider ofemployment.

To find out health condition a study has been carried out in June 2017 in three large mines of Raniganj Coalfield where the number of underground and opencast project workers are considerably high.

**Table 6: Total Work Force and Sample Size in the mines under study**

<b>Name of Mine</b>	<b>Total Work Force Sample Size</b>		
Kajora Underground	1461	238	
Khottadih Underground Mine	1620	267	
Rajmahal OCP	1848	182	
<b>Group of Diseases</b>	<b>KhottadihUnderground</b>	<b>kajora Underground</b>	<b>Rajmahal Opencast</b>
Lung related	45.37	44.94	39.02
Pain	62.18	46.19	56.09
Intestinal Infections	36.28	34.08	20.73
Tension Related	22.33	25.09	23.17
Chest Pain	12.56	10.49	13.17
Dermatological	15.39	11.98	10.97

In a few such studies record of hospital admission and cause of death statistics have been used to create the disease profiles.

The two main disease groups are lung related ailments and different types of body pain. The incidence of intestinal infections and tension related diseases are also high. Feeling of discomfort in different body parts among underground coalminers. Studies have shown that the mining industry had the second highest incidence ratio for low back disorders. Low back disorders are consistently the single leading cause of lost-time MSDs (Shin splints) in Lower limbs were associated with the long standing and awkward posture and prolonged working posture is mainly associated with the development of musculoskeletal disorders. Repetitive operation and awkward posture are the risk factors in the neck & shoulder (Impingement syndrome). The underground coalminers engaged in drilling operations mostly complained about wrist (Wrist tendonitis) and shoulder trouble

**Table 7 Name of Group Diseases and Symptoms in Group**

Lung related -- Asthma, Breathing Problem, Cold Cough, Tuberculosis, Whooping Cough.  
 Pain -- Body pain, Gout, Low back Ache, Spondylosis.  
 Intestinal Infections -- Gastritis, Intestinal Infection  
 Tension Related --Blood Sugar, High Blood Pressure, Low Blood Pressure, Headache, --Vertigo.  
 Chest Pain --Chest pain  
 Dermatological --Skin infection  
 Miscellaneous --Accidental injuries, Diabetes, Ear, Eye, Jaundice, Neurological problem, Renal problem, Surgical cases, Thyroid, Typhoid

**Table 8 Mine workers suffering from various disease**

*Source:-Personal Survey through collection of data from Hospitals of ECL Carried in June 2018*

The public sector coal companies offer free medical treatment to the family members of workers' comprising of the worker himself, his wife, daughter and sons. Though many of them suffer from various diseases as per the hospital records the list of diseases that workers suffer have been listed below:-

Gastrointestinal disorder, Respiratory Disease  
 Ear Disorder Eye problem (Age group from 30 years and above), Anemia  
 Cardiovascular Disease Injury in Mine while working  
 Skin Disease  
 Joint pain  
 Spine, Hip, Knee  
 Other ailment – TB, Jaundice, Typhoid, Neurological problem

Since Periodical Medical Examination (PMEs) are not carried out properly and also due to lack of qualified doctors in this sector the figures of occupational diseases in the mines cannot be ascertained correctly. Many actually don't report to Mine dispensary.

The several thousand miners here must contend with air filled with coal dust. Some say they have developed asthma and other respiratory problems. Others say the environment exacerbates existing health conditions

Chemicals used in mines are often the cause of long term health issues for miners as inhaling dangerous chemicals along with dust can cause terrible long term health issues. Miners also work with heavy electrical equipment which puts them at a risk of electrocution, often caused by working with electricity in a damp environment.

There are also a number of known health risks that miners are exposed to during their careers. Miners in underground mines are at a risk of developing occupational disease or respiratory related issues caused by ventilation hazards and exposure to harmful substances.

Whether it is deep or surface mining there are risks, and in recent times it has been a widely publicized subject, and every year we have more and more information available to us through research and testing.

### **Factors affecting Health of Mineworkers:**

Having established that mining exposes the workers to health problems and adversely affects their health, it is necessary to identify the factors influencing health of the mine workers.

From extensive study it is considered that the following factors can affect health of mine workers.

1. Level of education of the Coal workers
2. Type of job they perform
3. Extent of training in work place
4. Experience of the job
5. Place of work of the worker; and
6. Exposure to the mining environment;
7. Physical fitness

In the following sections an attempt will be made to examine whether and how these factors affects health of mineworkers.

1. Level of education of the Coal workers: Generally the coal workers engaged in manual jobs are mostly illiterate. For earning livelihood they undertake arduous job of underground mine.

2. Type of job they perform:- Besides many jobs related to underground mine the workers are engaged in mainly heavy manual job such as i) carrying on head /shoulder loaded coal baskets and loading unloading in coal tub, ii) carrying timber props for roof supporting,iii) carrying rails for laying lines underground for movement of coal tubs , iv) carrying heavy explosive box, v) pushing of empty and loaded tub, vi) carrying heavy drill machine and for drilling holes in coal seam.

3.Extent of training in work place. The young employees lack training and they take time to adjust with the working environments in the mine though at the initial stage vocational training is imparted to all workers.

4. Experience of the job. Generally workers hail from rural areas and villages. They earn experiences with the passage of time.

5. Place of work of the worker; The place of work has different environment depending upon the depth of the mine, size, production capacity, distance of coal face from pit bottom ( Some time distance is over one kilometer or more considering the age of mine)

6. Exposure to the mining environment;due to their rural background, apathy to work to carry out 6X8 hours laborious work a week, the workers some time feel mentally tired and develop repulsive attitude for drudgery in the work.

7. Physical fitness: Traditionally the local people belonging to backward strata of the society such as Bauri, Kurmi, Dusad,Hanri, Dome generally work as coal loader , wagon loader and their physique is generally thin in their stature, They are usually irregular in the work and mostly addicted to country liquor

Coal mines have workforce from all over the country. For heavy manual jobs the people from Punjab is preferred, for Masonry jobs person do come from Jamtara, Giridhi,of Jharkhand. For Loader's job people fromUP Bihar are found competent as they are physically tough.

### **Deep Coal Mining Community Health Risks (11).**

The health outcomes associated with living in a deep coal mining community are various. Everything from increased rates of lung cancer, respiratory disease, and low birth weight can be linked to communities that are located near mining facilities. Some illness and disease rates (COPD and hypertension specifically) are directly correlated to the number of tons of coal that are extracted from mines. These health issues pose a significant risk to all people located within proximity of deep coal mining facilities.

## Surface Mining Community Health Risks

Communities located within proximity of mountaintop mining sites face a broad array of health concerns due to several factors. The use of explosives at these sites causes a great amount of dust which can affect the respiratory health of nearby communities. These explosives are also created from chemicals which have been linked to poisoning in local area residents. These explosions are also capable of fracturing underground water tables and lead to the contamination of drinking water by heavy metals, mine drainage, and methane gas. Explosions have caused flying debris that have crashed into homes causing structural damage and even loss of life. Also, several of the illnesses associated with deep coal mining are also present in communities located within proximity of surface mining sites.

### Recommendations:

Mining industry has been a topic of increasing attention in the last few decades. The accidents and disasters of the past years due to different causes push for a moment of reflexivity about learning from accidents. The increased interest in improving the safety at workplace has been driven mainly by a series of mining disasters that have occurred in India as well as in the rest of the world

There are numerous measures that have been put in place to try to ensure the safety and health of miners including introducing sophisticated ventilation systems, respirators and ear protectors which have dramatically improved the work environment for many miners worldwide, however the reality is that mines are still dangerous and accidents do still occur.

People should not eat or drink in areas where coal dust is prevalent.

Arrangement of supply of filtered water for the workers has to be made near working face both underground and Opencast Projects

Coal dust on the skin should be washed off as soon as possible, and clothes covered in coal dust should be removed promptly and washed thoroughly.

After and before blasting of coal seam water spray and sprinkling will be important to suppress the dust.

To improve safety position the application of effective risk management has become a requirement in the mining industry.

To avert accident from Roof fall, regular inspection and checking of roof is required before the workers enter the workingface. Where necessary Roof Stitching and Roof Bolting will be essential..

As far as possible proper illumination in underground mines are needed to avoid accidents

Laying of Electric cable need to be done properly and checked regularly so that leakage if any is detected. Necked live wire may ignite trapped gas and become a cause for explosion underground .

To improve safety the application of effective risk management has become a requirement in the mining industry. The application of risk assessment in mines has become important not only for ensuring a safe working environment but, also, it is now a legal requirement.

Coal India Ltd.( CIL) has formulated a Safety Policy for ensuring safety in mines and implementation. If the same is truly followed and closely monitored at several levels then there will be gross improvement in the safety aspects. The safety polices of CIL are:

- 1) Operations and systems will be planned and designed to eliminate or materially reduce mining hazards;
- 2) Implement Statutory Rules and Regulations and strenuous efforts made for achieving superior standards of safety;
- 3)To bring about improvement in working conditions by suitable changes in technology;
- 4) Provide material and monetary resources needed for the smooth and efficient execution of Safety Plans;
- 5) Deploy safety personnel wholly for accidents prevention work;
- 6) Organize appropriate forums with employees' representatives for Joint consultations on safety matters and secure their motivation and commitment in Safety Management;
- 7) Prepare Annual Safety Plan and Long term Safety Plan at beginning of every calendar year, unit-wise and for the company, to effect improved safety in operations as per respective geo-mining needs to prepare the units for onset of monsoon, to fulfill implementation of decisions by Committee on Safety in Mines and Safety Conferences Source Annual Report of CIL(12)

Trade unions have to play a major role in the improvement of the health and safety conditions in the mines. Fortunately, there is a strong trade union in this sector (unlike many other sectors in India). However, they have to perform a critical balancing act between ensuring better health and safety at workplace that does not threaten their jobs. No doubt it is very difficult as Mining Companies always quote their losses as a reason for their inability to invest in health and safety and many a times also threaten privatisation or closure if such things are demanded. The need of the hour is to develop a holistic approach towards safety, which should not mean just more personal protective equipment.

### **Conclusion:**

With the increasing demand of Coal , production will go up in future. While safe mining will ensure safety of workers continuous medical checkup will also protect their health. To bring about improvement in working conditions continuous updating and suitable changes in technology through R&D will be the prime task of the Management. It is also important for the Management to provide material and monetary resources for the smooth and efficient execution of Safety Plans.

To improve safety the application of effective risk management has become a requirement in the mining industry. The effectiveness of mining risk management essentially depends on the risk assessment process, as the output of the risk assessment process helps the mine management to decide upon the control measures to be employed to mitigate the risks



identified in the mine. The application of risk assessment in mines has become important not only for ensuring a safe working environment but, also, it is now a legal requirement. The capability of a risk assessment process depends on the hazard identification phase, as unidentified hazards may lead to unknown and unmanageable risks. Therefore, it is essential to identify all the potential hazards to manage the risks in mines.

Unsafe acts of the worker are the most critical human factors identified to be controlled on priority basis. A significant association of factors (namely age, experience of the worker, and shift of work) with unsafe acts performed by the operator is identified.

There have however been significant strides in recent years to improve the working conditions for miners, and to create a safer, healthier work environment. With the introduction of strict safety legislation and protocol, as well as advances in safety equipment, the industry has seen a significant fall off in fatalities in recent years.

Coal mining, world over, is highly regulated industry due to presence of many inherent, operational and Occupational Hazards. Coal Mine Safety Legislation in India is one of the most comprehensive and extensive statutory framework for ensuring Occupational Health and Safety (OHS). Compliance of these safety statutes is mandatory. The operations in coal mines are regulated by the Mines Act, 1952, the Mine Rules –1955, the Coal Mine Regulation-2017 and several other statutes framed there under.

Unhygienic environment in the working face is responsible for occupational diseases for the workers. The workers who suffer from acute or chronic diseases due to working in the mines for a long period continue to face health problems throughout life. Moreover any death caused due to mine accident is recorded merely as a number in the report and statistics. It however will not speak about the misery of the rest of the members. Such untimely death which causes irreparable loss to the family of the deceased. The story of tragedy will remain untold in the statistics and report. It is the ill fated family who loses the only bread earner either husband of a wife, or son of father, or father of a son or daughter will continue to remember the dear one.

Considering the human aspect it is desired that the persons in the helm of the Management of coal mines will be much considerate to find out avenues to make mine as safe as possible by introducing effective technologies regular mine inspection and ensuring strict safe practices.

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