



Government of India  
Ministry of Labour & Employment  
Directorate General of Mines Safety

DGMS (Tech.) (S&T) Circular No.01

Dhanbad,

Dated 21<sup>st</sup> January 2010

To:

**All Owners, Agents and Mangers of Mines**

**Subject: Respirable Dust Measurements and Control to Prevent Pneumoconiosis in Mines.**

Dear Sir,

It is to bring to the notice of all concerned that an integrated effort is being made by the Government of India to significantly reduce the prevalence of Pneumoconiosis/Silicosis by 2015 and to totally eliminate Pneumoconiosis/Silicosis at workplaces by 2030 in line with the International Labour Organisation (ILO) and the World Health Organisation's (WHO) Global Programme for the Elimination of Silicosis.

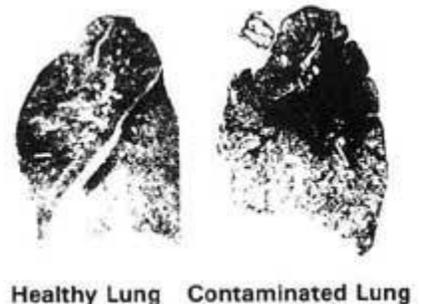
### **Pneumoconiosis**

Excessive or long-term exposure to harmful respirable dusts may result in a respiratory disease called pneumoconiosis. Pneumoconiosis is a general name for a number of dust-related lung diseases including:

- **Silicosis** - Silicosis is a form of pneumoconiosis, a disease of the lungs due to breathing of dust containing silica particles. Silica dust can cause fibrous or scar tissue formations in the lungs which reduce the lung's ability to work, extract oxygen from the air. There is no cure for this disease, thus, prevention is the only answer.
- **Coal Worker's Pneumoconiosis (CWP)** - Coal Worker's Pneumoconiosis (CWP) also called Black Lung Disease is a form of pneumoconiosis in which respirable coal dust particles accumulate in the lungs and darken the tissue. This disease is progressive.
- **Asbestosis** - Asbestosis is a form of pneumoconiosis caused by asbestos fibers. This disease is also irreversible.

### **1.1 Symptoms**

There are several stages of pneumoconiosis/ silicosis. Early stages may go completely unnoticed. Continued exposure may result in the exposed person noticing a shortness of breath upon exercising, possible fever and occasionally bluish skin at the ear lobes or lips. Pneumoconiosis or Silicosis makes a person more susceptible to infectious diseases of the lungs. Progression of the disease leads to fatigue, extreme shortness of breath,

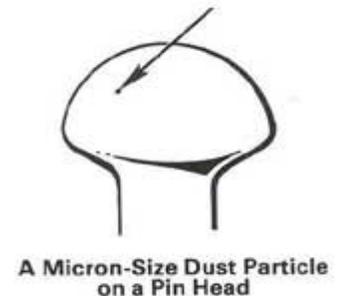


loss of appetite, pain in the chest cavity which all may lead eventually to death. Acute pneumoconiosis or silicosis may develop after short periods of exposure. Chronic silicosis usually occurs after 10 or more years of exposure to lower levels of quartz.

## 1.2 Defining the Dust

A number of materials hazardous to health are present at the work place in the form of aerosols i. e. suspensions of solid or liquid particles in air. Dust is generally understood to be an aerosol of solid particles of size  $0.1\mu\text{m}$  and above. Most of the dusts contain particles of wide range of sizes. Behaviour, deposition and its effect after entry into the human respiratory system depend on the nature and size of the particle.

Dust consists of solid particles carried by air currents. Coal or Rock dust originates at impact points (including drilling, blasting, loading, unloading, crushing and grinding), from previous accumulations, or from weathering. A wide range of particle sizes can be produced during a dust generating process. Larger particles settle more quickly than smaller particles, and the smallest particles can remain suspended in the air indefinitely. Dust is typically measured in micrometers (commonly known as microns). Coal or Rock dust can range in size from over  $100\mu\text{m}$  to less than  $2\mu\text{m}$ . As a comparison, red blood cells are typical  $8\mu\text{m}$  and human hair ranges from  $50\text{-}75\mu\text{m}$  in size.



For the purposes of occupational hygiene, it is important to consider the concentrations of dust present in different size fractions.

- (a) **Inhalable Dust** – It is the fraction of airborne dust that enters the nose and mouth during breathing, and is therefore available for deposition in the respiratory tract.
- (b) **Respirable Dust** – It is the fraction of inhalable dust that penetrates into the gas exchange region of the lung. It is mostly in the size fraction of  $0.1$  to  $10\mu\text{m}$ .

## 2.0 Exposure Limits

In order to ensure that the work place is safe for the workers to work continuously for a period of eight hours in a shift, many studies and investigations have been carried out world over and the maximum exposure limits (MELs) have been prescribed. In USA, MEL is prescribed as  $2\text{ mg/m}^3$  for eight hours time weighted average provided the concentration of silica in the respirable dust remains less than 5%. In case the % of Silica content in the respirable dust exceeds 5, the MEL is calculated to be 10 divided by the % of Silica content in the respirable dust. In India, the MEL is prescribed as  $3\text{ mg/m}^3$  for eight hours time weighted average provided the concentration of silica in the respirable dust remains less than 5%. In case the % of Silica content in the respirable dust exceeds 5, the MEL is calculated to be 15 divided by the % of Silica content in the respirable

dust. It is, therefore essential to determine the concentration of silica in the respirable dust in order to define the threshold limit (MEL) of the concentration of respirable dust at any work place. Regulation 123 of the Coal Mines Regulations, 1957 as well as regulation 124 of the Metalliferous Mines Regulations, 1961 clearly specify provisions therefor.

In many countries, the maximum exposure limits (MEL) for **crystalline silica** in respirable airborne dusts has been prescribed to be  $0.3\text{mg}/\text{m}^3$  for eight hours time weighted average (TWA). However, in most of the cases, it is reasonably practicable to control exposure to  $0.1\text{ mg}/\text{m}^3$  (8 – hour TWA) or less by engineering or process control.

It is advised that the mine management should ensure that the workers are not exposed to respirable crystalline silica dust concentrations above this level. If exposure can not be controlled to  $0.1\text{ mg}/\text{m}^3$  (8-hour TWA) or below, by elimination, engineering or process control, then the exposure must be controlled by provision and use of suitable respiratory protective equipment as provided under sub regulation (4) of regulation 123 of the Coal Mines Regulations, 1957 and that of the Metalliferous Mines Regulations, 1961.

### **3.0 Sampling and Analysis of Respirable Dust Concentrations**

In order to ensure that the work place is safe and free from the risk of respirable dust, it is essential to measure and analyse the concentration of respirable dust at the work places. Specific provisions have been made in this regard under sub-regulation (3) and (4) of regulation 123 of the Coal Mines Regulations, 1957 and the Metalliferous Mines Regulations, 1961. Provisions for static monitoring and portal to portal personal monitoring have also been made under these regulations.

However, it has been found that the determination of respirable concentration of dust requires weighing of the filters and analysis of the silica content therein, which takes time, during this intervening period, the persons are exposed to higher dust concentration levels in cases where the concentration exceeds the threshold level, before any corrective measures and controls are put in place. Advances in instrumentation for dust measurements have been made and Real Time Dust Monitors are now available which indicates the actual dust concentration level on the site of measurements directly but the Silica concentration level is to be determined in the laboratory only.

There are mainly two standard analytical methods for determination of crystalline silica content in the dust that are Infra Red Spectrophotometry and X-Ray Diffraction methods. Standard Methods and Instruments are available for this purpose. Central Institute of Mining and Fuel Research (CIMFR), Dhanbad and M/s. Startech Labs Private Limited, 2nd Floor, SMR Chamber, H. No. 1-58/7, Opposite St. Ann's Junior College, Madaniguda, Serilingampally, Hyderabad - 500 050, A. P. have been approved for this purpose. It is however advised that each mining company having large numbers of mines should have properly equipped and approved laboratory

to assess the dust concentration and free silica in the dust so that the delay, in obtaining the results and follow up actions thereon, is avoided. Detailed Guidelines on the issue of determination of dust concentration at work places in mines have already been provided in the DGMS Circular No. 1 of 2004. Companies owning more number of mines having established such facilities may also extend the services to smaller companies and mines especially in un-organized mining sector.

### 3.1 Sample Survey of Dust Control Measures in Mines

The Science and Technology Wing of DGMS have recently conducted airborne dust survey in some of the mines of Coal Companies as well as Non-Coal Companies during the years 2004 to 2009. During the Survey, the following observations were made:

- (i) The Time Weighted Average Concentration 30m outbye of the return airway in a **Longwall Panel** was found to be 31.40 mg/m<sup>3</sup>. TWA concentrations of dust for Face Crew, Shearer Operator and Helpers measured by Personal Dust Sampler were 5.64, 9.54 and 7.02 mg/m<sup>3</sup> respectively.
- (ii) SDL & Drill Operators at the Face in depillaring districts of underground coal mine were subjected to higher level of dust concentrations when measured by Personal Dust Sampler.
- (iii) In most of the Opencast Coal Mines, dry drilling was being done and the water spraying arrangements were either non functional or ineffective, which resulted into exposure of Drilling Crew, Shovel & Dozer Operators to the level of dust beyond permissible limits.
- (iv) System was not established to measure and control the dust exposure to persons within permissible limits.

In view of the observations made above, it is recommended that –

- (a) The concentrations of dust and crystalline silica content therein should be determined for the strata encountered during drilling in Overburden Benches and also for every coal seam in the mine.
- (b) Wherever there is change in the strata condition, the same measurements should be done at such places also.
- (c) In underground workings, the concentration of respirable dust should also be determined while drilling in the floor as well as into the roof up to a level/depth which are required to be used for roof bolting, cable bolting or for any other purpose.
- (d) Dust Measurements should invariably be done while using new drill bits/picks and while rejecting the bits/picks so as to know the dust generation profile of the drill machines/Continuous Miner or any other cutting Machine.

#### **4.0 Occupation Health Survey and Monitoring**

In spite of the all the best efforts and system put in place in the mine, it has been found that the persons working at places prone to generate airborne dust are exposed to respirable dust beyond permissible limits. Such persons or Group of persons are more likely to get affected with the diseases caused due to airborne dust i. e. silicosis and pneumoconiosis. The cases of such affected persons are detected only at the time of medical examinations which are conducted an interval of five years or on complaints of ailments reported in the hospitals.

In view of the potential danger of dust prone disease existing at the work places/ processes in the mine, it is recommended that-

- (a) The Medical Examination of Identified persons or Group of persons working at places or operations/processes prone to generate airborne dust should be conducted once in every year and the Results of such medical examinations should be correlated with the dust exposure profiles of that place(s) and or process(s).
- (b) During the conduct of Medical Examination of such select persons or group of persons, an Officer of Occupational Health Wing from this Directorate should also be called as an external member.
- (c) In case of any person found suspected for contracting disease due to airborne dust, the case may be reported to this Directorate immediately in the prescribed format (Form V).
- (d) Apart from the above, an independent team of Medical Experts on Pneumoconiosis and Silicosis may be formed by selecting doctors from outside the companies and such team should be entrusted with the work of medical examinations at least once in every year for the above purpose independently.
- (e) The Reports of medical examinations of such independent team should be submitted to this Directorate at the end of every year.
- (f) In case, a person is found to be affected with pneumoconiosis or silicosis, the details regarding his work profile, degree of disability, medical history and expenses, compensation and the status of health and rehabilitation measures taken by the company etc. should be sent to this Directorate immediately in the prescribed Form-VA.
- (g) Suitable Training Module for imparting training to Medical Officers engaged in conducting medical examinations for identification of Silicosis/Pneumoconiosis as per the ILO Classification of Chest Radiograph shall be prepared and conducted once in every year so that the Medical Officers are adequately trained and equipped to identify the cases of Silicosis/Pneumoconiosis without any doubts or ambiguity.

It is, therefore requested to all concerned that a concerted and integrated efforts in line with the above recommendations be made at all levels to ensure that the incidence of diseases due to respirable dust is eliminated from the mining industry.

It is further requested that the expertise and the facilities for dust monitoring and medical surveillance existing in the organized sector should also be extended to unorganized sector mines so that the menace of silicosis and pneumoconiosis is eliminated and the miners are protected from this industrial disease.



(S. J. Sibal)

Director General of Mines Safety