

Dust Generation and Its Separation Method

Hitesh Kumar, Karan Bhatia, Vaibhav Purswani

ISM DHANBAD

bhatiakaran1994@gmail.com

Abstract— Dust control in underground as well as open pit mines has been an area of intense research and study. Dust controlling by dust capturing or dust consolidation and using appropriate method for different causes of dust generation has been the concern of this paper. Dust is generated mainly in every activity of mine from drilling to transportation to using any modern mechanization for ore extraction. Dust generation can cause less visibility more accidents, breathing problem, affects agriculture and vegetation. Various methods deployed for its control and separation does not impact its originator rather reduces its percentage in mine air. Wet drilling, water spraying, ventilation, dust collector and air flow to control the generation of dust have proven profound impact to control dust. This paper embeds the detailed causes of dust, how dust can be reduced in mine air and what can be done to prevent it, if possible.

I. INTRODUCTION

In mining industry, dust is an accepted fact for almost every operation. Many processes like drilling, blasting, haul roads, coal cutting by continuous miner, conveyor belts and crusher houses contributes to dust generation. With an increased level of mechanisation and boost in production, for minimising the supply gap, generation dust is increasing which requires more effective dust control practices. Being a labour intensive industry, more efforts are made to minimise the respirable dust from mines.

If dust is not controlled, it will affect the workers by causing breathing problems and diseases like bronchitis, asthma, TB. It may also lead to accidents if visibility is reduced. Indirectly it will reduce the production if workers and machines are not available.

Dust is controlled either by dust capturing or dust consolidation. Dust consolidation is practised for settled dust as in case of Haul road of surface mines. Dust capturing or dust collector captures the dust which is air borne. It is practised while drilling, blasting, crushing and many other processes.

II. CAUSES OF DUST

A. In Surface Mines

Drilling: Overburden drilling generates most of the respirable dust that affects workers at surface mines. Overburden removal by mobile excavation equipment such as bulldozers, front-end loaders, and haulage trucks can be dusty, particularly under dry and windy conditions.

Blasting: Sometimes with improper charging and detonation, there is huge dust cloud which may effect vegetation and nearby areas.

Haul Road: Due to movement of dumpers and other HEMM, there is dusty environment due to dusty particles of haul road.

Dropping: When dumpers and conveyor drops the rock in the crusher, due to height, dust particles get separated.

Crusher: Crusher breaks the rock into small fragments. While breaking, it generates lot of dust which needs to be controlled.

Conveyor: A conveyor belt can generate large amounts of respirable dust.

B. In Underground Coal Mines

Continuous Miner: Since the working face less opening, when the continuous miner works, it generates a large amount of dust which makes it difficult for operator and other worker to work.

Longwall Mining: Longwall production levels are high, and there are several different sources of dust. 1. Shearer, 2. Shields, 3. Stageloader-crusher and 4. Intake.

Drilling

Blasting

Machinery Movements

Conveyor Belt

C. In Underground Metal Mines-

Road Header: Cutting rock produces dust. As it cuts the rock, so it is also a cause of dust at working face.

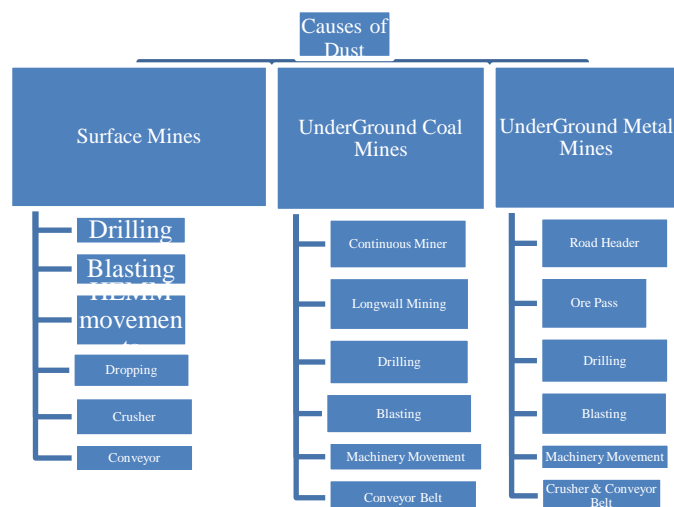
Ore Pass: The broken rock delivered to the passes contains a considerable amount of attached dust from preceding operations such as blasting and loading. The grinding action on the rock as it falls down the pass produces even more dust.

Drilling

Blasting

Machinery Movement

Crusher & Conveyor Belt



III. EFFECTS OF DUST

1. Due to heavy dust cloud in underground mines and on haul road of surface mines, visibility is reduced which results in accidents.

2. Dust may result in damage to the vegetation and agriculture. The deposited particulate matter may block the plant leaf stomata hence inhibit gas exchange, or smother the plant leaf surfaces reducing photosynthesis levels.

3. Besides the impacts on vegetation, health effects of particulates on mine personnel and public may also be significant. The inhalable fraction of dust passes through the nose and mouth, and is easily deposited in the trachea and bronchial section of the lungs. Respirable dust penetrates airways in human lungs, and lodges in the alveolar region. Depending on the chemical and physical characteristics of the particulate matters, there may be significant health effects. Dust containing heavy metals, certain silica and asbestos forms are known to have increased adverse health effects.

4. The corrosive effect of the dust shortens the life of lubricants of HEMM, increases maintenance costs and reduces its operating efficiency.

IV. METHODS TO CONTROL DUST:

A. In Surface Mines-

A. Drilling:

a. Wet drilling: In this method, water is injected into drill hole with a fixed pressure which reduces the amount of respirable dust in air. If pressure is more, it may cause bit degradation.

b. Dry drilling: This method is helpful in winter. In this method, enclosure is constructed by hanging a cloth shroud from the underside of the drill deck. The enclosure is then ducted to a dust collector, the clean side of which has a fan and fan creates a negative pressure capturing dust.

c. Cab Sealing: Enclosed cabs can effectively control the operator's dust exposure.s

B. Haul road: Continuous spraying of water by water sprinkler on haul road is helpful to reduce the dust generated by the movement of machinery.

C. Crusher: Crusher is packed from all sides to avoid flow of dust in free space while cutting. At each stage of crushing, there is exhaust duct which separates the dust (generated while cutting) & takes it out of crusher plant.

B. In Underground Mines(Coal & Metal)-

A. Continuous Miner:

a. Modified Cutting cycle: In this method, machine is sump a foot below the roof and then it is shear down the floor. This is continued for at least 2 shear and miner is then back removing the remaining part. This method not only helpful in removing dust but also gives good control to machine.

b. Remote Control: If machine can be operated by remote control, then an operator can operate it from uncontaminated area. After finishing his job, dust can be removed by exhaust ventilation.

c. Water Spray System: All the water sprayer system are well maintained. Also water is sprayed to the material before discharging into the shuttle car which can prevent dust from the operator.

d. Reduction of Intake dust: Intake dust is often overlooked as a source of dust overexposure. Intake sources may include movement of equipment on dry roads and conveyor belts. So these sources of dust must be controlled.

B. Longwall Mining:

a. Air flow to control dust: The flow of air is raised so as to dilute the respirable dust at the working face.

b. Using Water to Control dust: Dust generated by the shearer is reduced by increasing the quantity of water supplied to the shearer drums, so it is important to supply as much water as possible to the drums.

c. Reducing Dust from stage loader-crusher: The stageloader-crusher can be a major dust source on longwall faces. To reduce this dust, the stageloader-crusher is enclosed with steel plates and strips of conveyor belting. All seals and skirts must be carefully maintained to ensure that dust stays inside the stageloader-crusher enclosure.

d. Gob Curtain to aid air flow: A gob curtain is a brattice curtain installed from the roof to the floor between the first support and adjacent rib in the head gate entry. It prevents air from leaking into the gob, forcing more of the ventilation airflow to make a 90° turn and stay on the face side of the supports. This permits more dilution of dust in the region of the face near the head gate.

C. Drilling:

a. Water: Drill dust is suppressed by injected water, which has been a common practice for many years by this respirable dust is reduced by about 90%.

b. Drill type: If we are using compressed air drill and by chance it is leaked from the front head, it will carry dust out of the hole. So we must eliminate the use of compressed air drill.

D. Blasting:

a. Water: Water is important in controlling dust generated by blasting. The area surrounding the blast (walls, floor, and back) should be thoroughly sprayed.

b. Ventilation: Blasting dust and fumes should be diluted quickly and exhausted to the surface via return route or we can allow contaminated air to flow through working place in absence of workers.

E. Crusher:

a. Water spray: Since there is lot of generation of dust while breaking, so water is continuously sprayed to control the dust.

b. Local exhaust Ventilation: Along with spraying, there is exhaust ventilation to remove the dust.

F. Ore Pass:

a. Water Spray: Dust from ore and waste passes will be reduced if the rock is thoroughly wetted before delivery to the tipping site. More water can be added at the tipping site by spraying the rock as it falls into the pass. However, too much water at ore passes can be objectionable for many reasons. (1) an adverse impact on crushing and milling; (2) accumulation of a large quantity of water on top of the material in the chute, which creates a hazard for workers on the lower levels; and (3) plugging of chutes caused by water-softened clay minerals.

b. Ventilation: Dusty air in the passes can be discharged into a return airway. Discharging air into a return airway eliminates the need to install a dust collector. Also, tipping location should be short because there is some leakage from the doors no matter how ore and waste pass are designed.

G. Conveyor:

a. Wetting of dry belts: Several studies have shown that wetting the bottom (return) belt can reduce dust from a dry belt. It prevents dust from being knocked loose by the tail pulley.

b. Belt cleaning: Conveyor belts are equipped with belt washers and scrapers. When the level of dust is high, scrapers are increased to two or three.

H. Road headers: Road headers are also one of the sources of dust in underground mines. In case of underground coal mine, methane is released with dust. More concentration of dust confining more methane concentration. Dust generated by it can be controlled by locating operator chamber far from cutting boom. Remote control can also work to some extent.

I. Other control methods:

a. Transfer point and crusher must be closed properly.

b. Modern engines and filtration system must be used in diesel operated machines to avoid diesel particulates.