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Dust Diseases

Incidence and Symptoms of Dust Diseases . . Methods of Controlling Dust in Industry

CAUSE and prevention of industrial diseases arising from the inhalation of dust have received very close study in the past 25 years, and mining and industrial organisations have carried out much detailed research and adopted very definite policies in regard to dust control measures. There is a wide range of technical literature on this important subject to which can be added an excellent, brief and concise summary of "Dust Diseases," which appears in the Department of Mines of South Australia, Mining Review No. 74, and which is reprinted below.

In the last 20 to 30 years increased attention has been paid to occupational diseases in various industries. One of these is pneumoconiosis, which is brought about by the inhaling of dust of various kinds into the lungs. The mining and allied industries are particularly concerned with this disease.

Drilling, both hand- and machine-drilling, shovelling broken rock, crushing operations, and to some extent the handling of crushed rock, all produce a certain amount of dust which is suspended in the air. When the air is inhaled a proportion of the dust escapes the protective mechanism of the nose and throat, and lodges in the lungs, giving rise to pneumoconiosis.

The disease takes years to develop but once contracted cannot be cured, although in milder cases it may not incapacitate the workman. The amount and kind of dust taken into the lungs are the two chief factors, apart from the individual characteristics of the workman, that influence the course and severity of the disease. Of the various dusts, silica dust is considered the most harmful.

The fact that dust diseases are usually only contracted after a number of years tends to produce an attitude of indifference towards them, especially in the smaller mines or plants. It is well to remember, however, that the effect of dust on the lungs is cumulative, and that no cure for these diseases is known.

The following points give a general outline of the information available on the subject:—

1. Dust has been defined as solid particles (usually dry, but they may be wet) ranging in size from less than 1 micron (about 1/25,000 in.) to about 150 microns.

2. Dust is definitely a menace in mines and quarries, chiefly because of its effect on the respiratory organs, but also in its action on other internal organs (stomach, liver, kidneys, etc.). The latter phase has not been studied sufficiently for a definite pronouncement to be made on the diseases brought about.

3. The principal dust diseases of the lungs are:

(1) Pneumoconiosis, a general term for all dust diseases.
(2) Silicosis, a condition of the lungs due to the inhalation of free silica.
(3) Silicatosis, a disease of the lungs thought to be caused by silicates.
(4) Anthracosis, a dust disease of the lungs of coal miners.
(5) Siderosis, a diseased condition of the lungs of metal workers, particularly in iron or ores of iron.
(6) Asbestosis, a lung disease caused by breathing asbestos dust.

The generic term "pneumoconiosis" or "dust disease" appears to represent more accurately the common type of dust disease because numerous dusts are usually involved.

4. Silicosis is characterised by fibrotic changes in the lungs which are said to be more clearly noticeable and easier to diagnose than changes due to other dust diseases. The dust of free silica is considered more dangerous than other dusts, chiefly because its victims are thought to be more liable to contract tuberculosis than persons exposed to nonsiliceous dusts.

5. No cure is known at present for silicosis.

It is not always beneficial to remove an affected workman from a dusty job. The progress of the disease is not altogether arrested though it may be substantially slowed down. The rate of slowing would depend mainly on the amount of dust taken into the lungs.

Men suffering from tuberculosis in addition to silicosis should leave dusty work but men in the primary stage of silicosis could remain. They would probably be much better off in the same working places which have been freed from dust, and from which men suffering from tuberculosis were excluded, than in other occupations where no health standards are maintained among the workmen.

6. The symptoms of silicosis are:—Shortness of breath, pains in the chest, cough, spitting material, spitting blood, night sweats, loss of strength, and gastro-intestinal symptoms. Most of these symptoms also accompany diseases caused by other dusts.

7. The most dangerous dust is said to be that ranging in size from 5 microns to 0.5 micron or smaller; the smaller the particles the greater the danger. Particles of these sizes are too small to be seen by the naked eye.

8. Large quantities of larger sizes are harmful, because they tend to clog the mechanism of the respiratory tract and thus allow more of the smaller sizes to penetrate the lungs.

9. The quantity of dust taken into the lungs is all important.

10. The length of exposure to silica dust required to produce silicosis depends primarily on the individual, and the amount and size of the dust particles in the air breathed; but numerous other factors may exert a definite influence.

In the granite industry in the United States of America some workers exposed to the heaviest dust develop silicosis after two years, whereas other do not develop the disease for 50 years. Data collected by the United States Bureau of Mines in one study show that first-stage silicotics had worked underground an average of 12.99 years for all men irrespective of occupation; second-stage, 15.8 years; third-stage, 18 years. In this particular study the shortest period worked underground for a first-stage silicotic was two years, and the longest for a third-stage, 40 years.

11. It is not logical to assume that the harmfulness of dust is in proportion to its free-silica content; no one knows whether a dust of 1 per cent. silica is or is not more harmful than a dust containing 2 per cent. or 3 per cent. Then again, men differ in susceptibility; men working on a contract basis are more likely to become "dusted" than those on day-pay; and the temperature and humidity of the working place would also have a big effect on the harmfulness of the dust.

To attribute harmfulness to dust on the basis of the silica content of the original rock, without due regard for the nature of the rock and the processes through which it goes, is even less logical.

The physical properties of the rock and the crushing appliances have a big effect on the size and quantity of the dust produced, as well as on the proportionate breaking up of the particles of the constituents of the rock. The dust produced from a rock might contain a larger proportion of one constituent than the analysis of the rock would show, if that constituent were more easily pulverised than the others. There is also the point that air-borne dust containing particles differing in specific gravity would vary in composition as the heavier particles settled.

12. No definite, absolutely reliable standards of allowable dustiness are known. If some standards have to be laid down, they should be tentative and flexible.

13. Results have been obtained, however, that show definitely the effectiveness of dust control measures.

"South African Mining and Engineering Journal," vol. 46, p. 11, 1935—comment in the "United States Bureau of Mines Bulletin" 400, on statements in that issue—"The fact that no new miner who entered the industry since 1923 has yet contracted silicosis is encouraging."

"Mining and Metallurgy," July, 1935—referring to Broken Hill (New South Wales) mines and the system of medical examinations for miners which began in 1920—"So far no case of dust disease of the lungs has been detected in a man who has passed the Bureau's initial examination and had done no mining prior to that examination."

14. Measurements of dustiness are made by gravimetric and particle-count methods. Gravimetric methods (for example, using a sugar tube or a water tube) take no account of the size of the particles—a definite drawback, since particle size is very important. It is apparent also that one very large particle may nullify the value of a sample.

Particle-count methods (for example, using a konimeter or a thermal precipitator) deal only with dust within the dangerous limits, but the small amount of air taken in a sample makes the reliability of any one test questionable. Taken in accordance with a standardised routine, samples should give good comparative results, if the number taken is large enough.

15. The South African standard of permissible dustiness is 300 particles per c.c. (8.5 million per c. ft). Dust is said to contain 85 per cent. free silica as quartz.

Wisconsin (United States of America) standard is 15 million particles under 10 microns in 1 c. ft.—silica content of dust 35 per cent.

16. Methods recommended for eliminating dust are as follows:—

Local exhaust ventilation at point of origin, steam and water sprays, ventilation, plant cleanliness, and housing of dusty operations. The various methods and appliances are considered hereunder:—

(1) Fan-Exhaust System—For this system to be effective the crushing plant must be compact, or else be capable of being sectionalised into compact units. The suction will only be efficient if the units are properly housed. It is obvious that, if there are gaps or leaks, the fan will not

drawing its full capacity of dust-laden air ng to the admixture of fresh air from outside.

ome points to remember are:—

Each section should be properly housed and the housing kept in good order.

There should be a minimum number of of exhaust pipes feeding into the main system.

The dust should be collected as near as possible to the point of origin.

Advantage should be taken where possible of any natural currents of air, or currents induced by the movement of the machinery.

The best positions for suction leads are:—

(a) Jaw crusher—on the top side of the chute under the crusher, so as to draw air down through the crusher.

(b) Elevator—on the upper side of the housing, a little above the loading point.

(c) Revolving screens—on the upthrow side near enough to the feeding point to control the movement of dust released there.

(d) Vibrating screens—on the top towards the upper (feed) end of the housing.

(e) Conveyor belts—on the top side of the housing towards the feed end.

2) Steam and Water Sprays—The value of ys should not be overestimated. Although ffect is at times very noticeable to the eye, doubtful whether they remove all the finest cles of dust from the air, and these par- are the most dangerous.

e advantage of sprays is that they can be d almost anywhere, but the disadvantages hat the effect is local, by no means perfect, not long-lasting. In summer time especially, may be caught up in the spray only to be sed not far away owing to the evaporation e water.

rays are useful in the feed bins, over a jaw er (there is often a certain amount of ng of the feed; a spray will control the ant dust which may be temporarily too for, say, an exhaust system), around s (steam sprays), in dead ends and corners re difficult to ventilate, and at the foot of vator, especially if the elevator is housed.

Ventilation—Where a plant is situated in ding, care should be taken to arrange the ation so that dust-laden air is carried away he places where men have to stand while ng.

Cleansing of Plant—All accumulations of hould be removed from the floor and work of the plant buildings, preferably after a thorough wetting. On windy days, in open plants, dust raised by the wind can be much worse than that being produced at the time by general operations. A periodic spraying of the walls and floor of a building will help in keeping the atmosphere clean by providing wet surfaces on which dust will stick.

(5) Housing—With a fan-exhaust system housing is essential. In the absence of such a system much good can be done by housing, particularly if supplemented with other dust-allaying methods, such as water sprays.

In any case elevators should be housed, as well as screens, chutes and conveyor belts. It may be possible to house one whole section of a plant with advantage. This might be done in a section that requires only an occasional inspection.

(6) Respirators—Though respirators do not afford the wearer absolute protection at all times, the use of them should be encouraged. The discomfort caused by wearing them continuously is against their use for many jobs; but for short periodic inspections of dusty processes they are very well suited.

Piezo Quartz Crystals

Of all the many crystalline substances which have piezo-electric properties only rochelle salt, tourmaline and quartz are suitable for commercial use. Tourmaline is little used because the crystals are scarce and expensive. Rochelle salt crystals can be prepared as required, but quartz is particularly useful as a source of large crystals from which slabs, rings, plates, bars or rods can be cut to meet specific requirements. Resonators and oscillators containing piezo-electric quartz are useful in depth sounders, submarine detectors, directional submarine signal devices, radio apparatus, range finders, direction-reading seismographs, periscopes, gunsights, and other instruments. Twinned quartz crystals are unsuitable because they are not piezo-electric. It is also necessary to reject some crystals because of electric twinning which is about as common as optical twinning but cannot be detected until the crystal is tested for piezo-electric response. It destroys the asymmetry and hence the electrical response of the crystal. True piezo-electric quartz crystals are mostly imported from Brazil but they occur in many places. They also find applications in optical goods, scientific instruments and fused silica ware. Hence there are other outlets for crystals which are not piezo-electric.—Abstract from paper " Piezo Quartz" by Alfred W. G. Wilson, Canadian Mining and Progress Industries, 1942.