FILE NAME: Visible Dust (VDT)

DATE: 1937 June

DOC#: VDT005

DOCUMENT DESCRIPTION: Article from Trade Journal

Commercial Union Insurance Co [redacted]

# OCCUPATIONAL DISEASE HAZARDS

## ANTHRAX

Anthrax is a contagious disease, common to man and most domestic animals, and transmitted by the skin or hides, hair, wool, or bristles of infected animals to man. With human beings it appears in two forms; first, on the skin and second, infrequently within the body. The disease is found in cattle, sheep, goats, horses, and pigs, especially those from foreign countries. It may occur in carpet mills, leather industries and tanneries, among brush makers, plasterers, felt makers, rag pickers, mattress makers, veterinarians, farmers, butchers, longshoremen, freight handlers, and occasionally in persons outside of any industry. It may also be found in connection with the preparation of skin in fur manufacturing.

The infection in the skin occurs, in a great many cases on the exposed parts of the body, such as the face, throat, neck, chest, hands, and forearms. The germ lodges in a cut or break in the skin and is rubbed in by the worker's dirty hands or the rubbing of clothing. It is particularly difficult and stubborn to correct and requires competent medical attention. The first step in the control of the infection is to use only hides, and skins from non-infected areas. Disinfection, by satisfactory methods, should be made of the hides and skins that have entered the country and are known to be from anthrax infected countries.

The usual course of an epidemic of anthrax, is that every year or so in the large leather tanning centers there are one or two cases which may be fatal. Immediately, after this there is considerable investigation and the greatest of medical precautions are taken for a short time. After a period in which the utmost precautions are observed, the scare dies down and the industry returns to its normal operations and no notice is taken until there is another outbreak. Due to the comparative rarity of anthrax it is difficult to maintain observance of, all the safety precautions.

Some of the methods for the prevention of the infection from anthrax are as follows:

1. Remove all visible factory dust by means of mechanical exhaust at the point of origin.
2. Dispose of the dust collected by burning.
3. Make provision for a first aid kit with sterilized dressings, bandages, cotton, and a 2% solution of iodine.
4. Post a notice as to anthrax and its prevention.
5. Provide overalls for all workers exposed to the hazard.
6. Have lunch room separate from workroom.
7. Provide adequate washing facilities, hot water, soap, etc.
8. Have employees keep work c[redacted] from street clothes.
9. Provide good, natural ventilation with sunlight wherever possible.
10. Instruct the workmen to prevent contact of hides with the bare skin.

1937

## ASBESTOSIS

A potential asbestosis hazard is to be looked for wherever asbestos dust is created. Among the possible sources are the mining and milling of asbestos, and the weaving, machining and the mixing of asbestos and asbestos compounds. Industries which have this exposure are insulation, brake lining and gasket manufacturing.

One of the most common operations where asbestos is used is in the manufacture of patch material for roofs. The practice is to dump the asbestos into a putty chaser with asphalt and the two materials are mixed together. There are a number of small plants that do this type of work without any particular attempt to control the dust.

While it is true that fewer workers are exposed to asbestosis than silicosis, it is a definitely important occupational disease hazard and should be considered as such. In the opinion of certain authorities it is established that asbestosis may cause disability and death, and that any well defined case of asbestosis is very likely to progress to a fatal conclusion. The pathology of asbestosis differs markedly from that of silicosis. The dust particles being larger, the damage is to the bronchioles rather than to the alveoli, the latter being too small to admit any large proportion of the particles. The fibrosis of asbestosis is characterized by the formation of so-called "Asbestos Bodies", a phenomenon quite different from any found in silicosis. The symptoms of asbestosis are generally similar to those of silicosis, particularly as regards a gradually increasing dypsnea (shortness of breath). Prolonged exposure to asbestos dust caused a pulmonary fibrosis of a type different from silicosis and demonstrable on X-ray films. Cases of definite heart enlargement are frequently found associated with asbestosis. A predisposition to tuberculosis does not appear to be caused by exposure to asbestos dust. It is not believed that asbestosis may add to the mortality of pneumonia, and acute non-tubercular pulmonary infections. The concentration of dust in asbestos fabricating plants depend primarily on the grade of asbestos; mill fiber gives rise to a higher concentration than crude fiber. Operation arranged in decreasing concentration of dust are preparing, carding, weaving, spinning, twisting and warping. The control is rather difficult but

CU000011

(Okonite Discovery)

it is important that all new employees be examined physically, including X-ray examination of the chest.

Inasmuch as exposure to this dust will cause enlargement of the heart it is also important that men with weak hearts should not be exposed to asbestos dust.

Some of the methods used to minimize the hazard from asbestosis are as follows:

1. Remove all visible factory dust by means of mechanical exhaust at the point of origin.
2. Improve the general plant ventilation by fans in the roof or sidewalls.
3. Physical examination of new employees and periodically for the older employees. This recommendation should be discussed with the Claim Department.

## BENZOL

Benzol is a volatile, inflammable, almost colorless liquid with a strong sweetish smell. It evaporates very easily and makes a very good solvent for gum, resins and fats. Its vapors are heavier than air. It is also called benzene, but it must not be mistaken for benzine, which comes from petroleum and is much less harmful. Benzol comes from coal tar.

Benzol is used in industries in the manufacture of rubber cements, lacquers, varnishes and stains, paints and varnish removers, in the chemical industry, in cleaning of printers rollers, engraving plates, etc., in the manufacture of rubber goods, artificial leather, sanitary tin cans, oil cloth and linoleums. Also, at times it may be present in connection with the manufacture of airplanes, rubber reclaiming, phonograph record manufacturing, imitation leather and pyroxylin manufacturing, including such substances as viscoloid, fiberloid, and celluloid. It is used very extensively in the manufacture of dyes and is the starting point for a good many of the dyes and explosives. While much has been done to eliminate the use of benzol as a solvent or to control it in many industries, the use of benzol as a raw material in the manufacture of nitro-benzene, aniline and the other various dye intermediates will probably increase rather than decrease. There can be no substitute recommended for its use in connection with the manufacture of dye intermediates.

Poisoning usually occurs by the breathing of benzol fumes. When these are drawn into the lungs, benzol is dissolved in the blood and carried through the body. Acute poisoning occurs when large amounts are breathed in a short time. The nervous system is poisoned and the breathing apparatus paralyzed. Smaller amounts breathed over a period of time cause chronic poisoning which weakens and thins the blood. This type of poisoning is more common in industries. Benzol is also a skin irritant. It may be absorbed through the skin and the most common instance in industry is where the material is spilled on the clothes and no attempt is made to remove it.

The control of the benzol hazard depends upon the prevention of inhalation or skin absorption of the material. The following practices should be put in operation wherever possible:

1. *Don't use benzol.* This is often the simplest means of control. It is possible many times to find that another solvent may be used and the hazard completely eliminated. The dye and explosives industries are, of course, the exceptions to this general rule. Toluene is one material that might be used as a substitute. It is poisonous, but much less toxic than benzol. High boiling petroleum fractions also provide a non-inflammable, non-toxic substitute for benzol. In seeking to eliminate the hazard from benzol this recommendation should always be given careful consideration, and it will be found that in a majority of cases a suitable substitute can be found.
2. Remove benzol fumes at point of origin by exhaust ventilation.
3. Keep tight covers on receptacles containing benzol.
4. Do not allow articles treated with any compound containing benzol to dry in workrooms unless the vapors are removed.
5. Make drying chambers for materials treated with benzol mixture as gas tight as possible, and have the air pressure inside the chambers slightly less than that outside.
6. Spray objects with a paint mixture containing benzol only when they are in properly constructed and ventilated booths.
7. Inspect carefully pipe lines and other apparatus containing benzol to detect and prevent leaks.
8. Provide positive pressure helmets for workmen who repair leaks, enter benzol tanks or use any mixture containing benzol in a confined space.
9. Supply rubber gloves to workers in contact with liquid benzol.
10. In arranging exhaust ventilation remember that benzol fumes are heavier than air.
11. Test the concentration of benzol fumes in the air of work-rooms. Benzol should not be allowed to exceed one hundred parts per million of air.
12. Provide medical supervision for workers with benzol. This should be discussed with the Claim Department.
13. Transfer workers to other departments if benzol affects them.
14. Have a complete physical examination made of each employee, including a blood examination, before this employee works with benzol.

from dust containing free silica and serecite (white mica) although no inorganic dust should be considered as non-hazardous until definitely proved so.

*Asbestosis* is a disease, in some respects similar to silicosis, caused by the inhalation of asbestos fibres. Its clinical features include the slow development of a characteristic type of fibrosis (fibrous tissue). Because asbestos dust consists of fibres, it does not penetrate as deeply into the lungs as does silica dust, and, instead of killing the migrating cells (phagocytes) it lodges in the walls of the bronchioles (air passages) producing fibrous tissue which tends to constrict these passages. Infections, such as tuberculosis, are not so frequent as with silicosis. Asbestos fibres may constrict the blood vessels in the lungs, resulting in an overtaxed heart and heart trouble. An individual may be free from symptoms for a number of years, although exposure of a very few years has produced definite symptoms. The prevention of asbestosis must be accomplished through dust control measures.

*Anthracosis* and *siderosis* are types of pneumoconiosis resulting from the inhalation of coal and iron ore (siderite) dust respectively. In the absence of silica, these dusts produce a fine diffuse fibrosis in the lungs, accompanied by pigmentation — black and red respectively — due to the color of the substances. In neither case does disability result. From a practical standpoint, dust in hard coal mines usually contains free silica and may produce anthraco silicosis. Most hematite ores are associated with free silica and can produce disability.

It is generally considered that the development of these forms of pneumoconiosis is based on these factors: (1) The concentration of dust in the air: (2) The proportion of the free silica or asbestos (as the case may be) in the dust: (3) The length and continuity of exposure. There may also be individual susceptibility, but, from an engineering standpoint the first three named factors are the principal ones.

This, therefore, means that the higher the proportion of free silica (quartz) or asbestos in the dust of the air that is breathed, the lower should be the total concentration of dust. On the other hand, if the silica or asbestos content of the dust is low, it is believed that higher total concentrations of dust can be breathed without physical impairment. However, there is an upper limit of dustiness, irrespective of the nature of the dust, beyond which certain types of lung conditions may develop if this dusty air is breathed. This limit is at present considered to be 50,000,000 particles of dust per cubic foot of air.

PART II

Silicon is one of the most abundant elements in nature. Free silica is silicon dioxide ($SiO_2$) as differentiated from physiologically inert silicates which are metal salts of the hypothetical silicious acid (i.e. $Ca\,SiO_3$, $Ca\,Al_2\,Si_2\,O_8$). It occurs either as a principal constituent or as an impurity in most ores, rocks, clays, sands, and other inorganic substances of industrial importance — the higher the percentage of silica the greater the health hazard.

QUARTZ, QUARTZITE, FLINT, CHERT, TRIPOLI, DIATOMACEOUS, EARTH, SAND, AND SANDSTONE, (S) are the most common forms of silica, varying only in creptalline form and occurrence in nature.

A reasonable standard of permissable dustiness for inert dusts is as follows:

| | Million particles per cubic foot of air |
|---|---|
| When associated with no quartz | — 50 |
| " " " low " | — 30 |
| " " " 30% " | — 15 |
| " " " 100% " | — 5 |

these standards are *purely arbitrary*, being based on experience plus slight medical evidence.

ASBESTOS is a fibrous mineral widely used in industry. CHRYSOTILE ($H_4\,Mg_3\,Si_2\,O_9$) is its most common form. Certain varieties of *Tremolite, Amphibole, Serpentine* and *Anthophyllite* are also known as Asbestos, although of lesser industrial importance. The handling of asbestos generates a dust compound of fine fibrous particles which when inhaled over a period of time, may cause asbestosis.

GRANITE dust contains about 30% free silica and is one of the worst offenders in the causation of silicosis. The frequency of silicosis, tuberculosis, bronchites, pneumonia and other respiratory ailments is abnormally high among workers exposed to granite dust.

MARBLE AND LIMESTONE are composed principally of calcium carbonate which is physiologically inert. Unless silica is present in excessive amounts, this class of rocks may be considered relatively non-hazardous.

CHALK mostly calcium carbonate of fossil origin may be included in this group.

SANDSTONE, a rock consisting mainly of particles of quartz sand cemented with silica, is used in grinding wheels and in building material. Its high silica content renders it a definite occupational disease hazard.

MICA AND SERECITE (White Mica) are possible offenders as causes of silicosis. Wherever possible, the use of sand containing needle-like crystals of serecite should be avoided.

GYPSUM, PLASTER OF PARIS are principally Calcium sulfate and do not present a serious hazard.

CARBORUNDUM (Silicon carbide, Si C) ALUNDUM, ALOXITE, CORUNDUM (Oxides of Aluminum) are widely used as artificial abrasives, especially in grinding wheels. An investigation revealed no unusual hazard in breathing the dust of these substances.

COAL OR CARBON dusts, in the absence of free silica may produce a mild fibrosis with discoloration of the lungs, but are not disabling.

CEMENT DUST usually contains from 1% to 6.5% or more free silica. The frequency of respiratory ailments among workers exposed to cement dust (dustiness ranging from 22 to 63 million particles per cubic foot of air) is about twice that of workers in non-dusty trades.)

TALC (Soapstone) is used in toilet powders, as a filler in paper manufacturing, in slate pencils, etc. Talc usually contains impurities especially tremolite. Talc dust containing 40% or more tremolite may induce a fine diffuse bilateral fibrosis of the lungs which is demonstrable in the X-ray. In the absence of free silica it cannot be said to be disabling.

SLATE dust reacts in a manner similar to high-tremolite talc.

GEORGIA TALC dust containing only 10% tremolite with traces of free silica has produced a high frequency of pneumonoconiosis and tuberculosis.

ORGANIC DUSTS (Wood, fur, textiles, leather, etc.), are not pneumonoconiosis producing but may exhibit irritating or toxic properties, depending on the nature of the substance.

## DUST CONTROL

In industrial hygiene work, the following are the chief factors in determining the dust hazard.

1. The nature of the dust
   - (a) Its composition
   - (b) Its particle size properties
2. The concentration of dust in the air
3. The degree of exposure of the workers to dusty air
4. Its physiological action, whether it is
   - (a) Physiologically inert
   - (b) Capable of producing an allergic reaction (hay fever)
   - (c) Toxic — (lead, etc.)
   - (d) Capable of producing pneumonoconiosis

Dusts are solid particles generated by the mechanical disintegration of solid organic or inorganic materials. A dust cloud may be composed of billions of particles of varying sizes and shapes, each visible particle accompanied by many minute particles visible only under the microscope. As the dust is generated the larger particles settle out with a velocity depending, among other things, on size. The smaller particles settle out more slowly and may be caried throughout the plant by air currents.

In a material of uniform properties, the average particle size is the same as the size of the individual particles, and a chemical analysis by weight can be applied numerically.

In an industrial dust cloud, however, there is a wide variation in the sizes of the individual particles. One large particle of quartz will weigh more than one hundred small particles of feldspar. A chemical analysis reported by weight will show the presence of over 50% quartz, by number, less than 1%.

In occupational disease work we are interested in the number of particles of quartz less than 10 microns in size per cubic foot of air, since the frequency of respiratory diseases was correlated to numerical dust counts.

Because of the difficulty in distinguishing free silica from combined silica, chemical analysis must be accompanied by petrographic analysis in which minerals are identified by their optical properties.

Dust particles in the air may contain a positive or negative electro-static charge. The attraction between particles of opposite electrical properties causes them, upon contact, to cling together, a process known as flocculation. Flocculation increases the settling rate of a dust cloud.

In dealing with this problem, a dust cloud must be visualized as a suspension of non-uniform particles of constantly varying size, percent composition, of irregular concentration and unpredictable behavior.

The first step in dust control work is to determine the concentration of dust in the air, involving the collection of dust from the air and its quantitation by laboratory means — making dust counts.

Dust counts are reasonably accurate approximations of the number of particles of dust contained in a given volume of air. The information, when obtained, merely signifies that at that particular instant and location, the sampling device used collected the determined amount of dust. A sample taken shortly afterwards under different weather conditions, or in a slightly different location will vary considerably. An instrument sampling small volumes of air will produce a greater percentage of error than will an instrument sampling large volumes of air.

To obtain a representative picture of conditions, it is necessary to average the results of a number of large volume samples taken in the same spot over a long period of time, employing an instrument of known efficiency against all particle sizes of the given dust.

When dust in the air is visible we know the hazard exists, when not visible, dust counts should be employed.

The earliest practical instrument for sampling dusty air was the Konimeter (dust meter) developed by engineers in the South African mines. A measured volume of air is drawn by a small hand piston through an orifice and impinged at high velocity upon a circular glass plate which is usually coated with a film of gelatin. The dust in the air sticks on the plate in a spot roughly circular, and can be counted directly through the attached microscope. While this instrument is of low efficiency and can sample only very small volumes of air, it can take 30 samples on one plate, is compact, and obviates the necessity of laboratory counting. It was used successfully in South Africa as a comparative instrument, and aided materially in South African dust control work.

The *Owens meter* was first used to sample atmospheric dusts. A hand piston draws the dusty air through a tube lined with wet blotting paper which serves to humidify the incoming air. The air passes through a slit orifice, and expanding, is chilled, causing the moisture in the air to coat the dust particles with water. The coated particles are impinged on a small cover glass, opposite the orifice, in the form of a ribbon. The particles in this ribbon are counted under a microscope, usually employing oil immersion methods. The Owens jet meter is very efficient for extremely fine dusts. For industrial dusts it is about 40% efficient, but its compactness and simplicity render it invaluable. Like the konimeter it takes small "grab" samples and unless used properly may give misleading results. The principal disadvantage of the Owens instrument is that a new cover must be inserted for each sample, and in changing, exposes the clean slip to contamination from dust in the air. A variation of the Owens meter will be brought out shortly in which many samples may be taken without changing the glass plate.

BAUSCH AND LOMB DUST COUNTER — This is an ingenious improvement on the Owen's Jet Meter that has just recently been put on the market. It counts the particles by the dark field technique which give much higher results than the impinger. The chief objection at the present is that it gives abnormally high results in the presence of smoke which constitutes little hazard. It will doubtless be improved or modified in the near future.

The standard method of dust sampling in American (U. S. Public Health Service Technique) employs the *Greenberg-Smith impinger* apparatus. This method is invaluable because it was used to establish correlation between dust conditions and the frequency of respiratory diseases.

Dusty air is drawn, at constant rate, through a glass tube and impinged against a flat plate immersed in water. The force of the impingement coats the dust particles with water and they remain suspended in the liquid. The clean air passes out through a baffled tube. Suction is supplied by an electric suction pump or by a compressed air ejector. A known volume of the dusty water is placed under the microscope and the particles counted.

The advantages of the impinger apparatus are that it samples large volumes of air, can be left running for hours without attention, and is the standard method for this country.

Its disadvantages are that it is bulky and hard to transport, is fragile and expensive, and dusts so collected cannot be measured directly.

There are two instruments claimed to be 100% efficient, the *electric precipitator* which utilizes an electric field to deposit the dust particles on a celluloid cylinder; and Green's *thermal precipitator*, utilizing heat waves for the same purpose. Of these instruments, one is useful in the laboratory only and the other is still in the early stages of development.

Several short-cut methods of sampling and comparative quantitation are available for routine plant operation.

There are four general methods of dust control arranged below in order of their effectiveness.

1. Substitution of Process
2. Isolation of Process
3. Removal, dilution, or suppression of dust at its source
4. Respiratory Protection

In many plants, materials containing silica are used in dusty operations for which non-silicious materials may be substituted. For example, in sand blasting, the use of metal abrasive instead of silicious sand will reduce the dust hazard considerably. Flint, used in packing kilns, may be replaced by another less hazardous material. Sometimes a dusty operation or a defective or dusty machine may be replaced by another with consequent increase in efficiency and decrease in dust dispersion.

If substitution is not feasible it may be possible to isolate the process either by use of a separate building, a sealed enclosure, or by carrying on the operation at night when fewer workers will be exposed. For example, the shaking out of large castings in a foundry may be done at night by a few well protected men, thus preventing all other workers from inhaling the dust during the day.

The most practical method of dust control is that of (1) suppression, (2) dilution, or (3) removal at the point of generation.

It is possible to produce dust without dispersing it and a non-dust producing operation may disperse accumulated dust from other operations without producing any of itself. The actual mechanical force that generates the dust is not sufficient to project the tiny particles very far into the air. It is the vibration and air motion inci-