PLAINTIFF'S
EXHIBIT
TPI-683

TOXIC DUSTS

Their Origin and Sources in Various Industries

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THE SUBJECT assigned to me presupposes that many industrial diseases are produced through contact with or inhalation of industrial dusts of a toxic nature. Personally, I do not believe that the consideration of occupational disease prevention should confine itself to dusts alone; it should include all materials produced in such manner that they may be inhaled by a worker. The question of whether a material exists as a gas, a vapor, or a dust is but one of particle size and chemical make-up; but with materials whose source is in industry, it does not seem fitting to stop with substances commonly known as dusts and thus fail to consider those which usually exist as vapors.

It is a common fault to focus attention upon one object to such an extent that others of equal importance are thereby relegated to obscurity. For the present, pneumonoconiosis, or more particularly silicosis, occupies the center of the stage and possibly for the purpose of this meeting such importance is justified. However, the engineer interested in the control of occupational disease by plant equipment and operation must not forget that there are many occupational diseases produced through exposure to industrial dusts other than silica-bearing ones and to vapors, and that the control of these industrial diseases may be brought about through the application of the fundamental principles which will be propounded by other speakers today. At present and until new avenues of control are discovered, explored, proved, and utilized, the problem in many instances seems almostl acking a complete solution, but it is unquestionably true that certain occupational or industrial diseases need not occur. The engineering aspects of their control are so well known that in the hands of capable plant officials there can be little excuse for their occurrence. In the control of such diseases, industry today faces a problem, the solution of which rests in the hands of the scientist, the physician, and the engineer.

While the generation of dust in various types of industries has a more or less common mode of origin, namely, the production of finely divided material, yet it does not seem fitting to group industries together even though the operations producing dust are somewhat similar. Therefore, in this paper, operations will be discussed as individual to a general industry rather than as individual unto themselves and assigned to many industries. While this may produce some repetition of material, yet for the sake of those engineers who are especially interested in an individual industry, I feel the paper will have added value.

QUARRY OPERATIONS

Although the exposure in a quarry due to dust varies in severity based upon the chemical composition of the material being quarried, most operations are similar. Drilling operations, both well and small-bore, produce voluminous quantities of small particles of the material in which the operations occur. Air-flushed drills distribute these particles over a wider area than do water-flushed drills, but the offal from water-flushed drills dries and then becomes distributed in the air. When crushers are operated, either gyratory or jaw, dust is produced in an amount depending mainly upon the size of the unit involved and upon the fineness of the material which is being processed.

Sizing and screening operations also distribute dust, although they may not in themselves be producers.

SHAFT SINKING, TUNNELING, EXCAVATION, AND DEMOLITION

Drilling operations in all such activities afford opportunity for dust generation. Again, the exposure depends upon the type of rock encountered. Transportation of materials to and from the face or working area also allows dust to be distributed. Steam-shovel work in excavations exposes workers to dust clouds. In demolition work, the pulling of walls, the dropping of floors, the loading and unloading of debris causes the generation of much dust. Blasting operations when required not only generate dust through the action of the explosive itself, but may precipitate other settled dusts by the shock transmitted to the surrounding structures or areas.

STONE DRESSING AND FINISHING

When this activity is in conjunction with quarry operations, the same quarry items previously listed pertain. Stone dressing and finishing is probably one of the most prolific sources of dust known. At least the exposure is one of the most serious due to the intimate personal contact of employees to the area in which the dust is generated. Stone dressing promotes much hand-tool labor.

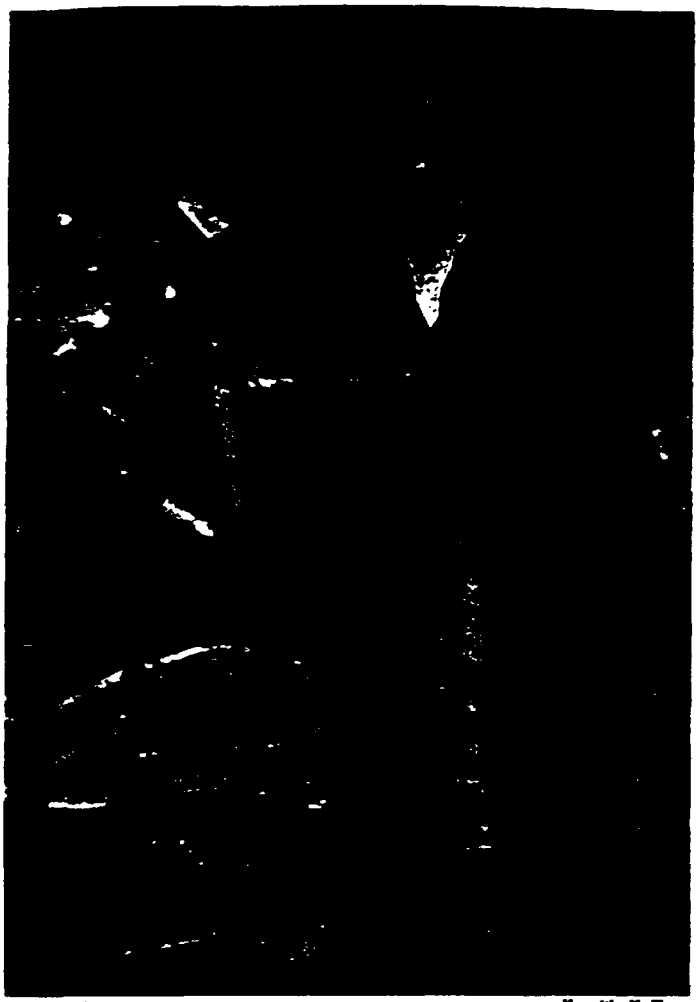
Surfacing work, both hand and machine, produces quantities of fine dust. Sawing, cutting, and channeling, as well as drilling, are also prolific sources of contamination. Hand chiseling produces a certain amount of fine dust but in this work the larger particle sizes usually predominate. Hand polishing produces some dust but only a very small quantity as compared to a mechanical polishing mill or jack. Even when wet polishing is done, the quantity of dust is only slightly reduced. Sandblasting operations, if not isolated, are dust producers. Such dust generation is cumulative, as the abrasive material is broken and forms a dust in conjunction with the material which is being blasted and eroded.

In addition to the operations indicated, workers themselves create a dust hazard by the blowing, by means of a compressed-air nozzle, of dust which has accumulated around the tools or operations.

BUILDING CLEANING

The cleaning of buildings by hand or machine may be considered a dusty operation. This is particularly true when sand blasting either by air or steam is employed. The seriousness of the hazard somewhat depends upon the type of material being cleaned. Naturally, this is additive with the dust from the sand used for blasting purposes.

Contributed by the Safety Committee and presented at the Annual Meeting, December 3 to 7, 1934, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.



Nesmith, N. Y.

ELIMINATING DUST IN ROCK DRILLING

(The drill operates through a dust collector consisting of a metal cap connected by a hose line to a suction tank and dust catcher.)

MINING

The more common forms of mining are coal, feldspar, glass, sand, metals, mica, refractory materials, and talc. In any form of mining, dust is produced in the use of drills and excavation machinery. This is true even in open-pit work. The exposure varies according to the rock encountered. As in other cases, the use of wet tools does not entirely eliminate the generation of dust.

SAND AND GRAVEL DIGGING—FLINT AND SPAR MILLING

These two operations are oftentimes associated. Underwater sand and gravel production is relatively non-hazardous but the sizing and screening operation, even though upon moist material, may be a source of dust generation as the fine particles will collect on machines, ledges, and parts of the buildings and later be swept into the air.

When flint and spar milling is carried on either in conjunction with sand and gravel digging or with any other source of raw stock, the hazard varies, as has been previously stated, according to the composition of the material being handled. Practically all operations are sources of dust contamination. Primary crushers, either gyratory or jaw, produce dust; secondary crushers, screens, jigs, air separators, conveyers, and other types of machinery generally produce dust in air to a greater or less extent. Bagging, packaging, and shipping either as individual items or as bulk may produce dust. Spoil heaps unless salted down may generate dust when the ordinary land breezes blow over them.

CONCRETE PRODUCTS AND ARTIFICIAL-STONE MANUFACTURING

Mixing operations are dust producers in this type of industrial activity. Finishing operations if by sandblast or hand tools also produce dust.

BRICK MANUFACTURING

In the manufacture of brick as well as tile and terra-cotta articles there are several sources of dust generation. The clay-drying department, whether natural material is used or a mixed slip is used, produces dust when the dried materials are thrown into the air through handling. The dropping on the floors of small quantities of material allows it to become dry and then be dispersed in the air by workers walking or by transportation. Mixing operations give off dust. The operation of pug mills and brick molders may generate dust through the drying of the waste material. Storage departments may be a source of dust occasioned through the handling of material.

CEMENT AND LIME MANUFACTURING

When operating in conjunction with a quarry or mine, previous sources of dust listed under such headings apply. In addition, all crushing operations produce dust. The charging operations to burners either hand or mechanically done will create dust. The operations of the finishing and packing department where bags and barrels are packed, closed, crated, and shipped are a source of dust generation.

FOUNDRIES

The exposure to dust in foundry operations varies only slightly according to the type of foundry. A non-ferrous foundry may be little if any different on an overall exposure from a ferrous foundry. Sand-conditioning operations produce dust. The use of sand cutters or blenders, screens, riddles, slingers, grab buckets, and other conditioning machinery or operations may create dust. In molding processes the general work on the molding floor or the use of sand throwing and blowing machines may produce a hazard. The application of parting compounds to the mold may create a dust. This situation is naturally more serious when the parting material used is of high free-silica content.

Shake-out procedure, rattling and tumbling with or without air, sand-blasting, grinding, and snagging are dust-producing operations. Scratch-brushing work may generate dust.

As previously mentioned, sand-blasting generates dust under any circumstances. Charging operations in loading a cupola or any other type of furnace may generate dust in the immediate vicinity and later contaminate the remainder of the premises. The storage of raw stock, such as limestone, coal, sand, and pig stock, may through handling generate additional dust.

METALS REFINING—LEAD

In addition to the exposures enumerated under mining and ore production, there exist in the refining operation dusty exposures. Furnace operations, such as charging and drawing, generate dust. This is particularly true when all or portions of the charging material consist of scrap, such as storage-battery plates. Trucking of such may screw the fine material on the ground or floors where it may be picked up and thrown into the air by walking or by the wind. Skimming, reheating, and

sampling operations produce dust. The handling of the collected material in bag houses, flues, or Cottrell precipitators may create a dusty exposure which is particularly serious during the cleaning operations necessary to keep Cottrell precipitators or bag houses operating at proper efficiency. The transportation of materials in leaky containers, non-enclosed mechanical conveyers, or uncovered cars creates a hazard. Hand shoveling may produce dust in serious quantities.

MERCURY, ZINC, AND COPPER REFINING

The items enumerated under lead refining apply here also. In the production of zinc, one added exposure appears which is the dust produced in the blowing out of retort condensers, either by barring down or by "shooting" the condenser with a slug of water.

BATTERY MANUFACTURING—STORAGE AND PRIMARY

In the manufacture of storage batteries an exposure to dust exists in the preparation department. The handling, weighing, and mixing of the lead oxides either by hand or machine generates dust. In the pasting operations, either hand or machine, the material may be spilled upon the machine or the floor, become dried, and later be thrown into the air in the form of dust. The brushing of pasted grids will generate dust in a like manner. On the assembly line even when only hand operations are in progress, dust may be generated.

In the manufacture of primary batteries not only may dust be generated by metal-casting operations, but also in mixing, filling, and sealing.

CHEMICAL MANUFACTURING

It would be impractical to attempt to list all the operations in chemical manufacturing which may be dust producers. Here again the seriousness of the exposure depends upon the material handled and the amount of material that is thrown into the air. Chemical dusts, particularly some dye and dye intermediates, are positive sources of dermatitis where the dust generated lodges upon the skin of employees. It is sufficient to say that dusts are generated in the chemical industry and each individual operation requires study by itself.

In chromic-acid manufacturing the sintering of ore is a dust-producing job. The handling and transportation of the ore prior to the sintering either in furnace or kiln produces dust. The quenching of the sintered material may generate dust as also the crushing of the sintered stock.

ASBESTOS AND ASBESTOS-GOODS MANUFACTURING

Any mining operations and quarry operations are exposures, previously discussed. In the manufacture of asbestos goods, particularly dusty atmospheres are created in the break-out, fiber, and picking operations. The crushing and grinding of the fiber, as well as all spinning and weaving operations, have a tendency to throw asbestos fiber into the air and create a source of dust contamination. Crushing and grinding asbestos products generates dust.

INSECTICIDE MANUFACTURING

The toxicity of any dust generated in insecticide manufacture varies according to the material being processed. There is a similarity of operations in most insecticide manufacturing. The preparation department, where the raw materials are manufactured, involves dusty processes. The grinding of cakes from filter presses, the mixing of different ingredients, either by hand or machine, the packaging of the insecticides into bags, cartons, barrels, either by hand or mechanically, and the transportation of materials from point to point in the plant generate dust in varying degree.

Hamilton, N. Y.

ROCK DRILL MOUNTED ON TRIPOD AND EQUIPPED WITH DEVICE FOR THE ELIMINATION OF SILICA DUST

(The bottles shown on the tripod measure the amount of silica which would be inhaled by the drill operator.)

PAINT AND COLOR MANUFACTURING

The handling of bulk raw materials, as well as the grinding of filter-press cakes, will generate dust. Mixing and blending operations either wet or dry produce dust. This exposure is inherent in the handling of dry materials, but the spillage of water-wet materials may dry out and later be thrown into the air. Batch weighing when the handling is by hand produces dusty exposures.

GLASS MANUFACTURING

The most hazardous dusty areas in glass manufacturing are located in the raw-materials receiving department and the batch-mixing department. The unloading of glass sand, soda ash, spar, flint, and other materials from box cars or trucks into storage bins produces dust. Even when these materials are mechanically handled, dust is generated. Batch mixing where the various ingredients are drawn from storage bins and weighed preparatory to being transported to the furnaces also produces dust.

POTTERY MANUFACTURING

What has been listed for glass manufacturing also applies to pottery manufacturing. This is true even when a slip system is used. In addition, the grinding and kiln-firing operations are important sources of dust contamination.

ENAMELING AND ENAMEL-WARE MANUFACTURING

In the preparation of enameling material by mixing, grinding, in either bar or ball mill, blending, and solution-making dust is generated. Spray coating or dipping objects may create a dusty atmosphere through the dispersion of the fine droplets in air and drying out at the suspended material. The rimming of articles to produce stripes is a dust producer of high severity. Loading kilns for firing including the operation of continuous tunnel kilns may produce dust in large quantities. In such manufacturing as well as in many others, the transporting, storage, and handling of raw materials may be sources of dust.

TEXTILES

This caption also includes paper, linoleum, felt, hair, and other similar types of manufacturing operations. Such dusts are not generally considered as being toxic, but yet a sufficient number of instances have arisen to make it appear warranted to include them within the scope of this paper. Picking, opening, mixing, blowing, carding, willowing, spinning, and other similar operations produce dust. In linoleum manufacturing the receiving of the raw filler material, such as soapstone, talc, and mica, as well as the storage of these materials and their handling during process work, may produce dust. Both in hair and in hair-goods manufacturing, the dust may also include the spores of anthrax and the origin of such contamination may be particularly prevalent in the blowing and curling operations.

METALLIC-POWDER MANUFACTURING

Where a cupola is operated in connection with such operations, certain exposures previously listed may be found. In stamping the metal, dust may originate. In coating operations dust also occurs. Where an air-float method is used for the separation of fine particles from large, dust may be exhausted into the atmosphere of the place of work in copious quantities.

MISCELLANEOUS EXPOSURES

There are certain exposures where a material may exist in the form of a dust, a vapor, or possibly a spray of fine droplets. The correction of any exposure of this type requires recognition on the part of the engineer of the material to which workers may be exposed and a determination of the point of origin of such material. A few miscellaneous exposures are discussed in the following paragraphs.

Exposure to Mercury. Exposures to mercury may occur in the mining of the ore, the reduction of the ore, and in the amalgamation of gold ores. Exposure is also found in the manufacture of thermometers, vermillion, and other dyes, the felt-hat industry, the treating and handling of furs; incandescent-lamp, radio-tube, and other electrical-apparatus manufacture; explosives manufacture; and laboratory work, including photographic and research laboratories.

The exposure may be from the dust of the salts of mercury, the generation of fine droplets of mercury together with dusts of other nature, and the vapor of mercury which is generated at high temperature as well as small amounts which may be given off at ordinary room temperature.

Exposure to Chromium. The exposure to chromium is usually found in the generation of the dust of the salts of chromium. There are certain processes in the manufacture of chromic acid and chromium salts from chromium ores which produce dust. The manufacture of paint pigments containing chromium, yarn dyeing and calico printing, the use of bichromates in dye preparation, the chrome process of leather tanning may also have dusty operations. In electroplating with chromium many fine droplets of chromic acid may be thrown into the air by the bubbles of hydrogen disengaging at the surface of the liquid in the electroplating tank.

Exposure to Benzol. Exposure in the case of benzol is usually due to the vapor of the material. The operations of its production, its use in artificial-leather manufacture, in degreasing operations, and in others may result in an exposure. Information may be found in the report on benzol which was published several years ago by the National Safety Council.

Exposure to Lead. As lead is used in widely varied operations and in widely varied forms, it would be relatively impossible to list all of the operations which might include an exposure. The exposure usually exists in the form of dust of the material itself or its compounds or in the form of fumes which may be generated at points where the material is handled at temperatures above its melting point.

Dusty operations may occur in lead mining, lead refining, lead smelting and sintering, the manufacture of plumbers' supplies, foundries, battery manufacture, both storage and dry, pottery operations, glass manufacture, certain printing trades, rubber-tire manufacture, and paint manufacture. In addition, dusty exposures may occur in the chemical-manufacturing trades which involve the manufacture or use of lead or its compounds.

Exposure to Arsenic. Exposure to this material may often be found in the dusty operations surrounding the refining of copper ores and the manufacture of insecticides containing arsenic, either in the form of the oxide or other salts.

Exposure to Radium and Radioactive Substances. The exposure to this material while not by any means general has been recognized in isolated sections and attained for itself relative prominence. The exposure may exist in the inhalation of dust from radium-bearing materials or the exposure to and the inhalation of emanations from radium. In general, this exposure is produced in the mining and handling of radium ore, the refining of the ore, the collection of radium emanation, and the use of the material in producing luminous dials for watches, clocks, and instruments.

CONCLUSION

One should not necessarily conclude that every operation listed in this paper is an absolutely dangerous source or point of origin of a toxic dust. It should not be a foregone conclusion that the operations listed in this paper include all of the possible sources of toxic dusts. The operations discussed, however, are typical of those where known cases of exposure have occurred. To the engineer unfamiliar with sources of air pollution, even in the so-called non-hazardous industries, the listing may seem far-fetched and ambiguous. It should not be assumed that an exposure listed in this paper is prima facie evidence that trouble is inevitable, but to an engineer interested in protection against the more important sources of air contamination by dust generation from ordinary industrial procedure, the listing will provide a basis upon which he may work. All in all, it is best for any engineer to proceed upon the basis that any dust of any type in any concentration creates an industrial exposure and to suppress the dust at its origin.