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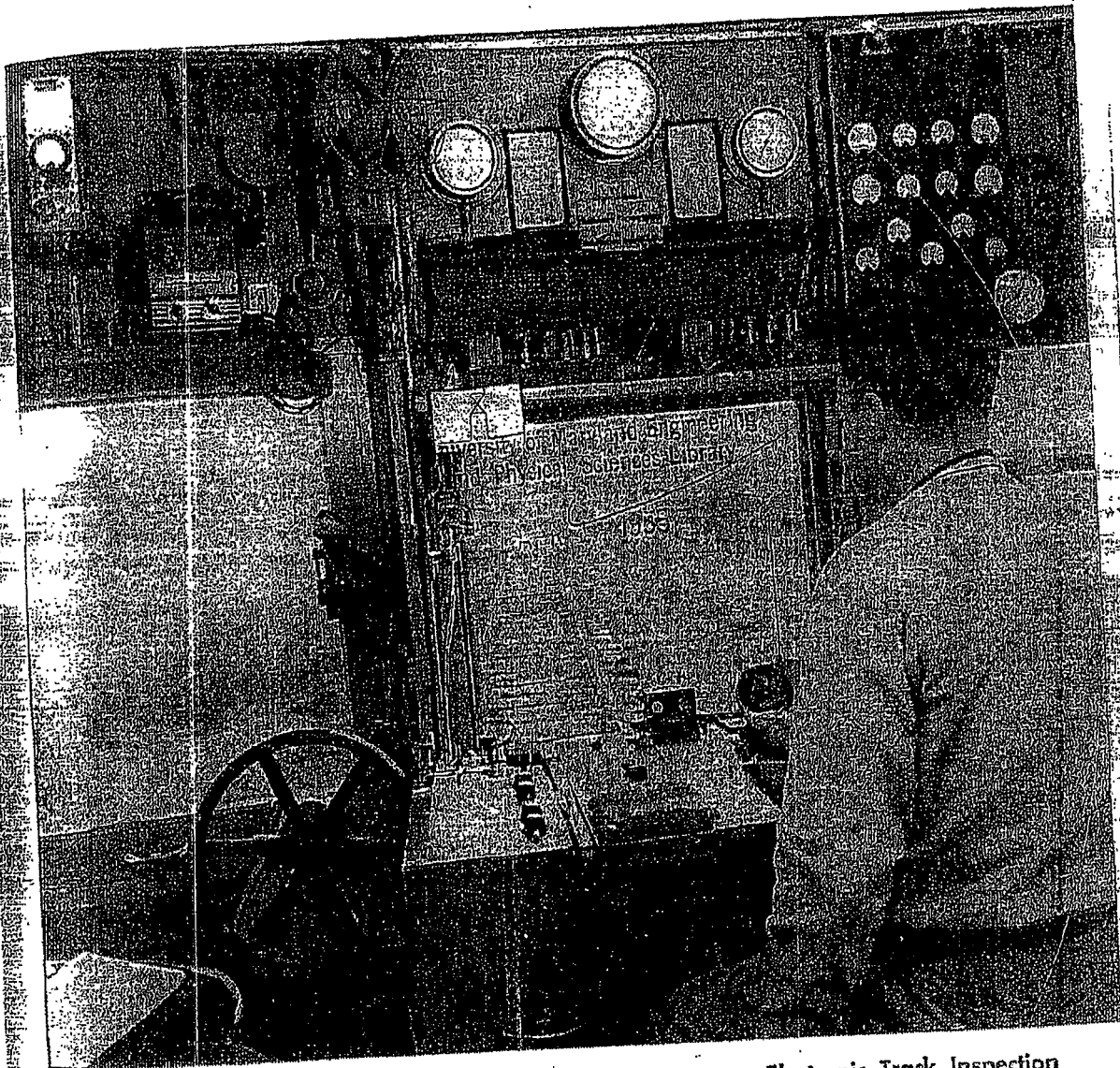
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Article by Pabst

National

SAFETY NEWS

APRIL 1955

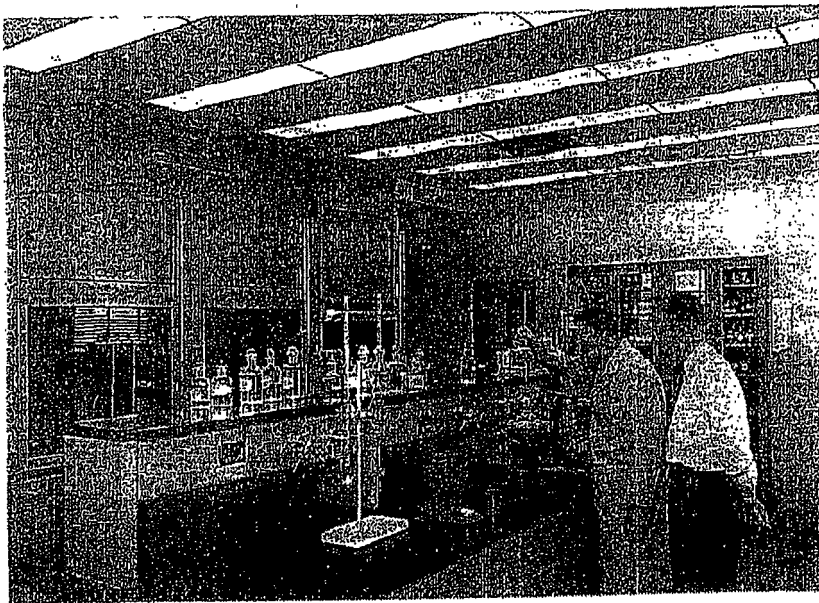


Electronic Track Inspection

IN THIS ISSUE

The Growth of Industrial Hygiene
Industry's Pack Mules
What Do Accidents Really Cost?

PLAINTIFF'S
EXHIBIT
NSC-78



The industrial hygiene laboratory has become a center of research for better working conditions through study of materials used and control of manufacturing processes. (Courtesy General Electric Co.)

The Expanding Field of Industrial Hygiene

By A. C. PABST

Twenty years ago industrial hygiene was a new science. Today the hygienist and the safety engineer are on the same team working for a safer environment

INDUSTRIAL HYGIENE is a field that is closely interwoven with industrial safety. In fact, it can be regarded as a medical engineering phase of safety.

Unfortunately, many people know little about industrial hygiene and the functions of the industrial hygienist. Industrial hygiene is a comparatively new science—practically unknown 20 years ago. Today there are only 800 industrial hygienists in the United States, and a large num-

ber of them are not in industry but working for the federal government or state departments.

Usually, the word "hygiene" recalls hygiene courses in school which dealt with personal habits, such as bathing, brushing teeth, cleaning finger nails, etc. People jump to the conclusion that a hygienist in industry must be interested in keeping employees clean. In my initial visit to many of our refineries, it seemed that the first stop in the tour was to visit the locker rooms and to inspect shower and lavatory facilities.

Industrial hygienists are interested in personal cleanliness so far as it is necessary to protect the employee's health. We are

more interested in keeping his lungs free from poisonous dusts and gases, his bones free from lead, his liver free from chlorinated solvents, etc.

Hygiene is defined as that branch of medical science that relates to the preservation of health. Therefore, industrial hygiene may be defined as the science of prevention and control of occupational illness. It resolves itself into the problem of finding factors or conditions in work places that may cause or contribute to the illness or serious discomfort of employees, and of devising the methods and means of eliminating or controlling such conditions.

The industrial hygienist has

A. C. PABST is Industrial Hygienist, Socony-Vacuum Oil Company, Inc., New York. This article has been condensed from a paper presented at the Petroleum Section, 42nd National Safety Congress.

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done much toward bringing medicine and safety engineering into close cooperation partly because his interest overlaps these two fields.

The typical industrial hygienist started out as a chemist or chemical engineer who became interested and studied toxicological effects of chemicals on man. Consequently, he has a good background of chemistry and engineering combined with some medical knowledge—a sort of one-third doctor, one-third engineer and one-third chemist. His objectives are the protection and improvement of the health and safety of workers from all manner of harmful exposures related to occupation.

From this you will note that industrial hygienists and safety engineers have pretty much the same objectives and are members of the same team. Actually, the functions of each are sometimes so inter-related it is not possible to draw clear lines of separation. Nor is it necessary to do so, for if a man's health is endangered by working conditions it is an important part of his safety picture. In many industries, safety and industrial hygiene are combined in the same department.

In the petroleum industry, how-

Like people, chemicals are of many types and dispositions. Most are uncomplaining, law-abiding citizens who present no special problems. Some are unstable and unpredictable. Some are out-and-out neurotics, requiring a sharp and observant discipline. Others, harmless by themselves, may be influenced by bad company. Still others are troublemakers in solitary, but docile and helpful in tandem. Some are just plain bad actors.

—From a publication by Du Pont's Haskell Laboratory of Toxicology

* * * * *

ever, industrial hygienists are usually attached to the medical department and work as closely as possible with the safety department. There is good reason why the petroleum industrial hygienists must lean heavily upon the safety department. In the petroleum industry the concept of industrial hygiene is relatively new and is considerably behind similar activities in the chemical and other industries, consequently, the number of petroleum industrial hygienists is exceedingly small.

On the other hand, safety departments are well established, well acquainted and close to the every day problems of the petro-

leum industry, and have considerably more coverage and manpower. To illustrate, the American Petroleum Institute's roster of safety and fire protection personnel lists some 1200 names, probably not all, in this occupation.

Contrasted to this, to the best of my knowledge, there are at present only 17 industrial hygienists working for petroleum companies—an industry ratio of approximately 70 safety men to one industrial hygienist. Most of the major oil companies now have at least one industrial hygienist and from 50 to 100 safety men, so you can see it is very necessary for us to work with and through our safety people.

Basically, the practice of industrial hygiene in the petroleum industry is the same as in any other industry and it can be boiled down to four general principles:

1. A knowledge of the toxicology of chemicals and materials.
2. A review of all chemicals or materials used and how handled and the tabulation of toxic or potentially hazardous substances.
3. The measurement of worker exposure to hazardous substances.
4. If required, the recommendation and installation of adequate control measures and the evaluation of the effectiveness of such corrective steps.

Toxicology of Chemicals

In regard to Item 1, the Toxicology of Chemicals, it is usually difficult to adequately define a hazardous material because practically anything can be safe or harmful depending upon how or where it is used. For example, air and water are not regarded as harmful, but both are quite deadly under certain conditions—air if injected into the blood stream and water if introduced into the lungs.

In the same manner, the use of carbon tetrachloride in a process having properly designed ventilation would not be hazardous, while the use of carbon tetrachloride for mopping floors would be quite dangerous. Most safety people are aware that carbon tetrachloride is a hazardous chemical because there has been con-

—To page 103

TABLE I—EFFECT OF ALCOHOL LEVEL IN BLOOD*

Quantity of Whiskey Consumed in 1 Hr. or less	% Alcohol in Blood	Behavior
1/4	0.01	Normal
1	0.02	Feeling of warmth, pleasant social behavior.
2-3	0.05	Judgment blunted Boastful, impulsive Officially still sober
5-6	0.1	Fumbling, staggering gait, clumsiness, slurred speech
8	0.15	Officially drunk. Responses and motor coordination strongly affected.
10	0.2	Helpless, nausea
16	0.3	Stupor
24	0.4-0.5	Coma
30	0.6-0.7	Paralysis of the respiratory center—death.

*Pfirer Spectrum, JAMA, March 27, 1954

National Safety News, April, 1955

A Safe Job at Last (Want to Bet?)

Nicholas Alkemade, of Loughborough, England, has a new job and, for the first time in his life, he feels secure, says a *Chicago Tribune* story.

Alkemade's first job was rear gunner in a bomber. On a mission over Germany in 1944, his plane was hit and caught fire. The pilot ordered the crew to bail out. But Alkemade's parachute was on fire. So was his clothing. Faced by certain death if he remained in the plane, Alkemade jumped—without a chute.

As he tumbled head over heels, he lost consciousness. Three hours later he came to—in a big snow-drift. The 3½ mile fall, plus the snow, had put out the flames in his clothing. The snow had broken his landing.

He started to walk, but discovered a knee was injured. It collapsed on him. He spent the rest of the war in a prison camp.

After the war, Alkemade got a job in a factory. A nine foot piece of steel fell on him. He knocked out but lived.

He changed his job and started pumping ammonia from a tank, where nothing could fall on him. But his electric pump shorted. The shock knocked him out although his rubber-soled shoes saved his life. As he slumped in the tank, his gas mask slipped off. An alert colleague saved him.

He changed his job again. His new task involved transfer of sulphuric acid. The hose broke and acid sprayed over him, but prompt spraying with a neutralizing chemical again saved him.

Alkemade, now 32, and amazed to be alive, has a new job again—selling accident insurance.

Industrial Hygiene

—From page 21

siderable publicity regarding its toxicological effects, and in some cases, restrictive labeling requirements have been passed, for example, in New York City. Many other chemicals used in the petroleum industry have inherent toxic qualities of the same magnitude, yet are not so well known.

In regard to toxicology, there

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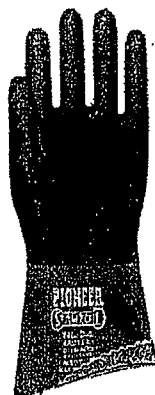
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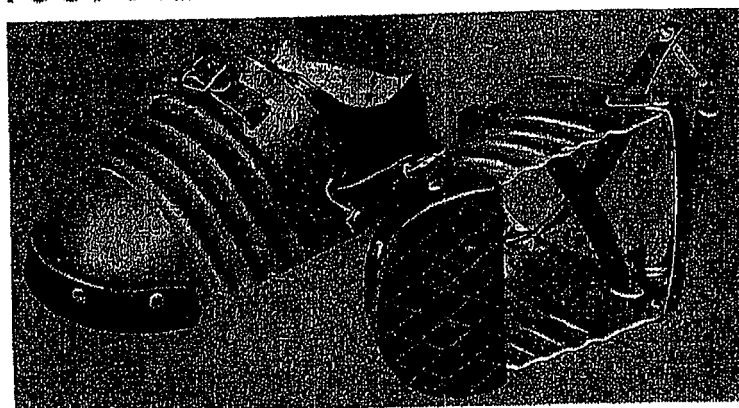
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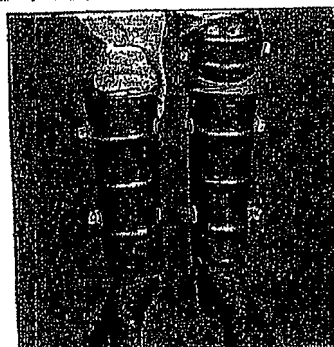
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The metal shield (above) is designed to furnish a maximum amount of protection to the entire front of the foot—not merely the toes alone, but also to the instep against hazards from falling, rolling or flying objects, or from accidental tool blows.

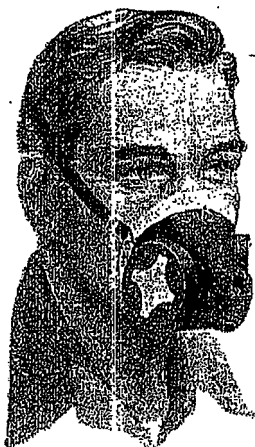
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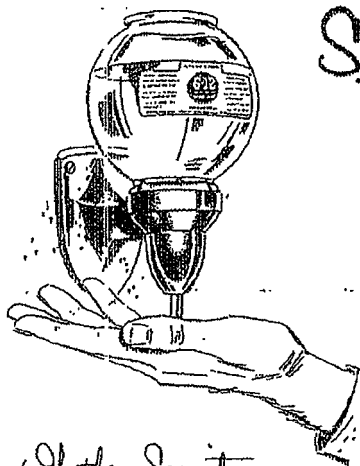
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are three ways in which a substance can cause adverse effects upon man:

1. It can be ingested or swallowed.
2. It can be harmful by direct contact with the skin or parts of the body.
3. It can be inhaled as a gas, vapor, mist or dust.

Ingestion

Fortunately, petroleum materials are not commonly or intentionally taken internally and therefore, trouble from this is rather rare in a refinery, although it does occasionally occur unknowingly. I recall watching a worker who had been complaining of stomach trouble, whose duties involved the compounding of litharge or lead oxide in a doctor solution—this man proceeded to empty the bags of litharge into an outdoor mixing tank and because of the dust and mists generated he correctly wore a respirator.

Of course, his hands were covered with lead oxide, and to my amazement, the first thing he did when he came down off the catwalk was to take an orange out of his lunch box which he started to peel and eat—probably one of the most effective ways to get lead poisoning.

Unfortunately, when petroleum products get into the hands of customers, ingestion is more frequent, usually by small children whose parents carelessly leave products within easy reach. You know that every year there are fatalities reported from children drinking kerosene. We have had hurry calls from doctors involving children drinking penetrating oil and fly sprays. Some times adults are even worse, as there are many cases of anti-freeze poisoning, drinking of brake fluid, and one I recall of our radiator flush which contains muriatic acid and chlorinated hydrocarbon. This product is fully labeled, including skull and cross bones.

It should be emphasized that hardly a substance exists that is not capable of producing effects on the human body if taken in sufficient amounts or under the wrong circumstances. Even common table salt, if used in sufficient quantities, is toxic. It is reported

that many years ago the Chinese used table salt as a means of committing suicide. Every chemical substance, therefore, has a non-toxic dose and a toxic dose for man. This can be illustrated by the following data on a widely used commodity, shown in Table I.

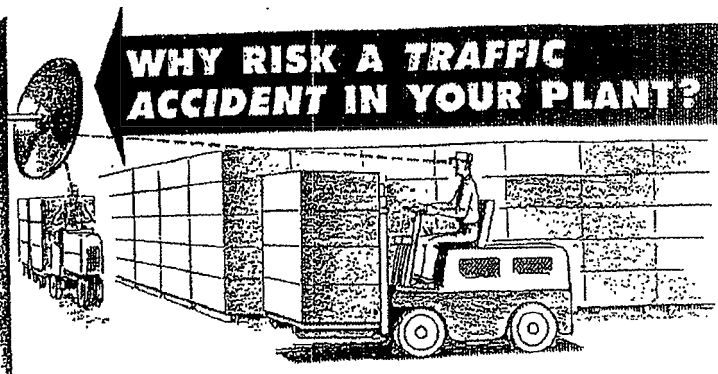
Skin and Body Contact

Approximately 60 per cent of all complaints received by our department are concerned with dermatitis and skin irritations resulting from contact with petroleum materials. By far, the majority of these complaints are from customers so this subject is very important in the marketing of petroleum products.

Cases among our employees or in our refineries are few when compared with those among industrial users of petroleum products, and it is believed that the reason for this is due mainly to the degree or extent of contact. In the petroleum industry skin contact is not generally experienced to the extent that it is, for example, in the metal working industries where a daily eight hour skin contact with cutting oils often takes place.

It is definitely established that skin is not an impermeable barrier to chemical substances, and it is increasingly important as a route of absorption for many materials. Action of chemicals on skin may be local, resulting in dermatitis. Examples we are familiar with are kerosene, cutting oils, etc., or a chemical may be absorbed through the skin and cause damage to blood or internal parts of the body. Lead tetraethyl, as an illustration, does not affect the skin or cause dermatitis but can penetrate the skin and cause internal poisoning.

Regarding external or local skin effects, chemicals may be classified either as primary irritants or sensitizing agents. A primary irritant is a chemical that may cause dermatitis in individuals frequently after only one contact. They may have a strong chemical action, such as acids, alkalis, amines, etc., or they may have a weak chemical action but require prolonged contact to cause dermatitis. Most petroleum hydrocarbons are primary irritants but



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Circular convex	240	24" diam.
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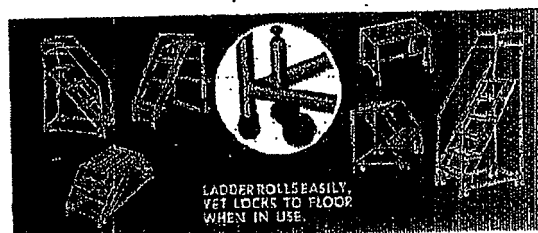
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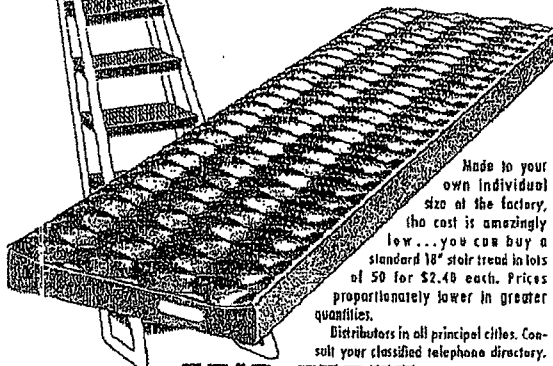
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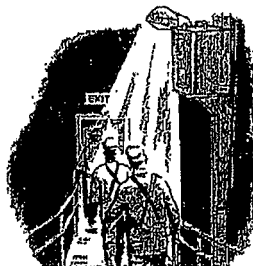
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are classed in the latter category in that prolonged contact is usually required to cause irritation.

Sensitizing agents, on the other hand, are chemicals that are innocuous to most skin but capable of producing dermatitis in a few susceptible individuals following repeated contacts over a long period. Sensitization may require weeks, months or even years of contact with the material before dermatitis develops.

As mentioned above, the petroleum industry is now handling large quantities of chemical additives and inhibitors, many of which are strong primary irritants and very active chemical compounds. By nature, inhibitors usually have to be very potent chemicals because while they are used in very low concentrations they exert a powerful influence on the characteristics or performance of the product, and many of the inhibitors are just as potent towards man.

One very active class of inhibitors are the amines and substituted amines, and we are particularly concerned about them because they are very damaging to the eyes, and a splash can readily result in blindness. The amines are usually strong smelling caustic liquids, insoluble in water, hence difficult to remove by washing. They can cause severe eye burns and necrosis of eye tissue. In addition, most amines are readily absorbed through the skin and even low quantities may cause internal damage and death.

Employees should, of course, be fully alerted as to the hazards of such materials and should be educated to the use of protective goggles, gloves and aprons.

The foregoing applies to concentrated or undiluted inhibitors. Finished petroleum products should and usually do contain such a small quantity, and the inhibitor is so diluted, as to result in practically no more harm in the finished product than there would be from the straight mineral oil itself.

Industrial dermatitis cases sometimes result in erroneous conclusions as to their cause, even by those who should know better. I recall the case of a young man

who worked in a gasoline station and developed a severe dermatitis. He went to a physician who made patch tests on him and found he had a sensitivity to special gasoline but no reaction to regular gasoline.

Apparently, the physician had heard special gasoline contains a lot of lead because the case was diagnosed as resulting from an excess of lead tetraethyl in the special gasoline. We thought this strange because while we all know that lead tetraethyl is a violent poison and can be absorbed through the skin, it is not a primary skin irritant and has never been known to cause dermatitis.

A review of records of gasoline shipments into the particular area showed the regular gasoline actually contained the same or sometimes more lead than the special gasoline, clearly proving that lead tetraethyl was not to blame, but that some other material was responsible.

Inhalation

Of the three avenues by which chemicals can be taken into the body, inhalation probably has received by far the most study and investigation because it is the most important consideration in industrial health. The vast amount of research on the inhalation of materials has resulted in the publication of very useful data on safe human exposure levels known as threshold limit values, or maximum allowable concentrations. The list is compiled annually by the American Conference of Governmental Industrial Hygienists and is published by the American Medical Association. It tabulates the maximum amount of the various materials workers can safely be exposed to for an eight-hour working day without injury to health.

A few of the materials encountered in the petroleum industry are listed in Table II.

TABLE II

Gases and Vapors

Substance	PPM
Benzene (benzol)	35
Carbon dioxide	5000
Carbon monoxide	100
Carbon tetrachloride	25

Original Safety News, April, 1955

New DRY TAMP PERMAMIX Floor Patch

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DRY TAMP MEANS SPEED • No sticky mass to dig out of the drum or to handle • Permamix dry pours • sets instantly • feather edges perfectly • no production delays • non-skid surface.



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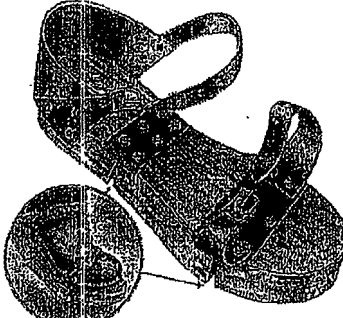
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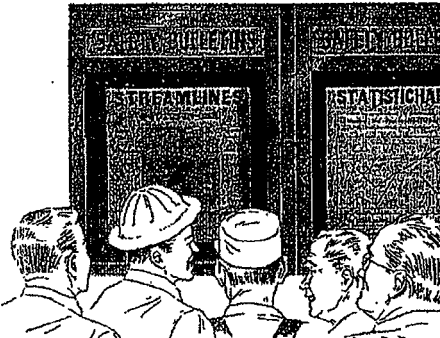
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Lead	0.15
Sulfuric acid	1

Mineral Dusts

Substance	MPPCP
Asbestos	5
Dust (nuisance, no free silica) ..	30
Silica	
high (above 50% free SiO ₂) ..	5
medium (5 to 50% free SiO ₂) ..	20
low (below 5% free SiO ₂) ...	50

These values are based on the best available information from industrial experience, from experimental studies, and, when possible, from a combination of the two. They are not fixed values but are reviewed annually by the Committee on Threshold Limits for changes, revisions, or additions as further information becomes available. Threshold limits should be used as guides in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentrations. They represent conditions only within which it is felt that workers may be repeatedly exposed, day after day, without their health being adversely affected.

I cannot overemphasize the importance of the threshold limit values. I believe that every safety man should be familiar with them and have copies of the complete table, because they have been incorporated in state codes and have the force of law in many states, and therefore, must be complied with. So far some 19 states have written threshold limit values into their laws and often management is not aware of such requirements but would be in a vulnerable position if trouble resulted from excessive exposure to any of the materials. Usually it is up to the safety people and the industrial hygienists to alert management to the existence of these codes and to institute measures for the measurement of air contaminants so as to insure compliance.

Even gasoline has a maximum safe level which is 500 parts per

million. The result of exposure to concentrations greater than 500 ppm is shown by the following:

TABLE III—GASOLINE EXPOSURE
Symptoms: Headache, irritation of eyes and throat, dizziness, nausea, loss of consciousness, death.

	Parts Per Million	%
Maximum allowable concentration for prolonged exposure	500	0.05
Slight symptoms after several hours	1000	0.1
Maximum concentration tolerable for 1 hr.	5000	0.5
Dangerous for short exposure	15000	1.5
Fatal for short exposure	25000	2.5
Lower explosive limit	14000	1.4

Product Labeling

One very important function of the industrial hygienist is in regard to precautionary labeling of product. This is receiving more and more emphasis as state after state passes labeling regulations. The most recent is the State of New York where the Council on Public Health passed labeling regulations which became effective August 24, 1954, as Chapter IX-A of the New York State Sanitary Code. These labeling regulations have the force and effect of law and require precautionary labeling on any product which entails a hazard in a reasonably anticipated use. A hazard is defined as:

The risk of injury or illness which may be encountered during or as a result of any reasonably anticipated type of handling or use of a substance, or during its specified use, if any, by reason of the toxicity of the substance through ingestion, inhalation or absorption through the skin, or due to its corrosiveness or irritating properties, or because of its flammability or explosiveness.

Similar labeling regulations already exist in California, Illinois, Oregon, and the Territory of Hawaii, and are in the making in New Jersey, New Hampshire, Ohio and Rhode Island. More can be expected. Fortunately, most state regulations are guided by recommendations of the Manufacturing Chemists' Association, Inc., and with some few exceptions, conformity in one state results in conformity in other states.

It is recognized that, as a rule, labeling regulations of many products are advisable and result in safer handling of the material



2 REASONS

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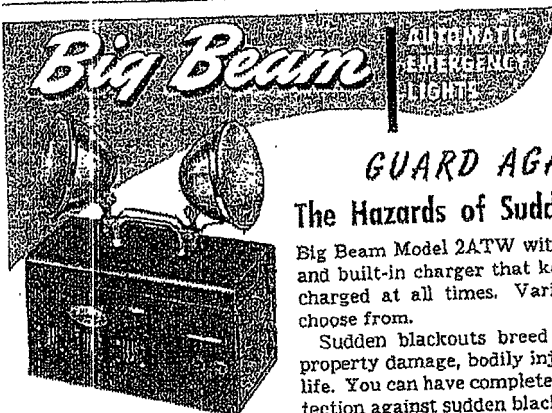


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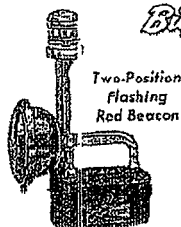
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Big Beam Model 2ATW with storage battery and built-in charger that keeps battery fully charged at all times. Variety of models to choose from.

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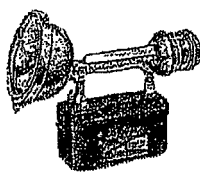
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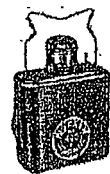


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by customers, but it requires extensive work, knowledge of product and toxicological information to determine what products must be labeled and how they should be labeled. In our company's operations, we use some what over 2000 basic chemicals or raw materials and manufacture some 3500 finished products which must be reviewed individually.

To illustrate, the following are just a few of the hazardous materials that are encountered in petroleum refinery operations or that might be compounded into finished products:

Respiratory Irritants
Acrolein
Acetaldehyde
Aluminum Chloride
Ammonia
Asbestos
Ditertiary butyl para cresol
Dusts, physiologically inert, general
Dusts, attapulgus clay
Dusts, bauxite
Dusts, catalyst
Formaldehyde
Fluorides
Furfural
Inhibitors
Lime
Nitrogen oxides
Ozone
Pine Oil
Silica
Smoke
Sulfur dioxide
Welding fumes
Toxic Materials
Aniline, liquid
Aniline, dye
Benzol (benzene)
Cadmium
Carbon Monoxide
Chlorinated hydrocarbons
Chrome compounds
Cobalt, metal
Hydrogen sulfide
Inhibitors
Lead, metal & fumes
Lead, oxide, litharge
Lead, soaps
Lead, tetraethyl
Manganese
Mercury
Methanol
Radioactive materials, general
Toluol (Toluene)
Xylol (Xylene)
Zinc
Skin Irritants
Acids—all kinds
Amines
Benzol (benzene)
Caustics
Chromium Salts
Coal-tar Compounds
Cobalt, metal and compounds
Dyes
Inhibitors

Nickel salts
Oils, general
Oils, high boiling from
Cat. & steam cracking
Oils, insoluble cutting
Phenol
Pitch
Solvents
Ultra violet radiation
Wax, untreated

The petroleum industry has made remarkable progress in the development of new and better products and in improving processing operations. Accompanying this progress have been new problems of toxicology and health engineering which must be studied with the same zeal as other types of research. The advent of catalytic cracking resulted in the production and handling of aromatic hydrocarbons, and of importance to us, health problems long associated with the coal-tar industry. The use of new chemical catalysts, inhibitors, and other chemical compounds involve health problems that the chemical industries have faced for years.

To illustrate this trend we need

only look at the modern gasolines, fuel oils and motor oils. Years ago motor oils were practically 100 per cent petroleum with little, if any, additives; today they contain up to 15 to 20 per cent of chemicals, additives and inhibitors, and this trend will continue because there is no question that additives contribute much to improve performance characteristics.

Every step in this direction, however, does pose new problems of health and safety among our plant personnel and our customers.

Fork Trucks

—From page 35
er catalytic muffler—on mining and construction equipment, may add impetus to two growing trends in mining—the shift toward trackless mining and the increasing use of diesel equipment underground.

The Coplay Cement Company, Coplay, Pa., has been using a

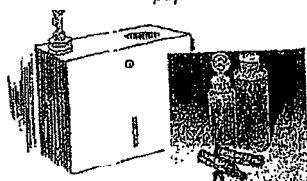
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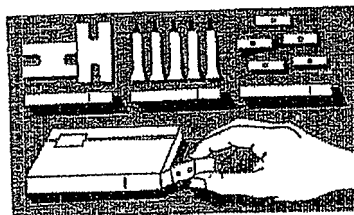
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National Safety News, April, 1955

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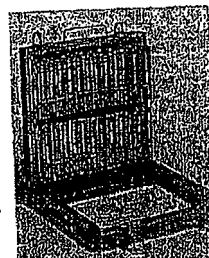


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PLANT ENGINEERING

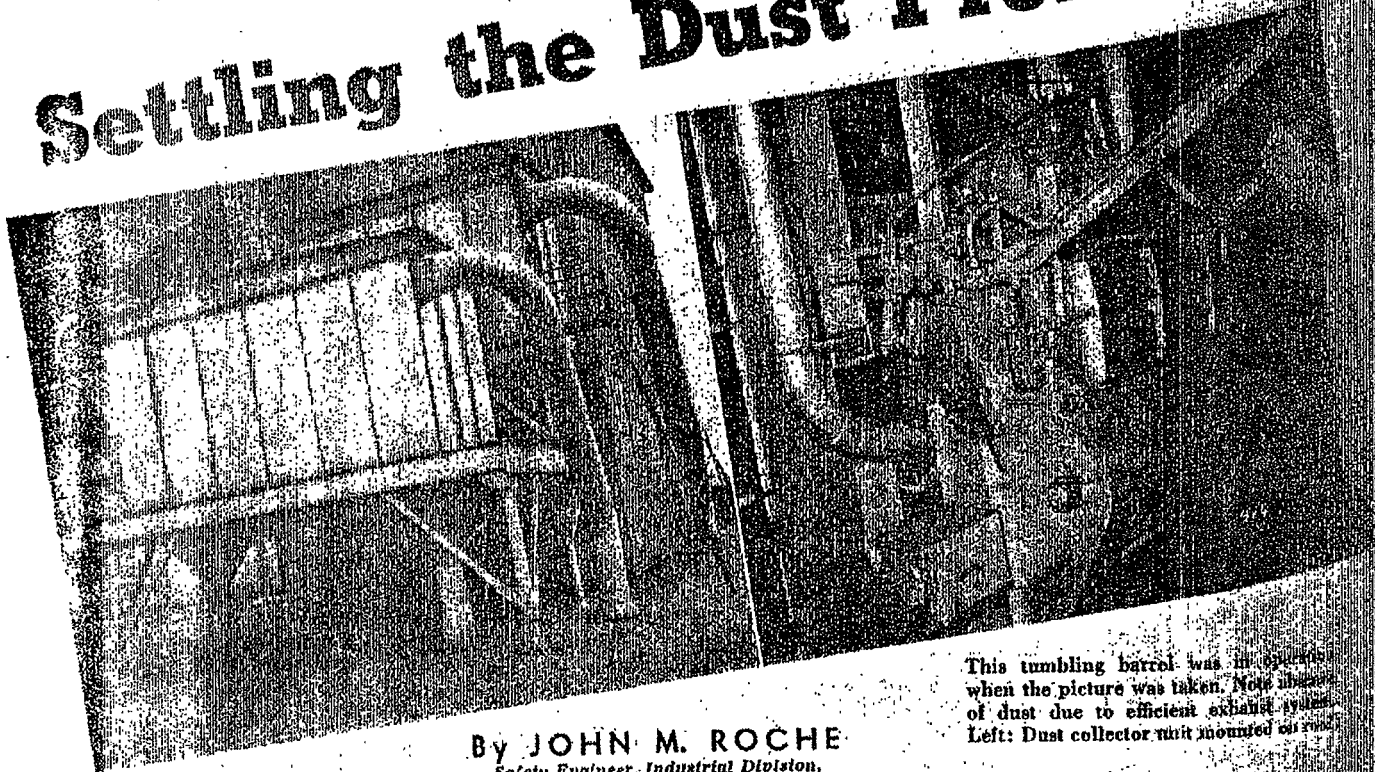
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IN SAFETY

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California

Settling the Dust Problem



By **JOHN M. ROCHE**
Safety Engineer, Industrial Division,
National Safety Council

This tumbling barrel was in operation when the picture was taken. Note absence of dust due to efficient exhaust system. Left: Dust collector unit mounted on roof.

THE inclusion of occupational disease claims in the compensation laws of several states, a few years ago, caused an almost hysterical response from plant operators and their insurance carriers. Because of the threat of retroactive compensation payments for past cases, visions of ruin seemed all too real. Happily, the fears proved groundless, for in every case the laws were modified so that the burden was equitably distributed between the employer, the carrier and the state, with just provision being made for the affected workers.

The turmoil of the period, before adjustment, however, focused attention upon the causative factors of occupational diseases and the needed corrective action. Much that was done in haste was ill considered and worthless. On the other hand, safety engineers and later management, because of the experience gained through this forced action, came to the realization that occupational diseases could be prevented and that the cost was not prohibitive. In many cases, oper-

Dust is one of the important causative agents in the occupational disease picture. Not only are certain types of dust involved in occupational diseases that are potentially most costly, but dust in general has a direct effect on efficient operation. Excessive wear of moving machine parts, spoilage of material, and sometimes damage to the finished product are part of the dust costs that can be eliminated by effective control. Another hidden factor is the lessened efficiency of men who must work in a dusty atmosphere, even when the dust is not toxic.

The effective control of industrial dust is an engineering problem in which many factors must be considered. Some of the most important factors are the type and fineness of dust involved and its physiological effect upon the worker. Other points which command serious attention are the type of building in which the operation is carried on, the specific operations conducted, the machines used, and the physical condition of the worker.

Where a new plant is to be erected for a definite process, the job of

simple than where the existing structure may not have been designed for the present operation. In the latter case, the engineer must rely more on mechanical control devices and structural difficulties frequently make impossible isolation of processes, arrangement of machines or the introduction of improved methods.

From the standpoint of physiological effect upon the worker's health, dust may be divided into three classes:

1. Those that are quickly poisonous through breathing, ingestion or bodily contact.
 2. Those which result in systemic damage over longer periods of time.
 3. Nuisance dusts which may be harmless or which may possibly cause slight respiratory inflammation, colds, or even pneumonia. In this latter class are included dusts which cause reactions, allergic in nature, which affect only individuals who are peculiarly susceptible to the particular substance.
 4. Flammable dusts, whose removal is extremely important from the standpoint of fire or explosion. This latter class includes many which are also members of the other three.
- Dusts which are instantly poisonous

Isolated cases have appeared from time to time in chemical and pharmaceutical plants and laboratories where such materials are elements in the production scheme. Their hazards, however, are so well known that adequate protection has long been in effect. The second class, however, is very common and consists of the pneumoconiosis-producing dusts such as silica and asbestos, the poisonous dusts such as lead, radium, manganese and cadmium, which cause systemic poisonings, and the fume dusts such as zinc oxide, which give rise to a temporary condition known as metal fume fever.

The nuisance dusts consist of any dust which does not fall under the first two classifications but which for reasons of cleanliness, possible respiratory troubles, and the effect on worker morale, should be removed. Where workers are found to be allergic to dusts in this class, the only recourse so far found to be effective is to remove the men from exposure. Since this grouping includes dusts which are explosive if mixed in the proper proportions with air, control is all the more important.

In the case of silica and asbestos, the particle size of the dust and its concentration with respect to the innocuous ingredients of the mass to be moved, are important. Equipment must be selected which will first remove from the worker's breathing zone the harmful particles and then trap them so that they cannot be recirculated through the plant. No at-

tempt is made in this article in discussing equipment to specify the type to be used for specific exposures. Each dust problem must be studied as a separate case, and equipment chosen which will effectively do the work.

The most important element in the control of dust diseases is to keep dust out of the worker's breathing zone and to furnish him a plentiful supply of clean air. Certain operations, such as stone cutting and rock drilling, are inherently dusty and can be controlled only by local exhaust systems applied as close as possible to the area where the work is being done. Small exhaust fans are used in stone cutting and polishing work with effective results, while rock drillers are now protected with an exhaust cup-like arrangement which entirely surrounds the drill and covers the hole so that the dust is drawn through a flexible rubber tubing to a point away from his breathing zone.

In England, a device employing a

suction hose attached to a special glove, worn on the hand holding the tube, is used to remove the dust when silica-bearing rock is being cut or dressed. This, while effective in removing the dust, hampers the worker somewhat in his movements.

Other forms of exhaust equipment employed for "spot" dust control use flexible tubing equipped at the end.

(Please turn to page 72)

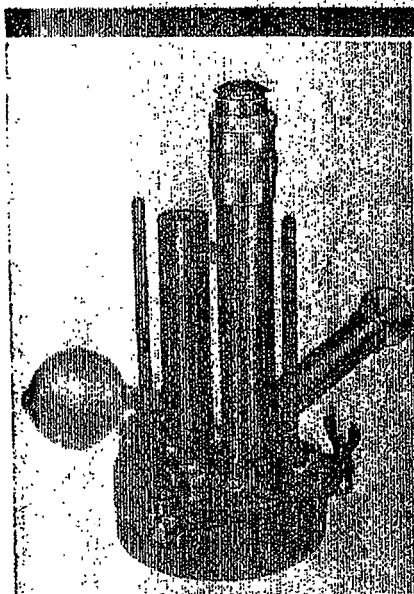


Top: View in iron foundry, showing bench grinders with exhaust hoods.

Middle: A method of receiving dust into trucks on auxiliary dust-collecting equipment.

Left: Dumping ground silica onto the apron of a conveyor. Note enclosed conveyor exhaust hood and use of approved respirator by operator.





What are the DUST CONDITIONS in Your Plant?

MORE effective dust control can be obtained by a daily check of dust concentration in your plant. Designed for simple, easy operation the B&L Dust Counter aids in accurately determining the efficiency of ventilating systems and other corrective and protective devices and methods.

The B&L Dust Counter is a compact portable unit including a sampling device, a dark-field microscope and an efficient illuminating system. It can be used anywhere in the plant. Comes complete with all necessary accessories in a rugged wooden carrying case. Write for details to Bausch & Lomb Optical Co., 681 St. Paul St., Rochester, N. Y.

BAUSCH & LOMB

Awards Show Aviation's Progress in Safety

PASSENGERS on scheduled flights on the airways of the United States were five times as safe last year as in 1930.

This announcement was made March 29 at a dinner in New York City held in conjunction with the Tenth Annual Greater New York Safety Conference at which six U. S. air lines were given certificates of special commendation by the Aviation Safety Award Committee of the National Safety Council for outstanding safety records in the transportation of passengers.

In 1930 the country's air lines flew 4,000,676 passenger miles for every passenger fatality, whereas last year this figure increased to 22,308,771.

The companies who received the certificates of special commendation were American Airlines, Eastern Air Lines, Pennsylvania-Central Airlines, Braniff Airways, Continental Air Lines and Inland Air Lines.

The awards were divided into three groups, according to operating mileage.

In Group A—lines flying more than 50,000,000 passenger miles annually—American Airlines was first with a world record of 410,237,966 passenger miles without a passenger fatality. This record covers a period of more than three years. Eastern Air Lines was second in this group.

Pennsylvania-Central took first honors in Group B—lines flying 2,000,000 or more but less than 50,000,000 passenger miles a year. This company in its 11 years of operation has flown 70,159,498 passenger miles without a passenger or crew casualty.

Braniff, which until late in March had never lost a passenger, was second in Group B with a total of 47,956,588 passenger miles without a fatality through the years 1932-38. Continental Air Lines and Inland Air Lines won safety honors in the third group—lines flying less than 2,000,000 miles a year.

A special safety award also was presented to United Air Lines in recognition of "outstanding contribu-

For the first time a special safety award was made to a division of an air line. This was won by the Eastern Division of Transcontinental and Western Air, Inc., which as a separate operating unit recorded 151,204,500 passenger miles without a passenger fatality.

The National Safety Council's Aviation Safety Award Committee consists of: Harry J. Guggenheim, chairman; Dr. George W. Lewis, vice chairman, director of Aeronautical research, National Advisory Committee for Aeronautics; Col. Edgar S. Gorrell, president, Air Transport Association of America; Edward J. Noble, chairman, Civil Aeronautics authority; S. Paul Johnston, editor of *Aviation*; D. D. Fennell, president of the National Safety Council, and Lew R. Palmer, secretary, conservation engineer, The Equitable Life Assurance Society.

Dust

(Continued from page 10)

trance point with various forms of hoods designed for the particular operation. Examples of jobs where this equipment may be encountered are switch point grinding, cleaning castings, grinding dies, or other jobs where portable abrasive wheels or dressing tools are used.

Most engineers are familiar with the great variety of applications of exhaust equipment on machines such as abrasive wheels, grind-stones, polishing heads, buffers, and other similar equipment. Specially designed hoods are frequently applied to tumblers, shake-out machines, sandblasting equipment, screening devices, mixing machines, ball mills, grinders, shredders and filling machines. These devices are mandatory in most states.

Properly designed equipment employed at the point of origin of dust will effectively remove the hazards of the particular operation. It is generally recognized, however, that in addition to local exhaust, a general ventilating system that will keep all the

all of which are efficient for the work which they are designed to do. Manufacturers of these systems will, as a rule, guarantee them as to performance and their ability to meet labor department requirements.

Where the building and process are suitable for their use, exhaust fans, strategically placed, may be used to draw air out of the building, through ducts with conveniently located inlet ports, and discharge it into the atmosphere. Fresh air is drawn in through vents, thus replenishing the pure air supply. If heating or humidity control is not a problem, this method has been found satisfactory.

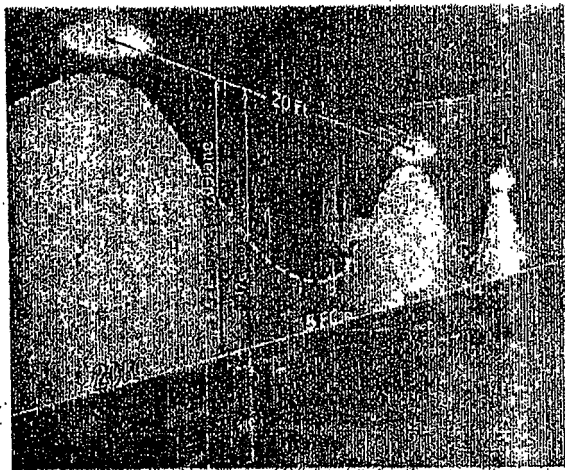
If, on the other hand, the dust collected from the local exhaust systems and the general ventilating system, are toxic, or large in quantity, they cannot, of course, be discharged into the air but must be trapped. Here, devices employing filters of various designs such as bags, filter packs and screens, are used. These filters trap the dusts and prevent their recirculation in the plant through being drawn into the clean air inlets. Filters are frequently employed to recover valuable industrial dusts which would otherwise be lost.

Some exhaust systems, instead of using filters for trapping the dusts, scrub the air by passing it through water screens. This method works well on many substances and has the additional merit where the dust is soluble, of allowing for easy recovery of possible valuable by-products. Here, again, there is no discharge of toxic dusts in the surrounding atmosphere.

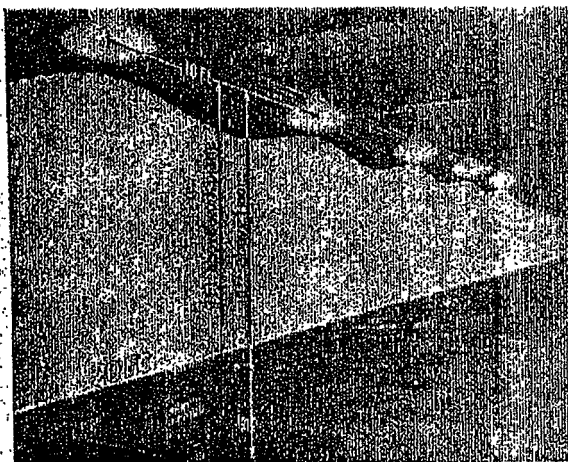
Electric precipitators have been found useful, particularly where the dust which must be removed from the air consists of very fine particles. These precipitators while efficient in their own right, may be used in conjunction with other purifying equipment to secure the maximum efficiency for the dust control system.

The common method of removing nuisance dusts, such as sawdust, is the local exhaust duct which feeds into a main duct that in turn empties into baffle type dust collectors. If the collector is cleaned regularly and there is no objection to the finer particles of dust being discharged into the surrounding atmosphere, this system will be found satisfactory. Some of the newer dust collectors of this type are so designed that even fine particles

HAVE YOU GOT ROLLER COASTER LIGHTING IN YOUR PLANT?



With lighting fixtures too far apart, poor distribution as shown in the top illustration, is the result. For best seeing conditions, the illumination in foot-candles throughout the work area should be reasonably uniform. Properly spacing the lighting fixtures, as shown below, results in greater uniformity.



"ROLLER COASTER" lighting is poorly distributed or uneven lighting. When the amounts of light directly beneath a light source and midway between light sources vary greatly, you have a lighting curve that resembles a roller coaster with its sharp dips and climbs.

The extreme contrasts that exist between bright and dim areas may cause eyestrain . . . slow up production . . . increase operating errors . . . and constitute accident hazards. Seeing is difficult because workers' eyes are con-

tinually trying to adapt themselves to the many lighting conditions in the working area.

In general, direct lighting units should be spaced no further apart than their height above the floor. Where supplementary lighting is required, general lighting should also be used.

Write General Electric Co., Dept. 166-NS-E, Nela Park, Cleveland, O., for the new booklet, "Lighting for Production in the Factory."

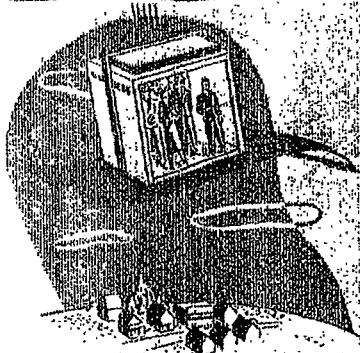
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Ask Us for Help with Any Elevator Problems



Manufacturers of all Types of Elevators

do not escape into the air if the equipment is properly maintained.

In existing buildings, mechanical removal of dust by means of exhaust systems, is probably the most effective means of control, although there are other points of attack which must not be neglected. Housekeeping is extremely important. Much can be done to eliminate a dusty condition by care in handling materials and by establishing and maintaining a thorough housecleaning program. This may entail the brushing down of walls, cleaning of ledges and beams, dusting of machines, and removal of dust from the floors at regular intervals. All of this can be done more efficiently by the use of built-in vacuum cleaning systems or by portable vacuum cleaning outfits. Regardless of the means adopted, the cleaning should be done frequently enough that there is no possibility of vibration shaking the deposited dust, or drafts blowing it, into the workroom air.

The isolation of dusty processes, either in separate buildings or departments, has been found satisfactory. Where this isolation exists, it is possible to reduce the installation costs for exhaust equipment which, of course, means that operating, maintenance and replacement costs are lessened proportionately.

Enclosing dust-producing machines and material-handling equipment offers another means of control that is receiving much attention. Machine manufacturers, realizing the demand, are designing to this end. Tightly fitted covers on mixers and tumblers, dust-proof joints on conveyors, and fully enclosed machines are examples of the good work done in this field. Exhaust systems built into the machines are becoming more common.

Wherever possible, buildings should be designed for the operations to be conducted. This entails the use of enclosed operations wherever possible, provision of ample space to prevent crowding, isolation of dusty equipment, and design of the building to facilitate good housekeeping. Bevelled ledges, rounded corners, enclosure or bevelling of exposed beams, and the installation of built-in vacuum cleaning systems, are possible

tained at a high standard to operate at maximum efficiency. Exhaust ducts reduced in area by heavy deposits of dust, whether harmful or merely nuisance dusts, lose their efficiency. Regular cleaning programs should be in effect, and air-velocity readings should be taken at exhaust hood inlets to determine the operating condition of the equipment. Any deviation from standard requirements should be checked at once. It is a sad commentary but true that many thousands of dollars are invested in exhaust equipment that might well have been spent elsewhere since poor maintenance has rendered it practically useless.

Air tests to determine the concentration of harmful dusts should be made at regular intervals by qualified engineers. These tests should be made even though velocity tests of the exhaust equipment indicate that it is operating at maximum efficiency. Leaks in ducts may be pouring out back into the workroom and sometimes these can be discovered only by careful inspection after high dust concentrations are discovered. New operations may be added, or machines rearranged, so that original velocities of air become insufficient to remove the dust. Air tests will reveal this condition.

Where air tests are made at regular intervals, the expense is often justified by the maintenance of higher employee morale. Also, any indication of toxic limits can be corrected before workers are affected and become subjects for medical treatment and possible compensation.

There are several other methods of dust control that have proved effective in cases where they could be applied. Substitution of innocuous materials for toxic substances, use of wet processes, and the application of binder dusts to "lay" the toxic dusts are common. In many cases, however, these are not practicable and no course must be had to the methods already covered.

Or Should Be

Safe drivers are now handsomely rewarded by automobile insurance companies with premium rebates.

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INDUSTRIAL HEALTH

Conducted by C. O. Sappington, M. D., Dr. P. H., Director
Industrial Health Division, National Safety Council

Air Conditions and Health

A Recent Survey of International Literature

Editor's Note—In Information Circular No. 6439 of the Bureau of Mines, issued February, 1931, Dr. R. R. Sayers, the Chief Surgeon, has made a summary of recent international literature on the subject "Effect on Workers of Air Conditions." An abstract of this material will appear on this page in four installments: I. "Dusts." II. "Toxic or Noxious Gases." III. "Abnormal Temperatures and Humidities." IV. "Summary and Bibliography."

I. Dusts

THE control of dust and dust diseases has continued to be a matter of considerable concern with most of the industrial companies of the world. This is indicated by the following summary of reports, which have been published in a number of foreign countries, as well as in the United States.

Australia. The report of the Workers' Compensation Commission provides information in regard to 1,300 of the 1,500 workmen examined up to August 23, 1929. In substance, this gives the number of men exposed in different dusty trades, who contracted tuberculosis, silicosis, and both diseases. In most instances the period of exposure was also noted.

The Broken Hill experience is rather unusual; during the period of the last eight years, the appearance of the first case of pneumoconiosis is still awaited.

George who reports this above experience feels that two factors operate in the development of pneumoconiosis in a miner. He maintains that there is a tuberculous element in every case of dust disease, even in so-called "simple" pneumoconioses and supports this idea by calling attention to the fact that of many men

exposed to exactly similar conditions only a percentage are affected by dust. A large percentage of the men with so-called "simple" pneumoconiosis have developed so-called "overt" tuberculosis, even when removed to surroundings where it is most unlikely they would be reinfected by the tubercle bacillus. Furthermore, in most radiographs of so-called "simple" pneumoconiosis, an area suspicious of either healed or incipient tuberculosis can be recognized, if a careful search is made for it.

Chapman believes that in some individuals, particles of silica are absorbed in the lungs without giving rise to silicosis, while in others, the particles are not absorbed but give rise to inflammatory areas starting silicosis. This leads him to believe that the inflammatory process occurs in persons who are already the subject of tuberculous inflammation. A further essential difference is found in the fact that early tuberculosis tends to attack the apices of the lungs, this portion tending to be the last attacked by silicotic inflammation.

England. Bridge gives credit to Collis in originally drawing attention to the effects of the inhalation of occupational dust containing free silica, but states that even he did not visualize the widespread nature of the industries in which free-silica-containing dust occurs.

Few if any, dusts occur in industry that will not produce, at least in certain individuals, an inflammatory condition of the skin; the economic results from this, however, are as nothing compared with cancer of the skin produced by dust.

Of increasing importance to the mining communities, according to *The Colliery Guardian*, is the occurrence of cases of silicosis in coal miners. Investigations of shales in the vicinity of coal seams and the quantity and nature of dust suspended in the air in underground places where drilling is carried on will probably be shortly undertaken by Birmingham University.

The Lancet emphasizes the difference in the fibroid reaction resulting from exposure to asbestos dust as that to silica dust as encountered in gold mines. The former shows in the radiogram, fine basal mottling and linear striae, whereas the latter shows scattered dense rounded opacities. According to Professor Matthew Stewart, a characteristic finding is the so-called "asbestosis" bodies in the sputum of workers suffering from the disease.

France. The only item of interest in this country is the issuance of a decree by the French Ministry of Labor in November, 1929, which obliges doctors to make notification of pulmonary affections caused by dusts of silica, lime, clay, or coal. The object of this is to obtain information as to the incidence of this type of difficulties. Feil believes that the decree should be modified to require notification of silicosis only.

Germany. In general, German investigators consider occupational dust the most important subject of industrial hygiene and that dust stands in first place as a cause of occupational disease.

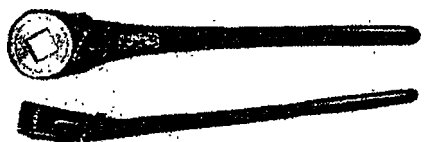
Jötten-Münster summarizes the investigation carried out by the Government Research Division of the Institute of Hygiene, University of Münster, Bochum, Germany, in stating that the severest experimental

(Please turn to page 76)

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Industrial Health

(Continued from page 46)

changes were observed to be caused by steel grinding dust, the next by dust of high silica content, such as rock dust (with clay slate) and porcelain. Coal dust and lamp black had a moderately injurious effect while cement, limestone, Thomas slag, textile, and tobacco dusts were still less injurious, with lime dust in the form of calcium hydroxide the least harmful.

A difference of opinion occurs among German investigators on the effects of dusts. Hollman of Solingen believes that tuberculosis should not be regarded as an occupational disease since its course is not more severe and the fatality not higher among grinders than among other industrial workers. There appears to be an individual constitutional disposition toward pneumoconiosis, the preliminary conditions of which have not been satisfactorily investigated in a scientific manner. As a preventive procedure, X-ray examinations and investigations should take place in dusty industries every two or three years. The most important problem is prevention and this can be accomplished by the reduction of the dust hazard and controlling the spread of tuberculous infection.

Von Döhren thinks that individual disposition toward the development of pneumoconiosis is important and that the measure of this has not yet been indisputably determined. The time required for the development of pneumocotic changes is extremely varied.

According to Sternberg there is still a wide differentiation between the findings of industrial dust-lung and the results of animal experimentation. This is explained on the basis of the anatomical-physiological difference between human and animal tissue, the long period of time required for the development of a dust-lung in man and other considerations.

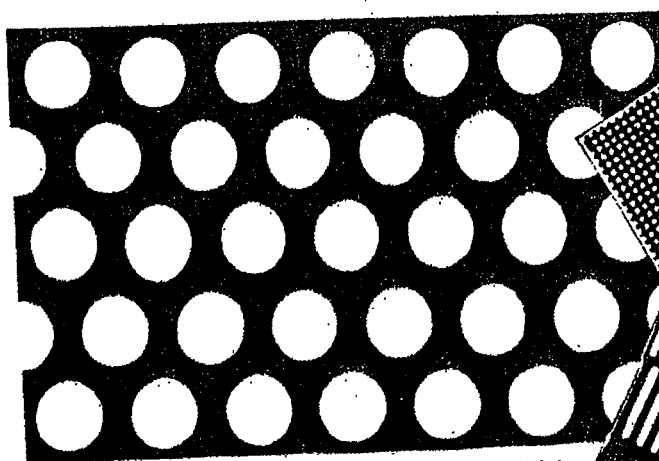
Grünwald thinks that most workers disregard the first results of the action of dust, believing that slight cough, sneezing and catarrh are necessary evils of the occupation and inherited weaknesses of their families. Frequently such minor changes go on to deep-seated conditions of the lungs. The significance of dust as related to the origin of an infectious disease, is not that it is

carrier but because it is a physical and chemical active preparatory irritation for retaining the tuberculous infection.

Russia. Various investigations have been carried out by the State Institute for Occupational Pathology and Industrial Hygiene of Ukraine. Porcelain dust was easily hydrolized when introduced into the animal organism, and caused local necrotic lesions and toxic effects of the internal organs. Crystalline kinds of silicate dust were not hydrolized; schamotte stood between porcelain and dust and flint and sand so far as hydrolytic properties were concerned; coal dust was not soluble; charcoal dust showed no observable picture of solubility and tissue reaction; marble and gypsum dust were hydrolized and tuberculous lesions determined around the foci of these dusts.

South Africa. The experience of this country can be very well summarized in the words of Irvine and Mavrogordato as follows: although it is believed that we have turned a big corner in the matter of silicosis, it is not anticipated that the actual number of cases detected will show any significant decrease in the immediate future. After years of hard work on the part of mining engineers, medical men, and others, a large measure of success has been attained, but it is incomplete. When in 1916 we found that the liberal use of water, suitably applied, would reduce the dust from drilling or blasting by 97 or 98 per cent by weight, the problem appeared to have been solved. It has been solved only so far. The question which we now ask is, could we not do better with less water and a greater extension of alternative methods?

In August, 1930, an International Conference on Silicosis was held at Johannesburg, South Africa, attended by representatives of the principal countries interested in this disease. Summarizing the results, Hall feels that although no material addition was made to pre-existing knowledge, it served the purpose of collecting together all the available information about dust diseases from all parts of the world; it showed the position of the gaps in our knowledge, pointing the way to future research; it made possible an agreement on standards for international research.



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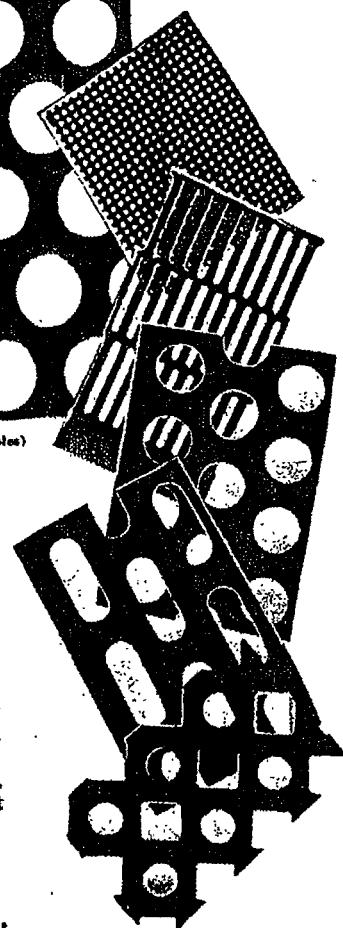
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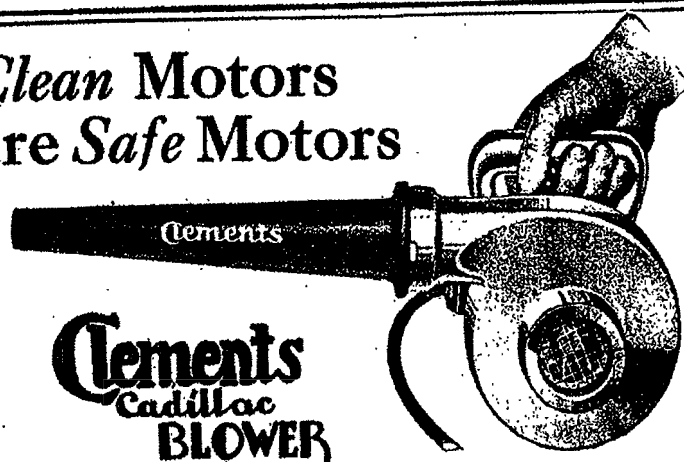
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