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39th National Safety Congress

NATIONAL SAFETY COUNCIL
425 No. Michigan Avenue • Chicago 11, Ill.

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*Resigned, October 9, 1951.

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Annual Council Meeting

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Minutes

The 1951 Annual Council Meeting of the National Safety Council was held in the Grand Ballroom of the Stevens Hotel, on October 8, with Mr. Ned H. Dearborn, President, presiding.

Following the singing of the National Anthem, the invocation was offered by the Reverend Kenneth N. Hildebrand, Minister of the Central Church of Chicago.

After appropriate opening remarks, President Dearborn turned over the chairmanship of the meeting to Mr. Charles R. Cox, President of the Kennecott Copper Corporation, and Chairman of the Board of Directors of the National Safety Council.

After a brief but sincere expression of his fundamental interest in the Council and the safety movement, Mr. Cox proceeded with the business of the meeting by announcing a quorum present, in person or by proxy. It was voted to dispense with the calling of the roll; also to dispense with the reading of the minutes of the previous Annual Meeting, the minutes having been printed and circulated to the membership.

Mr. Cox called for the report of the Nominating Committee, which consisted of the following members: George A. Jacoby, Chairman; Lawrence E. Dickson; Walter G. Legge; Miss Marion E. Martin; Guy L. Noble; Robert T. Ross; and W. A. Stewart.

Mr. Jacoby reported in behalf of the Nominating Committee, pointing out that the Constitution authorizes the committee to name candidates for election to the Trustees, to the Board of Directors, and to all Offices except the office of Executive Vice-President. The selections of the committee, Mr. Jacoby stated, were reported to the Secretary of the Council more than 75 days before this meeting, and were announced to all members of the Council on August 24, 1951.

Mr. Jacoby then presented as nominees for Trustees of the Council, to be elected for a three-year term: Melvin H. Baker, Cason J. Callaway, Cleo F. Craig, Frederick C. Crawford, Richard R. Deupree, Gustav Metzman, Benjamin O'Shea, Thomas I. Parkinson, Dr. John F. Thompson, C. E. Wilson, and Charles Deere Wiman. (Secretary's Note: A complete list of the Trustees, including those nominated and elected at this meeting, as well as those continuing in office from previous elections, is given on pages 6 and 7 of this volume.)

Mr. Jacoby presented nominations for Directors, to be elected for a term of one-year. (Secretary's Note: A list of the new Board of Directors, as nominated and elected at this meeting, will be found on pages 8, 9 and 10 of this volume.)

Mr. Jacoby presented nominations for Officers of the Council. In doing so, he stressed the Council's appreciation to four men who are retiring from their offices this year, namely, Dr. D. B. Armstrong, Vice-President for Homes; Kenneth B. Colman, Vice-President for Local Safety Organizations; E. W. Kempton, Vice-President for Membership; and Dr. John W. Studebaker, Vice-President for Schools and Colleges. (Secretary's Note: A list of the Officers nominated and elected at this meeting will be found on page 5 of this volume.)

There were no nominations, except those presented by Mr. Jacoby, and Mr. Cox announced that the entire proxy vote, numbering 10,781, was cast in favor of the nominees proposed by the Nominating Committee. Those attending the meeting also voted without dissent in favor of the nominations presented.

Mr. Cox referred to the booklet "The Fight for Life," which had been distributed to those attending the meeting. The booklet contained a summary of Council activities during the past year. Announcement was also made that the 1952 National Safety Congress would be held in Chicago October 20-24.

Officers of the

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NATIONAL SAFETY COUNCIL 1951-52

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Staff Representative—ARTHUR S. KELLY, National Safety Council, Chicago

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under the shade of a convenient elm tree. In any event, it should be appropriate, and due consideration should be given to the type of instruction which is to be given and the comfort of the employees.

As I mentioned a few minutes ago, some thought should certainly be given to the question of who needs training. A certain percentage of your employees can be depended upon to show up for work day after day and month after month. Perhaps this is 50 per cent and perhaps it is 90 per cent. The remaining 10 per cent or 50 per cent are the drifters down to a warmer climate when the wind starts getting cold. Any training program must be flexible enough to include both of these groups and to keep both of them interested. The job is not a simple one, but it is not impossible either.

Very little that is new can be said on the subject of training programs. The basic principles have existed for years, and the programs which have followed these principles have been successful. The failures have resulted when these principles were ignored. The safety engineer or safety director has available all the necessary tools and materials to solve this problem as well as nearly all the others which he may encounter. The wise safety man will avail himself of these tools which, if used properly, will assure him of success in his work.

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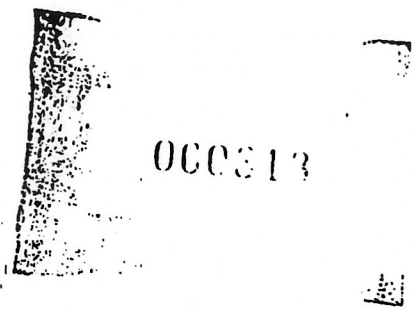
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a post about 25 feet from the face with the flattened discharge nozzle pointing toward the face. When the shotfirer has connected the wiring of his shots he turns the water and compressed air into the gun and regulates each until the discharge is in the form of a mist. He then goes to a safe place and fires the shots, and it has been found that he and the rest of the face crew can return to the face immediately, so that not more than five minutes are lost by waiting for the place to clear of smoke and fumes. About 12 pounds of powder is used per round of 8 shots. The device uses surprisingly little water. A test we made in the shops yesterday indicated only about 2 gallons per minute.

"The device used here seems to have been developed about 20 years ago by our present State Mine Inspector W. J. Evans at the Carbonado Mine of the Pacific Coast Coal Co., but was apparently not used extensively for a number of years. We have been using it about two years now.

"There is a good description on page 114 of the August, 1948 issue of *Coal Age* of an identical device used by the Hudson Coal Co. of Scranton, Pennsylvania. Also, of a much larger device used by the Walsh Construction Company in extensive rock tunnel work on the Delaware Aqueduct water system for New York City, as described on page 6224 of the August, and page 6230 of the September, 1940, issues of *Compressed Air Magazine*, from all of which it would seem that you should be able to effect improvements by the use of mist-sprays in the working faces of your Potash Mines."

Roof Drilling with Dust-Control Equipment

By JAMES WESTFIELD
Chief, Accident Prevention and Health Division, Region VIII,
Bureau of Mines, Pittsburgh, Pa.

Drillings for roof bolting have created a new dust problem for the coal-mining industry. Drilling is inherently dusty, and control of the dust produced by drilling vertical, or nearly vertical holes is much more difficult than control of that produced by drilling flat or down holes. Moreover, the dust produced by roof drilling differs in composition from that produced by drilling or cutting the coal face, in that it contains a significantly greater amount of free silica and therefore presents a greater potential hazard of causing the lung disease, silicosis.

Roof bolting has been practiced successfully in the mines of the St. Joseph Lead Co. in southeastern Missouri for over 20 years, but it was not until 1947 and 1948 that large-scale roof-bolting experiments were first conducted in coal mines. Although the need for dust control in conjunction with roof drilling was recognized from the beginning, the development and acceptance of roof bolting progressed so rapidly during 1949 and 1950 that solution of the dust problem lagged behind other engineering phases of the technique.

The roof generally is bolted where the immediate roof is soft and in many instances where the roof bolts can be secured firmly into a harder or more substantial formation above. The types of strata found in drilling a roof are coal, shale, sandstone, limestone, and all the impure and intermediate variations of these materials.

A comprehensive study of the geologic sections of the immediate roof of mines in Region VIII of the Bureau of Mines, where roof-bolting studies are in progress, reveals that 67.7 per cent of the footage of all the holes drilled for roof bolts is in shale, 23.4 per cent is in sandstone and sandy shale, 7.1 per cent is in coal and coaly shale, and 1.8 per cent is in limestone.

Shale consists chiefly of kaolin, muscovite, and quartz, with small amounts of many other minerals. Sandstone consists principally of quartz, with a cementing material of silica, calcite, or limonite. A limestone consists chiefly of calcite, with varying amounts of quartz. Even the coal may contain a small percentage of quartz. Thus, quartz is present in significant amounts in about 91 per cent of all the rock drilling for roof bolting.

The free-silica content of a mineral material (quartz is the most abundant form of free silica) is determined most accurately by the X-ray diffraction method, which is based upon the specific diffractive properties of crystalline substances. This method requires only a small sample, and the small size of industrial dusts does not affect the results adversely. Determination of free silica by this method was developed in part in the Bureau of Mines, where it is now used for quantitative analysis of samples of rock, rock dust, drill cuttings, and air-borne dust.

The free-silica content of the roof strata of 51 coal mines has been determined by X-ray diffraction analysis from roof rock, drill cuttings, and midget-impinger samples of air-borne dust collected in mines in nine Eastern States.

The average free-silica content of 80 samples from these mines is 31 per cent, and it ranges from seven to 88 per cent. The free-silica content of the roof strata of 43 of the mines classified as having shale roof averages 26.5 per cent and ranges from seven to 62 per cent. The free-silica content of the roof strata of eight of the mines classified as having sandstone roof averages 55 per cent and ranges from 31 to 88 per cent.

These results show that wide variation may exist in the composition of various roof strata and that the content of free silica encountered in drilling a shale roof may equal or exceed that found in drilling a so-called sandstone roof.

Although the composition of a mineral source material may not be considered an exact index of the composition of air-borne dust produced by mechanical disintegration of the material, some evidence on this subject is available. Unpublished data developed by the Bureau of Mines indicate that the quartz content of air-borne dust decreases as the time of settling increases, and direct comparison of analyses available in the Health Branch of the Bureau of Mines also indicates that the free-silica content of the air-borne dust produced by drilling is somewhat, but not significantly, less than the free-silica content of the material drilled.

These results, though too limited to be conclusive, give some justification for using the analysis of the source material in evaluating the dust hazard, particularly since the error, if any, is on the side of safety. It may be pointed out also that Industrial Code 53 of the State of New York, Control of Silica Dust in Rock Drilling, bases its definition of "injurious silica dust concentration" upon analysis of the source material drilled.

Any dust breathed in large quantities over a long period can impair the health of a worker, and silica is recognized as definitely harmful when inhaled into the lungs. Coal dust is less harmful but should not be considered completely harmless.

The hazard of exposure to silica-bearing dust is commonly gaged by the number of dust particles found in a unit volume of air and the free-silica content of the dust. Limits for occupational exposure expressed in such terms have been suggested by evaluation of the results of numerous clinical and engineering studies.

The Bureau of Mines has made the following tentative recommendations on allowable limits of air dustiness:

"In bituminous and lignite mines, the average full-shift concentration of atmospheric dust to which a workman may be exposed should not exceed 20 million particles per cubic foot of air, and a maximum concentration for any single operation should not exceed 40 million particles of dust per cubic foot of air. When the dust contains silica, not more than five million particles of silica dust per cubic foot of air should be present in the above limiting concentrations.

"The dust count may be multiplied by the percentage of silica concentration, and if the result is less than five million the dust concentration will be considered safe. The above limiting concentrations are based on impinger samples in which light field counts are made under a microscope."

To maintain these standards a dust concentration higher than 18.9 million particles per cubic foot of air would not be allowable when the average shale roof is drilled, and a dust concentration higher than 9.1 million

would not be allowable when the average sandstone roof is drilled. A dust concentration no higher than 5.7 million would be required in some instances.

Table 1 lists the types of drilling equipment used for roof drilling, the number of mines using each type, and the number of mines using or not using a dust-control method with each type. It can be seen that at 71.1 per cent of the mines roof is drilled with no dust-control equipment; contrary to the Bureau of Mines recommendation that "a dust respirator is not to be used as a permanent substitute for dust-control measures," reliance is placed upon the protection offered by respirators.

Table 1.—Roof-Drilling Dust-Control Practice, All Coal Mines, Region VIII

Drilling Equipment	Total Number	Some Method	No Method
Pneumatic percussion	278	91	187
Electric rotary	57	2	55
Hydraulic rotary	8	3	5
Pneumatic percussion and electric rotary	6	5	1
Pneumatic percussion and hydraulic rotary	4	1	3
Total, all types	353	102	251
Per cent, all types	100.0	28.9	71.1

Table 2 shows what dust-control methods are used in conjunction with pneumatic percussion, electric rotary, and hydraulic rotary drills. Note that the applications of dust collectors outnumber the applications of water.

Table 2.—Dust-Control Method and Application to Drilling Equipment, All Coal Mines, Region VIII

Dust-control method	Drilling Equipment: Pneumatic percussion	Electric rotary	Hydraulic rotary	Totals: Number	Per cent
Application of water	46	—	3	49	13.5
Dust collector	51	7	1	59	16.3
None	191	56	8	255	70.2
Total applications				*363	100.0

*Includes 10 mines using 2 types of drilling equipment.

Dust concentrations recently observed in five mines where stopper-type pneumatic drills are used without dust-control equipment averaged 607 million particles per cubic foot of air and ranged from 51 to 1,194 million particles per cubic foot. In six mines where electric rotary drills were used without dust-control equipment, the dust concentration averaged 31.3 million particles per cubic foot and ranged from 10 to 1,185 million particles per cubic foot.

The dust concentrations cited are indicative of the dust exposure of the driller but were obtained under such variable conditions that they should not be used for direct comparison. For instance, the averages indicate that pneumatic drilling produces twice as much dust as electric rotary drilling; actually the ratio may be higher.

The ranges indicate that either type of drill may produce dust concentrations higher than one billion particles per cubic foot of air. This amount of dust can pollute the air to such an extent as to constitute a serious menace to the health, not only of the drillers, but of any persons working in the return air from the place where drilling is being done.

Dust produced by roof drilling must be arrested or collected at its source if it is to be controlled adequately. This can be done by water or a dust collector. Water can be used effectively with pneumatic percussion or hydraulic rotary drills. Dust collectors can be adapted to any type of drilling equipment.

Introduction of water to the bottom of the hole through the drill steel when drilling is done with pneumatic percussion drills has been accepted as standard practice in metal mines. This practice is applicable to roof drilling and complies with the Federal Mine Safety Code requirements. Successful control by this method depends mainly upon maintaining the flow of enough water through the drill, using water continuously during the drilling period, and providing positive ventilation as needed.

High dust concentrations can result if too little water is used, especially when vertical holes are drilled with a stoper-type drill. It is advisable to maintain adequate water pressure so that a full flow of water can be realized. Collaring dry—that is, drilling the first few inches of hole before opening water valve—can also cause high dust concentrations and should not be allowed.

During recently observed roof drilling with a wet stoper drill, dust concentrations averaged 13.3 million particles per cubic foot of air and doubtless would have been lower had not all the holes been collared dry, as conditions for maintaining low dust concentrations otherwise were excellent. Wet drilling must be supplemented by ventilation to obtain the desired control, as the water does not arrest the dust completely. Other conditions being favorable, normal ventilating currents should prove adequate but will have to be directed to the drilling operation.

The most frequent objection to wet, pneumatic percussion drilling is that it is a disagreeable task. The splashing of the water and drill cuttings and the wetness underfoot are particularly objectionable to the driller when the headroom is limited, as in many coal mines.

Various hydraulic rotary drills have been developed, and the use of water to control the dust reportedly has been successfully applied to them. The Bureau of Mines has not as yet had opportunity to observe the results obtained.

The need for a water-distribution system or the use of inconvenient pressure tanks, the adverse effect upon some mine roof and floor, and the difficulty of using water with electric drills are other factors that limit the use of water to allay drilling dusts. Results of tests conducted with wetting agents, foam, and various types of water sprays, all with the hope of minimizing these factors, have been unfavorable. Satisfactory equipment for producing and applying foam has not been developed; water sprays have proved inefficient, and thus far the performance of wetting agents has not justified their use.

The operating principle of most dust collectors is application of exhaust ventilation near the source of the dust. Numerous dust-control systems based upon this principle have been devised for controlling dust produced by all types of pneumatic rock drills. Some of these have demonstrated that, by proper application of this principle, successful results could be obtained, even under the most difficult conditions. Regardless of results, unfavorable operating features restricted their complete development.

With the advent of roof drilling, the possibility that their use here might overcome the serious objections to wet drilling and the fact that they were applicable to electric rotary drilling again stimulated their further development. To meet this need, several types of dust collectors now have been made available commercially, and others have been developed and used locally.

In 1950, the Bureau of Mines inaugurated a program at the Experimental Mine, Bruceton, Pa., for testing dust-collecting devices developed commercially for application to roof drilling in coal mines. The reasons for conducting these tests were to assist the designers of the equipment by evaluating the effectiveness of the devices under controlled test conditions and to enable the Bureau of Mines to obtain information on dissemination of dust during roof drilling, and on methods of controlling it, that will be beneficial to the mining industry.

Under this program, performance tests were conducted for six different types of dust-collecting systems. Each design has included a collecting head, an exhaust ventilating system, and means for removing the entrained dust load from the air passing through the system before releasing it to the mine atmosphere.

The design of the hood is most important because it affects the dust-collecting efficiency directly and dictates the performance required of the other parts of the collector. Drilling in hard roof produces fine, readily transported particles, whereas drilling in soft roof, such as occurs above the Pittsburgh seam, produces large, scalelike particles that tend to plug a duct collector unless it is designed to accommodate their transport. The collectors apparently most successful have overcome this difficulty by avoiding restrictions and using the effect of gravity to full advantage in moving the drill cuttings from the hole.

The provisions for a tight seal where the drill steel passes through the hood are more critical than the provision for a seal where the hood contacts the roof. Unfavorable results caused by an ineffective drill rod seal cannot be overcome by any reasonable amount of exhaust ventilation. Either positive pressure exhausters or air injectors can provide an adequate rate of exhaust ventilation if the previously mentioned difficulties are avoided.

Removal of the dust load from air passing through the system has been no problem, being accomplished either by gravity

paration of the large particles and mechanical filtration of the fine particles or, more simply, by mechanical filtration alone. Two collectors have been designed for removing the dust load by a washing action.

No attempt has been made to evaluate the features of the various collectors other than their collecting efficiencies. It is obvious that size, weight, and portability should be given more consideration. It is noteworthy that one of the most successful dust collectors is so compact that one man alone can move it about and set it up with ease.

The results of some performance tests have shown that it is possible to reduce roof-drilling dust concentrations to five million particles per cubic foot of air with dry-dust collectors and that a dust collector can perform satisfactorily with either pneumatic percussion or electric rotary drills.

The favorable results obtained under severe test conditions indicate that dust produced by pneumatic roof drilling can be controlled more effectively by the use of an efficient dry dust collector than by the application of water.

The performance tests are not to be construed as approval tests, such as are conducted by the Bureau of Mines on other types of equipment under provisions of appropriate published schedules. Such a schedule, establishing permissibility tests, is being prepared and upon completion will allow the Bureau of Mines to grant formal approval to equipment passing the prescribed tests. Approval-schedule procedure tests have demonstrated the ability of dry-dust-collecting equipment to control dust in accordance with the tentative Bureau of Mines recommendations previously discussed.

Article IX, Section 1b, of the Federal Mine Safety Code is specific in requiring the use of water for controlling dust where roof or other rock is being drilled with percussion drills. This precludes the use of dry-dust collectors, successfully or otherwise, and the federal coal-mine inspector has no alternative but to cite a violation of the code where this practice is observed. The citation is not capitalized, as normally would be done when a serious hazard to health exists, if, in the inspector's opinion, the dust collector is doing a good job. Statements of the facts of the case are included in the report under the heading "General Information." The Bureau of Mines recognizes the situation of an operator thus cited and suggests that he appeal from the citation to the Joint Industry Safety Committee.

Acceptable dry-dust collectors have been developed, and the Bureau of Mines has proposed to the Joint Industry Safety Committee a revision of Article IX, Section 1b, to permit the use of dry-dust collectors with pneumatic drills.

Article XI, Section 7g, of the code states that men exposed to gas, dust, fume, and mist inhalation for short periods shall wear permissible respiratory equipment. Rock drilling, other than roof drilling, has been excepted from dust-control provisions, in many instances, under this section.

A comprehensive study of the airborne dust resulting from rock drilling in coal mines has been undertaken by the Bureau of Mines; and data obtained from this survey indicate that, in some instances, rock drillers and other workmen are being exposed to injurious concentrations of dust. The application of dust control to roof drilling will stimulate the application of dust control to other rock-drilling tasks. Rock drilling without dust control cannot be justified if and when suitable control methods can be applied.

Summary

1. In Region VIII, 353 coal mines are using roof bolting, and 63 million square feet of roof area are being supported by roof bolts.

2. The roof strata drilled for roof bolting contain significant amounts of free silica. The samples taken from 51 mines in Region VIII show that the free-silica content averages 31 per cent.

3. Roof drilling without provisions for dust control results in a serious health hazard, as drillers and other workmen in the return air from the place where drilling is being done are exposed to dangerously high concentrations of silica-bearing dusts.

4. Dust-control methods are not used in conjunction with roof drilling at 71 per cent of all the mines in Region VIII where roof bolting is being practiced.

5. Wet pneumatic roof drilling, if properly conducted, results in favorable dust concentrations, but it can affect the mine roof and floor adversely, is a disagreeable task (particularly in low coal), and requires a water-distribution system or use of pressure tanks.

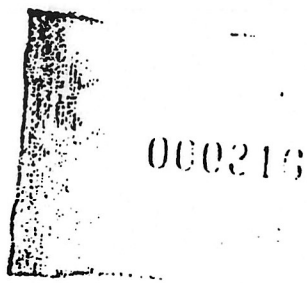
6. The development of dust collectors has been stimulated by the need for overcoming the objectionable features that accompany wet pneumatic roof drilling and by the fact that they can be adapted to electric rotary drills.

7. The Bureau of Mines inaugurated a program for testing the efficiency of dust-collecting devices developed commercially for application to roof drilling in coal mines, and the test work proved that the principles applied in these dust collectors are adequate.

8. In inspecting mines the federal inspector is forced to cite a violation of the Federal Mine Safety Code when roof drilling is done with a pneumatic drill, even if a dry-dust collector is used successfully; as a result, the Bureau of Mines has asked the Joint Industry Safety Committee to revise the code to permit use of dry-dust collectors in connection with roof drilling.

9. Control of the dust produced by roof drilling is difficult but must be accomplished. The effort being expended toward proper application of wet methods and newly developed supplementary devices should result in a high degree of success.

10. Rock drilling other than roof drilling has been excepted from dust-control provisions in many instances by the Federal Mine Safety Code. This exception has resulted in rock drillers and other workmen being exposed to injurious concentrations of dust. Development and application of dust control to roof drilling will stimulate application of dust control to other rock drilling tasks. Rock drilling without dust control cannot be justified if and when suitable control methods can be applied.



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The furnace continued to radiate to the steel structural and building walls. No provision was made for air supply from the basement or within the work space. The monitor remained in its conventional form dependent entirely upon gravity for removal of heat and gases from the furnace itself. This represents the condition that existed until a few short years ago in most of our plants.

With the application of the present knowledge of radiant heat, we continued to use the circulating fans in the space surrounding the furnace. Added to that were several sources of forced air supply through the floor in the workspace. In addition fans were placed in the walls of the building to produce a positive pressure within the building walls. Radiant shielding was installed by dropping corrugated aluminum sheeting from the roof level to within three feet of the floor and an extended hood type structure completely surrounding the furnace or hot object. To assure ourselves that positive flow would take place behind this shield, in some cases we have installed power type roof ventilators commonly used in the foundry trade.

The curtain or shield surrounding the furnace served two distinct purposes. They keep the radiant energy entirely confined to a central area. The infra-red cannot escape to be absorbed by the steel of the structural parts of the building which in turn might become a secondary radiant. Generated gases stay within the structure and do not escape into the work space. We are sure that the temperature on the outside of these shields will remain within a few degrees of that of the outdoor temperature. Circulating fans remain to assure ourselves that the air will remain uniform in temperature throughout the work areas.

While this installation may not be a profound one engineeringwise, the following will illustrate an actual installation using this principle in which very effective results were obtained over one very hot summer. A light steel framework was erected entirely around the hot furnace. Corrugated aluminum was attached directly to this light structure by means of a blank cartridge actuated nailing device. In this way we were able to erect the entire shield in a comparatively short time.

We erected the shields to the roof level, allowing only very small openings for piping, electrical services and the necessary structural steel work. For an idea of the entire structure surrounding one large heated area; within the enclosure is a continuous type lehr or annealing oven. Openings at both ends were necessary to allow the continuous flow of materials. These openings were covered by a tilted hood type structure. Access openings along the sides of this annealing lehr were provided with overhead garage doors constructed or corrugated aluminum. Every other bay in the roof of the building was open to the sky either through gravity type ventilators or the power type.

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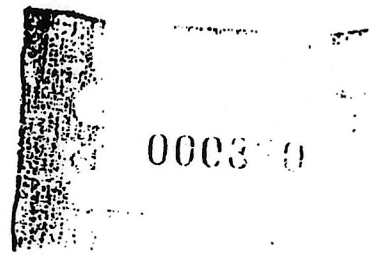
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Industrial Hygiene

Industrial Dusts—What Every Supervisor Should Know

By L. E. HAMLIN, M.D.
Medical Dir., American Brake Shoe Company, Chicago, Ill.

Most manufacturing procedures are capable of generating varying amounts of dust which may be visible, invisible, dangerous or inert. It is therefore important that these substances be properly classified in order to protect the health of employees and provide safe environments in which they may carry on their daily occupations.

Obviously the supervisor should have some knowledge of industrial dusts since the responsibility for enforcing measures instituted for their control usually falls upon his shoulders. Unless he has a good idea of the actual risks confronting him, he will be at a disadvantage in securing cooperation from those under his direction. Ability to answer questions concerning plant hazards in a convincing manner is a very important factor in any dust control program, and if the supervisor cannot explain the necessity of avoiding exposure to toxic materials the worker under his charge is very unlikely to pay attention to it.

On the other hand, a brief explanation that carries the ring of sincerity and truth can frequently correct unnecessary misunderstanding. For example, a capable young employee was worried about contracting silicosis because he worked in a plant where at times there appeared to be considerable dust in the atmosphere. He did not know that this dust was free from silica or other harmful ingredient, but his foreman did.

Knowledge of his own department enabled the supervisor to convince the workman that not only was the dust inert but also plans were under way for the installation of new ventilating equipment which would remove the particles that were already present. The man was satisfied and the company was able to retain the services of a good employee.

What then are some of the fundamental things a supervisor should know about industrial dusts? Dust is formed by reducing earthy materials to small size. Processes like grinding, crushing, blasting, and drilling produce dust particles of sizes from the submicroscopic to the visible.

Fumes are formed from combustion, sublimation and condensation. Those from burning or melting lead or zinc are typical examples. The size of the particles is generally below one micron. (A micron is 1/25,000th of an inch.)

Smoke is usually of organic origin from such things as burning tobacco, wood, oil or coal. The particle size is usually below a half micron.

Mists or fogs are formed by condensation of water vapor and the particle or droplet size varies widely.

The most important item to the supervisor is the realization that he may be dealing with a dust which can produce bodily harm. His first consideration should be "How is the man himself affected? Is the dust present in sufficient amounts in the air to be a source of danger? Does it exist in the pure state or is it mixed with other dusts? What is the actual count of particles per cubic foot of air, and what percentage of these is of respirable size (below 10 microns and especially those below three microns? How long does it take to develop occupational disease of the lungs from exposure to dust?"

All this may appear to be outside the scope of the supervisor's activities since after all his job is concerned primarily with production. However, most industries place the responsibility for carrying out safety measures on the foreman and it is apparent that his department will suffer if these are not properly enforced. Safety therefore includes precautions against occupational disease as well as accidents so that some knowledge of methods for controlling exposure from dangerous dusts, toxic fumes or other

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harmful materials is a proper part of the supervisor's armament.

It is not advocated that his duties be so expanded as to encroach upon the field of the industrial hygienist but it is reasonable and logical to suggest that he equip himself with the essential details concerning occupational risks in the department he manages. This information can be readily obtained from his company medical department or through other agencies such as the Division of Public Health of state and federal governments. These bureaus welcome inquiry of this type and their services are usually available without charge.

Much confusion and misunderstanding exists about the capacity of various dusts arising from occupational procedures to cause physical disability. Exaggerated reports and misrepresentation by individuals unfamiliar with their specific properties have incriminated certain materials known to be quite inactive and absolved others proven to possess harmful qualities. Experience accumulated through years of intensive study and research indicates that the great majority of industrial dusts have little effect on health other than their nuisance value and contribution toward poor housekeeping.

However, the fact that they are unlikely to cause occupational desease should not be used as an excuse to do nothing about them. A good working environment demands that they be removed in spite of their innocuous characteristics and the smart supervisor will do all he can to accomplish their elimination.

The wide assortment of dusts met with in industry makes their classification into "harmful" and "inert" categories difficult. Those arising from organic sources such as animal and vegetable products as a rule do not cause serious harm but are capable of producing local irritation like dermatitis or skin rashes, dental conditions, and inflammation of the eyes and the mucous membrane lining of the upper air passages.

The majority of harmful dusts encountered in manufacturing processes are inorganic in character. The specific effect on health varies. Chromium, cadmium, arsenic, and their compounds produce local irritation as do the organic dusts but they can also cause general intoxication if present in sufficient amounts. The dusts or fumes derived from the heavy metals like lead, mercury, and manganese can be highly toxic and poisoning from these substances has been recognized for many years.

Recently serious and even fatal illness has been found to occur from exposure to beryllium and some of its compounds while another occupational condition known as "Shaver's Disease" has produced severe damage to the lungs of workers exposed to fumes arising from the fusing of bauxite, the chief ore of aluminum, in the manufacture of artificial abrasives.

Generally speaking, the particle size which is most dangerous is in the range of one-half to three microns in diameter. Particles larger than these seldom reach the alveoli or terminal air saces of the lungs since they are filtered out by the "cilia" or natural protective mechanism of the nose, throat, and large bronchi. There is also good evidence that particles below one-half micron in size may be retained in the lungs in sufficient quantities to result in disease. This means that the visible dust in a working place may not be as dangerous as the particles which are not seen by the naked eye.

Industrial hygienists emphasize this and also point out that although the amount of visible dust in the atmosphere in the vicinity of a certain job appears great, it does not necessarily mean that the workman is inhaling significant quantities of harmful particles. The exposure may be intermittent and of brief duration, or the air at the breathing level of the employee may be sufficiently clear that no undue risk is involved.

With the exception of beryllium and bauxite few of the aforementioned dusts cause damage to lung tissue and, as explained previously, not every person so exposed does develop occupational disease.

At the present time it is generally agreed that the most important sources of industrial disease of the lungs are free or uncombined silica and asbestos. Silica or silicon dioxide which makes up approximately 60 per cent of the rocks and minerals of the earth's crust, is the specific cause of the ailment affecting the lungs of workers in dusty trades, known as silicosis.

It is very important to recognize the fact that this widely known condition cannot be acquired from any material other than free silica and also that it happens only when particles smaller than ten microns in size of this mineral have been inhaled over long periods of time, such as from two to 25 years with an average of ten years. The term "free silica" usually means quartz of which there are many varieties. There are also other forms of free silica.

The scarring or fibrosis of the lungs which results from the action of uncombined silica casts characteristic nodular shadows in the chest roentgenograms of those affected. Frequently this is the only way the disease can be detected as it causes no symptoms in the early, uncomplicated stage.

Other dusts may produce x-ray patterns which are difficult to differentiate from silicosis and some unrelated illnesses may resemble it closely. The x-ray picture observed after the inhalation of iron oxide particles among some welders and grinders shows densities which are all too often mistaken for those seen in silicosis. Since this condition (siderosis) is harmless, the implications of such misdiagnosis are obvious.

Unfamiliarity with industrial diseases of the lungs by those charged with evaluating them properly has resulted in employees becoming needlessly alarmed, forsaking their jobs and forfeiting seniority while industry has lost good workmen and production. It has also paid unjust claims for disability In a situation of this sort the supervisor suffers along with the rest since his department is bound to be affected by these conditions.

To attempt to tell the supervisor all h should know about the extensive subject o industrial dusts is an impossible assignment Suffice it to say that the more he learn about them through his own volition, th better his qualifications for his job will be Through such enterprise he will enter a new field of endeavor and discover a fascinatin experience which will pay dividends both t himself and his company.

The complexity of problems which co front the director of any department i today's exacting requirements presents formidable challenge to his resources, an this, along with the working man's reason able insistence on a better place to worl demonstrates that a knowledge of industri hygiene may well be a most important facto in the efficient discharge of his duties.

The best treatment of any disease associated with industry is not to let it happe in the first place. The problem is for engineers rather than physicians, but, regardless of the one on whom the burden falls, th final outcome depends upon the interest an efficiency of the man who manages a department.

Occupational Dermatitis; Teamwork in Engineering and Medical Control

By WALTER F. SCHOLTZ
Supvr., Industrial Hygiene, Allis-Chalmers Mfg. Co., West Allis, Wis.

We have accepted the challenge that occupational dermatitis presents to industrial medicine, and accordingly it can be stated that with proper care and intensive educational programs, occupational dermatitis can be checked and great savings effected.

Through the institution and maintenance of control measures workmen can be protected against dermatitis producing oils, chemicals, etc. The ideal control measures will protect workmen all along the line—from the manufacturing of the basic materials to the completed fabricated part.

Modern industry today is becoming so cognizant of the benefits of good preventive measures that they are not only relying the worker alone, but are seeking the team work of everyone concerned.

Since the proof of the pudding is in the eating, I would like to state what has been done through a concentrated program of occupational dermatitis control and prevention which started in 1943 at the West Allis works of our company. This concentrated program has resulted in a 71 per cent decrease and a reduction from 10.3 to 2.7 the number of cases per million man-hours of exposure.

The Evolution of Safety

By CAPTAIN EDWARD C. HOLDEN, JR.
Vice Pres., United States Protection & Indemnity Agency, Inc., New York, N. Y.

There was a time when, in the minds of many, the science of safety was the subject of derision and mockery, a time when it stood as a sort of fringe of disconnected mysteries bordering upon the black arts, a dangerous sort of thing capable of looking with equanimity upon the evils which lay on one side of it and with a hopeful and benign expression upon the conventionalities of life on the other.

Accidents were often considered to be acts of God and to take care was a violation of one's trust in God. In any event, in many circles, it was not polite or politic to speak frankly about safety, of human slaughter or the barbarities of accidents resulting in death or permanent disability, of human suffering and all the other attributes of such cases. The human tendency was to "soft-pedal" talks about safety and the accident problem. So, the whole safety movement was looked upon with a huge question-mark. A consistent "do-nothing" attitude prevailed in so many instances that the frequency and severity of accidents continued to increase at an alarming rate and became an economic burden.

Undaunted, a pioneering spirit prevailed in the regions of scientific safety inquiry. Although the voice of the safety advocate was all but lost in the wilderness, nevertheless his work continued in the firm belief that the man who dares to do something worth-while will utilmately gain a following.

As the fruits of accident prevention became more and more evident, it gradually developed to a stage where it could be regarded, at least, as respectable; and, the main criticisms of it concerned its so-called impracticability. Some executives said: "Safety will cost too much." Others said: "Safety is a fandangle idea, it will not work." And still others remarked: "We don't want these safety people telling us how to run our jobs, our business, etc., etc." This was the Age of Adolescence of the science of safety.

Then came the Period of Maturity, when the science of safety, feeling the strength of its wings, could no longer harbor itself within the cloister, but came out into the open and made the affairs of men its concern.

The Age of Utilitarianism in the science of safety was upon us. More and more the conservation of men's lives was done by the product of man's intellect in the processes of management rather than by resorting to the caprice of superstition and the vagary of the mystic charm, "Lady Luck."

The science of safety now stands ready, a willing servant, to reduce the uncertainties of life to the ultimate minimum when we, her masters, direct her efforts and utilize the skill which is within her.

As I have sat from time to time in gatherings of executives who are interested in safety, such as this meeting of the marine industries, I have been impressed with an ever growing feeling of cooperation and mutual understanding looking toward the solution of accident problems. You demonstrate that no human progress can be made unless we remain critical of defects, alert as to practical needs and fertile in mind and thought for possible improvements. The time worn doctrine of "laissez-faire" can no longer be accepted if business is to survive the perils and costs of accidents.

The entire marine industry owes a peculiar debt to you leaders within the industry who have recognized that safety has brought increased efficiency in operations. You have contributed much to the conservation of manpower which is all important during these critcal days of national emergency.

We know that you will not relax in your safety activities. To the contrary, we are convinced that you will increase the tempo of your efforts to meet new, challenging conditions. The greatest challenge of all is to prevent human failure in shipyards and in ship operations. This calls for continued and more intensive training programs.

By your safety endeavors, you will long be remembered with profound gratitude by all who go down to the sea in ships as well as by those who helped to build the ships.

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safety in steel warehousing where the variety of sizes, types, grades and finishes of the steel carried in regular inventory is particularly great.

Problem number four was the employee's mental attitude in relation to the work pattern of the industry. The high degree of flexibility in daily job assignments, bringing about a constant change in duties and industrial environment, demands a general safety knowledge of the warehouse operation. This is difficult to establish except through experience gained during an extended employment period.

The Use of Wetting Agents to Control Dust in Industries

By G. A. MAU
Vice Pres., Johnson March Corp., Philadelphia, Pa.

Within the past two decades chemists have developed materials with properties similar to soap but without the limitations, resulting in a large number of compounds with remarkable physical properties. The behavior of these materials has suggested their use in a wide variety of industrial fields.

These materials are known as Surface Active Agents since their primary effect is at the boundaries or surfaces between two phases.

Reduction of interfacial tension, lowering of surface tension, increase of wetting power, deflocculation and emulsification are some of the results of this activity. The synthetic surface active agents first came into use in this country about 1930. In the few years since their introduction, they have become numerous and varied, and have found many uses in diverse fields. The surface active agents can be subdivided into five groups. Wetting agents, penetrating agents, dispersing agents, emulsifying agents and foaming agents.

Reference will be directed particularly to the first and second groups. Namely, wetting agents; producing increased wetting or spreading of an aqueous solution or suspension over a repellent surface and the second group, penetrating agents, providing more rapid passage of a liquid into a porous solid.

With the above brief discussion on surface active agents, or as I will refer to them from now on as wetting agents or compound, I intend to discuss the use of wetting agents to control dust in industry and particularly, the foundry.

I like the popular definition of a wetting agent, which merely states that a wetting agent added to water makes it wetter. Perhaps, we should state for the purpose of keeping the chemical terminology straight, that a wetting agent is a material which, when added to water, or to any other liquid, will cause considerable reduction in surface tension. Safety and health have been benefitted by the use of wetting compounds in many industries. Safety—in providing better visibility around plant and equipment, health by preventing the absorption or inhalation of dust.

Dusts, whether toxic of not, are harmful and an attempt to group dusts under the headings "active" and "inert" (with reference to effect on health) has proved unsatisfactory. Investigations have proven that practically all dusts may be harmful if breathed in large amounts over long periods.

In this country, dust diseases usually designated as "silicosis" is more or less common among workers in the mining, grinding, granite and foundry industries. According to Lanza and Vane, the estimated number of men exposed to Silica-Bearing Dust in various industries are as follows:

Process	Percentage of All Employees	Number Exposed
Metal mining	100	62,000
Anthracite coal mining	20	30,000
Quarrying of granite, ganister, sandstone, etc.	100	22,000
Smelting & refining	100	18,000
Foundry workers	100	200,000
Potteries, glass works, stone products	50	70,000
Grinders, buffers, sand blasters, vitreous enamelers		62,000
Estimated total for mining, quarrying and manufacturing industries.		450,000

In addition to these there are "thousands of workers who have been exposed to silica dust in these various occupations and are now engaged in other forms of work."

In order that we may better understand the purpose of this discussion on wetting agents for dust control it will be necessary to discuss the dangerous dust particle size and the wetting effect of raw water compared to wet water with the proper surface tension and group combination.

Not all of the particles of inhaled dust gain access or are retained by the human lungs. For these reasons, the size of the dust present in the industrial atmosphere should be determined.

Investigations have proven that particles greater than 10 microns in longest dimension are very seldom found in the lungs, and that the particle size found most commonly in lungs were three to five microns. Due to gravity which causes rapid settling of suspensions and due to the protective action of the mucous surfaces of the upper respiratory tract, the larger particles do not penetrate to the terminal portions of the lungs.

Therefore, it is obvious that attention should be given chiefly to those particles which are less than 10 microns in longest dimension and which can enter the lungs.

This group particle size is very difficult to wet, and requires not only a low surface tension liquid but a fine atomizing spray nozzle. Dust control by wetting depends for its effectiveness upon the fact that, once the dust has been trapped in water or some other liquid, the particles are not easily dispersed again in the air, until proper disposal has been made.

Dust control by wet methods is attractive from the standpoint of cost but has not been highly successful in certain industries, with raw water. Many articles have been written quoting not too good results in such applications as grinding wheels, rock drilling, mining, etc.

Dust control with water is better than no wetting at all, but would not reduce the dust count sufficiently to be safe, and in the case of some dusts, could not be wetted at all, especially the sizes 10 microns or less.

To obtain better wetting, experimentation led to the use of wetting agents.

The physics of wetting is not entirely understood. This phenomenon is basically one of [illegible] surface a film of liquid must be adsorbed upon the solid before wetting can occur. A liquid will spread on a solid if the surface tension of the latter is greater than the sum of the interfacial tension between the solid and liquid and the surface tension of the liquid.

Therefore, the wetting power of a liquid increases with a decrease in its surface tension. Many dusts are wetted only with great difficulty because of the presence of another film already adsorbed on the surface. This film might be adsorped air, which occurs in a dust cloud. Then wetting will not take place unless the spreading force of the liquid is great enough to drive off the air layer.

A wetting agent or compound of surface active agent groups will in most cases furnish the spreading force of the liquid to drive off the air layer and wet the dust.

Time will not permit a discussion of other than the high points of dust control in the foundry industry.

About three years ago, I was handed some foundry dust that was collected around the muller, and asked whether it could be wetted with a wetting agent. Much to my surprise, it was a combination of foundry dusts that did not respond to water or any single type or group of wetting agents known at that time. We finally found a compound of surface active agents that would actively wet this dust. Dusts difficult to wet can be wetted if the proper wetting compound is used and the application correct. One without the other will not work.

So far we have touched on a discussion of the types of wetting agents, that a liquid with low surface tension is best for wetting, providing the dust and liquid are compatible, that the size dust particle we should be most interested in is three to five microns or generally particle size less than 10 microns. This size compares to fog particle sizes.

The efficiency of wet dust control is dependent upon the degree to which the particles are wetted. Important factors that determine wettability of dusts are the proper wetting compound and the application of the proper particle size spray solution with nozzles designed for the application and spray pressures to insure [illegible]

Another big factor for efficient wet dust control is the selection of proper type nozzles. It is common practice to employ "a nozzle" whether a solid or hollow cone or flat sheet spray. No matter how efficient the wetting compound may be, if the proper nozzle with proper spray pattern and angle are not at the right location, results cannot be obtained.

The methods usually employed to obtain fine atomization are high pump pressures, liquid with air misting nozzles and very low capacity nozzles.

High pressures are not desirable for dust wetting. The high pressure spray causes the dust to disperse beyond the spray area.

Liquid air misting nozzles are very satisfactory for spraying areas 10-20 ft. from the nozzles. A very fine fog or mist spray can be obtained with these nozzles provided sufficient nozzles are used for the spray pattern. These nozzles are recommended for top spraying of shakeouts, sand conditioning, crane shakeout, etc.

Low capacity nozzles can be grouped and used on medium pressures (40-70 psi) to obtain fine particle atomization, for close proximity dust concentrations near equipment or conveyor transfer points, etc. These nozzles are now available in capacities of 2 to 24 gallons per hour.

Most wetting agents are shipped in concentrated form and require dilution when used for spraying. Efficient, durable, automatic proportioning equipment is required for successful wet dust control. Proportioners meeting these conditions over a period of years are now available.

Wetting Compounds are of great benefit to foundries, not only for dust control but for such things as fire fighting, core knockout, cleaning castings, core wash, reconditioning the moulding sand, cupola smoke control, sand tempering, etc.

Dust control at crane and machine shakeouts, mullers, floors, sand conditioning, grinding and cleaning departments are the areas where foundries have proven wetting compounds very successful.

The application of wetting compounds on foundry floors or walks, prevents dust arising when rolling equipment or men travel over them. It keeps the floating dust particles from becoming airborne. For general use, where the sand is accumulating over large areas and is not regularly removed, wetting compounds are infinitely more effective than spraying with water.

Plain water wets the surfaces of the floor sand, causing mud, or may run to lower levels causing puddles and excess surface moisture in spots.

Because very little penetration takes place air currents absorb the moisture rapidly, allowing the sand to dry and become dusty shortly after the water application.

When applying wetting compounds to the floor a flat cutting spray nozzle has been found most effective.

Wetting compounds permit the wetting of floors in the melting and pouring areas because of quick deep penetration of the moisture in the sand and much less possibility that sand near the surface will be wet enough to cause spattering of metal. Penetration with water is difficult and evaporates quickly.

Crane shake out of castings usually involve large areas in the main bays of many foundries. While the shakeout periods might be confined to night or early morning hours, when few employees are in the area, most of the foundry becomes contaminated with airborne dust that is easily vibrated loose from the building structure and equipment when the full force of workmen are at work. A fine atomized solid cone spray applied from nozzles attached to the crane bridge over the shakeout area has been used successfully at a foundry.

At another foundry, a special portable stand was built with the fog air misting nozzles, which, is placed in a position at oposite sides of the working which might be 25 feet or more in diameter. This type nozzle is also used for spraying over the shakeout table.

The fog air misting nozzle is used successfully to supplement exhaust systems on shakeout machines. If the table is large and the dust is not being properly exhausted, the air fog misting nozzle has successfully controlled the dust in areas not exhausted. It might be over the ends of extra large work extending over the table, or due to sand not leaving underneath the shakeout fast enough.

The amount of dust produced by sand conditioning equipment is influenced largely by whether the sand is handled dry or moist. The sand should be moistened with wetting compounds to eliminate dust before processing.

Wherever sand is thrown from conditioning machines, direct pressure nozzles with capacities considerably larger than the average dust nozzles are recommended. This nozzle must have a fine atomized spray because wetting of the sand is necessary to properly control the atmospheric dust. Dependent upon bin capacity, we also recommend for large bins air fog misting nozzles over the storage area to control the dust and to revive the treatment in the event the sand stands long enough to become dry and dusty.

Wetting compounds are being successfully used to control dust arising during skip at hand loading of muller operations, which are not exhausted. Small capacity nozzles mounted over the muller bowl will wet the floating dust particles with very little or controlled moisture. If tempering of sand is required, the wetting agent is introduced in the water line.

Core knockouts may produce even greater

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[illegible] dustiness than shakeouts. Fettling or chipping on large or small, irregularly shaped castings disperses enormous amounts of dust. Wetting compounds are effective in softening cores, making them dustless and much easier to remove from the castings.

There are many other applications for wetting compounds to control foundry dust, and there are certainly many more uses, such as tempering and penetrating agents. The few applications mentioned are merely to show the possibilities.

I trust I have explained: 1. The purpose of wetting agents, that practically any dust can be controlled with the proper wetting compound. 2. That dust particle sizes of three to five microns or sizes less than 10 microns require low surface tension liquids compatible with the dust. 3. That a wetting compound must be atomized to fine micron size droplets for dust control. 4. That correct nozzles for tempering and general wetting, and fool-proof equipment are necessary, automatic proportioning and nozzle control to make wet dust control a success

The Administration of Safety Programs

By A. C. BECKSTEAD
Dir., Safety and Technical Employment, American Smelting and Refining Co., Salt Lake City, Utah

In order to properly administer a safety program, it is first necessary to establish the proper organization. This organization must have the support of all individuals in the company from the chairman of the board and president to the newest pay roll employee.

Second, a definite safety policy must be formulated by all levels of management in conjunction with all members of the safety organization. This policy should be flexible enough to meet changing conditions and emergencies without causing confusion or trouble.

Third, it is necessary that the importance and proper emphasis to safety be recognized by all levels of management and by every employee in the company including employees just being hired.

Fourth, a definite follow-up and check system through reports and on-the-spot inspections should be conducted constantly to follow the progress of the safety program and to prevent bad practices from developing and enlarging.

Fifth, individual plant safety department must be provided with trained personnel and provided with the authority and equipment to do the job expected.

The following outlines the organization for the administration of a safety program as it is presently set up in the American Smelting and Refining Company. Here safety is recognized with the same importance as production by all levels of management.

The committee on safety and technical employment is composed of the top executives of the company including the chairman of the board, the president, the operating vice presidents, and representatives from the financial and legal departments. The direc-

served solely for engineers, rather, we do mean that people engaged in safety work must be able to analyze, to judge, and to decide. Mr. Ward, will you discuss this matter of analysis?

MR. WARD: Often, accidents seem to stem from uncontrollable factors, and the apparent cause is that the accident was due to a hazard inherent to that peculiar job or occupation.

Now, in safety work, such identification is not sufficient. Since we are interested in the elimination of unsafe acts and unsafe conditions, we must go further. We must seek out the real cause of the accident. This can best be done by the application of logic.

We must take what we have learned of the real cause and set up our objective—the correction of the factors which caused the accident. Accident investigation has no value, whatsoever, if it does not succeed in developing a safer method of doing the job on which the accident occurred.

Thus, we have completed three points in our accident analysis program. We have looked at the apparent cause; we have searched out the real cause; and we have established, and set up our objective. But the full accident analysis, as we see it, is made up of four points. We must establish responsibility; not necessarily responsibility for the accident that has already happened, but rather, responsibility for the correction of the conditions that caused the accident. We've all heard the old proverb, "Something that is everybody's responsibility is nobody's responsibility." It never had a better application than it has in accident prevention.

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