FILE NAME: Caterpillar (CAT)

DATE: 1966

DOC#: CAT040

DOCUMENT DESCRIPTION: Articles from National Safety Transactions

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ignore them or avoid them. After all, we're going to be hiring them into our plants for as long as you and I will be around.

Let's recognize that these are an exceptional group of youngsters. They're better educated than we are, starting to school earlier, and continuing longer. In fact, they're better educated than any generation in history. If you doubt that, try to help one of them with his homework. These young people are intelligent. They are numerically powerful, because half the population of the United States is now under 25 years of age.

What they do not have that we have is the experience of having lived for a long period of time. They may weigh too lightly the rules for safe plant behavior that we have developed through long and painful experience.

Seems to me this leads us directly back to Accident Prevention Fundamentals—systematically analyzing the man and the job, then thoroughly and carefully training, instructing, and observing.

Initial safety orientation, initial job instruction, regular planned safety observations with correction as needed, are all a part of this program to help the supervisor help the employee understand just what good job performance is, which in turn is good safety performance.

Is this an easy task? Definitely not. Is it time consuming?—definitely yes. If we're going to get the job done, the time must be spent. For only by this thoroughness can we really help them become safe employees, and they are vital to us.

We must pay this attention to these young men and women—for in a breathtakingly short time, they will be sitting here where you and I sit today.

Safety's future—indeed our future is likewise their future. Let's make the most of it.

Oı. _ERS OF THE

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UP-TO-DATE INDUSTRIAL HYGIENE

WHAT'S NEW IN INDUSTRIAL HYGIENE

Opening Remarks

By JACK RADCLIFFE
Supervisor Industrial Safety Section, Ford Motor Co.; Past Chairman Occupational Health Hazards Committee, NSC Industrial Conference

Radcliffe:

This session is co-sponsored by two groups, the American Industrial Hygiene Association and the American Association of Industrial Nurses. There will be four key speakers and the subjects tend to inter-relate. At the conclusion of the papers we will have a question and answer period.

With the co-sponsorship of the American Industrial Hygiene Association and the American Association of Industrial Nurses, we have on the platform with us today their two presidents. First, William T. McCormick, president of the American Industrial Hygiene Association and Assistant Director in charge of Occupational Hygiene in the Medical Department of Inland Steel Company, Chicago. He is also a member of the American Society of Safety Engineers, and many other related safety and hygiene groups.

McCormick

The American Industrial Hygiene Association is most pleased to be a co-sponsor of this program on Up to Date Industrial Hygiene. I am particularly pleased that the ladies who make up the membership of the American Association of Industrial Nurses are also co-sponsors this morning.

In our company, the groups who are concerned with the health of workers both directly and indirectly enjoy a cordial and cooperative relationship with each other. This has been a benefit to both workers and the company alike. I think it is extremely important that those of us who have interests in the well being of people have the opportunity to meet together as groups periodically to share our information and to assist those in the common goal that we have. The program this morning consists of outstanding speakers, I'm sure each has a message for us to take back to assist us in our program. It gives me great pleasure to represent the American Industrial Hygiene Association this morning and to bring you greetings from its members.

Radcliffe:

The president of the American Association of Industrial Nurses is employed with the Guide Lamp Division of General Motors Corporation. She is a registered nurse and has done hospital work, private duty, supervision, and industrial nursing during the last 12 years, has worked on many committees and given many papers. She is a most active member of the industrial nurses in this country. Without them, our medical, hygiene, and safety programs would be lacking. It is my pleasure to introduce to you the president of the American Association of Industrial Nurses, Mrs. Edna Watson.

Mrs. Watson:

We are most happy to have been invited to co-sponsor this session in the Safety Congress and, on behalf of the Board of Directors of the American Association of Industrial Nurses, I thank you for being able to share this experience with you.

As industrial nurses, we are especially interested in all phases of safety and hygiene in our various job situations. As individuals we are vitally concerned with safety at home, school, on the highway, or wherever we find ourselves in a community setting, not only for ourselves and families but to be better informed and thus more effective as occupational health nurses.

We hear much today about the team approach to health, preventive medicine, and concern for the whole man, both on the job and away from work. We believe that it takes a combined effort of all of us to realize the goal of a safe and healthful environment in which we work, live and play. It takes knowledge, understanding and cooperation to have an efficient, effective safety program. That is why we are pleased to have a part in this session and you are to be congratulated in making it possible for all of those who are interested in safety to come together to share ideas and learn what part they can play in the accomplishment of an effectual program.

We as industrial nurses need to learn to be better prepared to care for the health and safety of workers on the job and to be able to answer questions about safety away from work. As an association, we're glad to be a participating factor in this worthwhile project for we are dedicated to the purpose of [illegible] fulfill the purposes of our organization. The we can do by taking part in meetings such as this with other national associations who have similar goals and purposes. Since health and safety are so closely related, you cannot have a good health program without a good safety program. One complements the other for a healthy productive worker must have a safe work environment.

By working together, to recognize safety hazards and cooperating to eliminate them, we can make the environment of the American industrial worker the most healthy, safe, and productive place in the world.

WHAT HEALTH, SAFETY AND PLANT PERSONNEL SHOULD KNOW ABOUT DUSTS, FUMES, MISTS, GASES, VAPORS, AND NOISE

By WARREN A. COOK
Professor of Industrial Health, Department of Industrial Health, School of Public Health, The University of Michigan, Ann Harbor, Mich.

A quick answer to what should be known by health, safety, and plant personnel about hazardous materials used in the plant is—everything! Practically, the extent of the knowledge must necessarily fall somewhat short of this Utopian goal. There are a number of categories of information which should be known. I propose to explore a number of these.

Perhaps the most critically needed information is that concerning materials which may cause serious illness or death without the worker realizing that he is being subjected to a dangerous atmosphere. An example of such material is one which has resulted in only some 20 deaths as reported in the literature over the last fifty years, and only three reported cases since 1956. Certainly, such a material should not deserve too great emphasis among the myriad of substances which compete for a place in the overall knowledge of health, safety, and plant personnel. But let us consider what the actual facts may be.

In January, 1966, a worker in California was brazing metal parts, using a silver solder. After some two hours of work he began to feel bad and the next day experienced some tightness of the chest, was coughing, and felt that he had been exposed to too much welding fume. As the condition worsened, he called a physician and they agreed that he must have permitted himself to be exposed to excessive welding fume. He was treated symptomatically. On the fourth morning after the exposure he was found dead in bed. Within a short time after this, a second worker on the same job became affected. By this time, it was known that the silver solder contained over 20 percent cadmium and that the condition was actually due to excessive exposure to cadmium fume. Following the report of the fatal and accompanying nonfatal cases, 10 additional cases were reported to the California Bureau of Occupational Health. Three of these fatal. A detailed account of the circumstances of the two initial cases is

be published soon by Dr Hector P Blejer of the California Department in the *Journal of Occupational Medicine*.

Here we have an example of a material which does not immediately become excessively irritating; one concerning which we have not had too many published reports of difficulty. Very possibly, the reason for this was that cases may have occurred but, being sporadic, they have not been recognized nor published

Since a welder or a worker engaged in brazing operations may have been using solders over the years containing no cadmium, and then such a solder is required for the next day's work, it is vital that not only the health and safety personnel but also the foreman in charge of the operation should be well informed concerning the hazards from cadmium oxide fume

Another example of hazardous materials in this category is chlorinated naphthalene This waxy material is melted in order to impregnate wire or cable insulation or electrical condensers The vapor from this synthetic wax condenses in the air above the melting pot as a fume On being inhaled in excessive amounts it may cause serious and even fatal liver damage.

Among the earlier fatal cases as result of such an exposure, one worker died with a diagnosis of yellow atrophy of the liver. At that time there had been no such experience with this material and it was thought that the fact that this worker was a rather heavy drinker may have led to his death A second worker continued the operation When he developed a liver condition which also terminated fatally, but with no history of alcoholic beverage complication, investigations were instituted which definitely implicated this harmless looking and non-irritating synthetic wax as the producer of these liver conditions.

As further categories of knowledge concerning hazardous materials, we should include those materials actually in use in a plant, together with those which may be contemplated for early future use Possibly the best and earliest source of information concerning such materials is through the purchasing agent Accordingly, it is strongly recommended that a close liaison be set up between the purchasing agent and the health and safety personnel so that early information will be provided concerning materials in use and those which are to be ordered.

These materials may best be discussed in categories related to their physical and physiological properties

Among the most important categories are the dusts that produce the pneumoconioses. In the major industries involving exposure to silica dust, there tends to be a good knowledge of the fact that too much of these dusts will cause a lung condition which may be disabling. Where the dust may contain crystalline free silica, such as is the case with molding sand in the foundry, or granite dust in a quarry or stone cutting shop, it is well understood that the greater the percentage of free silica in the dust the lower the dust concentration should be in order to avoid the development of silicosis It is known that workers should be given periodic X-ray examination, and that the extent of the dust exposure should be determined by air analyses, with control measures such as will be discussed later in this session.

Less knowledgeable, as a rule, are health and safety personnel concerning such exposures in those operations where crystalline free silica may be used rather incidentally in an operation at a plant not normally considered to be a dusty industry An example would be the use of silica flour as a filler in a paint mixture or as inert material in a variety of products

Asbestos has been much in the daily newspapers over the last year or two, not so much because of its action in causing asbestosis, but because of the association of a cancerous condition known as mesothelioma which has been found among workers with asbestos in far greater incidence than among the general population.

Talc and soapstone powders are used in such industries as rubber goods manufacturing, and may introduce appreciable amounts of such dusts into the air Whereas most dusts made up of silicates are essentially inert and, as such, as much as 50 million particles per cubic foot of air may be considered acceptable, these two minerals have been found to produce disabling pneumoconiosis in lesser concentrations with the result that no more than 20 million particles per cubic foot of air is considered within safe limits

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This, however, is [illegible] whole [illegible] in connection with talc [illegible]stone. Not infrequently, these two [illegible] are found to have some quartz content; this may be as much as 20 per cent Application of a formula given in the *Threshold Limit Value* list of the American Conference of Governmental Industrial Hygienists to a talc or soapstone dust with 20 per cent quartz limits the exposure to only 10 million particles per cubic foot of air. Consequently, when such materials are being used, it is essential to have the additional bit of knowledge as to percentage of crystalline free silica.

Somewhat the same situation occurs in connection with a dusty material made up of diatomaceous earth, a form of amorphous silica The natural material has been found to cause a disabling silicosis when the exposure exceeds 20 million particles per cubic foot However, where the diatomaceous earth is subjected to a calcining operation, some of this amorphous free silica changes over to the crystalline form known as cristobalite. Depending upon whether the diatomaceous earth is calcined with or without a flux, the percentage of the cristobalite may be in the order of 20 per cent or 10 per cent, the latter with the flux calcining. Applying the ACGIH formula, these calcined diatomaceous earths should be kept either to 10 million particles per cubic foot or to seven million, in order to avoid lung injury

In the category of metals, we would expect that all health and safety personnel are familiar with lead as an occupational hazard and that proper precautions are taken to prevent excessive exposure. In spite of this general knowledge, lead poisoning cases continue to occur in industry, not only in the industries that have produced the greatest number of cases over past years After a report in the literature that lead poisoning cases were occurring in plastic manufacturing in Italy and a subsequent report of such cases in this industry in France, a group of lead poisoning cases occurred in a plastic manufacturing operation in this country. Possibly if a close relationship had been maintained between the purchasing department and the health and safety personnel, the exposure might have been brought under control without occurrence of cases

Beryllium is well known as a producer of serious and fatal occupational disease [illegible] and it is felt that much of the [illegible] and was [illegible] when manufacturers of fluorescent lights agreed to omit beryllium in their phosphors in June 1949 This metal [illegible] many desirable properties and is finding increasing use in a diversity of operations In all plants where high temperature resistance metals or ceramics may be used, the health and safety personnel should be alert to the introduction of this material As an indication of relative hazards, the exposure to beryllium should be kept to about a hundredth of that considered permissible for lead

It would seem that everybody is well informed concerning carbon monoxide, the gas which is responsible for more exposures than any other, and also the gas responsible for the greatest number of cases of fatal asphyxiation In areas where there is an active possibility of escape of gases containing carbon monoxide, there tends to be an increasing use of multipoint carbon monoxide alarms Such installations have been placed in a number of blast furnace plants where carbon monoxide concentrations of the gas are in the order of 26 or 27 per cent

Fortunately, for most fuel gas purposes natural gas is coming into increasing use and this, of course, contains no carbon monoxide Furthermore, where in earlier years supplementary gas supplies have been provided through water-gas or producer gas installations, these are today being replaced [illegible] liquified petroleum gas with no carbon monoxide content It is of course, important always to keep in mind that imperfect combustion of natural gas or LPG will produce a sufficient amount of carbon monoxide [illegible] cause asphyxiation Cases of carbon monoxide asphyxiation have occurred over the years on Monday mornings where cold systems are being heated with natural gas [illegible] the impingement of the burning gas on cold surfaces interferes with complete combustion with markedly greater amounts of carbon monoxide in the products of combustion

Among the gases which might well be listed with those which may cause [illegible] death is hydrogen sulfide [illegible] of liberation of hydrogen sulfide in [illegible] area occurred in Poza Rica [illegible] where liberation of hydrogen sulfide [illegible] gas and oil field caused 22 deaths and [illegible] hundred cases of sulfide of severity [illegible] quire hospitalization [illegible] sulfide is being [illegible]

and made into elemental sulfur, an emergency plan should be set up in the event of rupture of hydrogen sulfide lines with possible escape of large volumes of this gas

Hydrogen sulfide is formed wherever there is decomposition of materials containing sulfur under reducing conditions, and cases of multiple fatalities, from two to five, have occurred. Wherever materials containing sulfur are being handled, all workers should be briefed about the rapidly asphyxiating properties of this gas. It should be emphasized that at the higher concentrations the sense of smell does not provide the warning to which one is accustomed on exposure to the lower concentrations of hydrogen sulfide. Workers should know ahead of time that, if one of them should collapse in some confined area where hydrogen sulfide could be the cause, the fellow workers should not enter the confined area to rescue the victim without gas mask protection. The usual precautions of providing watchers outside the confined area, provision of a proper harness with rope attached for rescue from the outside if required, and availability of adequate ventilation together with grab sample checks on the hydrogen sulfide concentration within the area should, of course, always be the practice.

A category of hazardous materials which includes many substances found in practically all plants is that of the solvents. A complete list of all solvents used in the plant should be maintained. Where proprietary solvent mixes are utilized, every effort should be made to determine the constituency of these or, in any event, whether solvents with threshold limit values of less than 100 parts per million are included.

With the extensive publicity given to the severe health hazards of carbon tetrachloride, it would seem that everybody knows that this should not be used as a general solvent. However, the experience has been repeated many times in which a highly toxic solvent has been substituted by one of less toxicity but at some later date the more toxic solvent, desirable for good solvent properties or low price, has been brought back into the plant without the health and safety personnel being aware of its re-introduction.

Increasingly, methyl chloroform is being recognized as a desirable substitute for carbon tetrachloride as it includes the attributes of eliminating a fire hazard and, in addition, has the advantages of low toxicity together with good solvent properties and a vaporization rate close to that of carbon tetrachloride.

It is to be noted that the hazard of a solvent depends on other properties than the threshold limit value, perhaps most prominent being the vapor pressure and corresponding boiling point. It is to be pointed out that even such a slightly toxic solvent as methylene chloride with its threshold limit value of 500 parts per million has caused fatal poisoning where its great volatility has resulted in build-up of concentrations higher than this value. Solvents with low vapor pressures and high boiling points often may be safely used with open surfaces at room temperatures but, if the operation involves heating the solvent, then there is always the possibility that even the high boiling point solvent may be vaporized sufficiently to exceed acceptable concentrations.

In past years, the use of petroleum solvents has indicated a low order of toxicity since these could be expected to be made up of aliphatic hydrocarbons. Today, there is much increased probability of presence of aromatic hydrocarbons from petroleum sources. It should be kept in mind that the aromatic hydrocarbon content may change with the same supplier from time to time and constant vigilance is necessary to make sure that the worker who may be exposed without injury to a couple of hundred parts per million of the petroleum hydrocarbon containing only aliphatic constituents may have his health seriously injured on introduction of aromatics. Benzene is, of course, the most toxic one of these ordinarily found in petroleum hydrocarbons.

The number of compounds that are implicated in the production of cancer of the lung, bladder, or skin appear to be on the increase. Epidemiological evidence points clearly to the chromium compounds as cause of lung cancer. Just how low the exposure needs to be to prevent this development among more susceptible people is currently not known. So far there seems to be no evidence that a sufficient exposure occurs at chromium plating operations to produce this condition. Certain dye intermediates are sufficiently effective in the production of bladder tumors that the State of Pennsylvania has passed a law, unprecedented in the United States, that two of these — beta-naphthylamine and benzidine—may not be produced or used in that state. Some years ago, on the basis of animal experimentation, it was believed that many of the high boiling oils from catalytic cracking operations in oil refineries were severe producers of skin cancer. Extensive control measures were instituted in many of the refineries to avoid contact with such oils. Over the years, observation has been continued of workers with some exposure to these oils and in a recent publication it was reported that the hazard to humans from this source does not appear to be as severe as initially contemplated.

Ionizing radiations of various types are increasingly common throughout industry today. Alpha, beta, and gamma radiations are the most frequent, but neutron exposure may also be a factor. Where sources of these types of energy are present, competent health physicists should survey the installations with appropriate instruments and make sure that adequate precautions are observed.

A final category that is not a material, but a vibration, is that of noise. In plant areas where it is necessary to use an elevated voice at a distance of a foot or so, or to shout in order to carry on a conversation, it is desirable to make a check of noise intensities with a sound level meter. Where the overall intensity exceeds 85 decibels, it is to be recommended that the sound level meter readings be supplemented with readings of intensities at sound pressure levels, certainly in the 300-600, 600 to 1200, and the 1200 through 2400 cycles per second bands. The American Academy of Ophthalmology and Otolaryngology recommends that the intensity in each of these bands should not exceed 85 decibels where a steady noise con[illegible] humans [illegible] five hours or more per [illegible] contemplated.

The United States Air Force extends [illegible] range over which octave-band determinations are made from 300 to 4800 cycles per [illegible]. An octave band level of 85 decibels is considered that at which damage risk [illegible] but the point at which personal ear protection is recommended. If an octave band level reaches 95 decibels, it is considered that damage risk is great and personal ear protection is mandatory. Engineering control measures should be developed wherever possible when octave-band levels exceed [illegible] decibels.

A hearing conservation program [illegible] include not only noise measurements [illegible] evaluation but also audiometric testing [illegible] workers before being placed in [illegible] noise areas and periodic testing thereafter. Personal protection admittedly has [illegible] but noise control measures should be [illegible]stituted wherever possible.

The health and safety personnel [illegible] avail themselves of the resources [illegible] able for obtaining information on the [illegible]ardous materials. A number of these [illegible] be listed by later speakers in this session. [illegible] is to be emphasized that the threshold limit value does not tell the whole story [illegible] hazard of the material but all factors [illegible] as vapor pressure, temperature, [illegible] confinement, extent of exposure and duration of exposure are factors to [illegible] consideration as well.

Only by being as completely informed [illegible] possible on all aspects of a material [illegible] to the possibility of injury can [illegible] wholly successful program in [illegible] outright occupational diseases and [illegible] provision of a workroom [illegible] ducive to the optimum well-being [illegible] worker.