New Ideas...

If safety is to keep pace with today's rapidly advancing technology, we must continually have "new ideas."

Each year, at the National Safety Congress, the ideas and experiences of many of the nation's top safety men are presented in the various sessions. Many of these ideas, devices and methods, first presented at a Congress session, later become generally accepted within their fields.

In order to present this information conveniently and at small cost, the Congress Transactions are published in volumes, one for each Section or Division, along with a General Sessions and Detailed Index to all volumes. The 34 volumes of the 1951 Congress Transactions are listed on the last page of this volume.

Safety directors everywhere have found the Congress Transactions a useful aid in their accident prevention programs. In industry, for example, their judicious distribution to key personnel in management and supervision has proved to be of invaluable service.

In preparing these Transactions, the proceedings of the Congress have been condensed and edited for reference purposes. Complete original manuscripts, with any charts or illustrations which were used, are available in National Safety Council files. Views expressed at the Congress or in this record are those of the Congress participants and are not necessarily those of the National Safety Council.

THE TEXTILE SECTION

This volume is a record of the sessions held at the 1951 National Safety Congress by the Textile Section. The conduct of these Congress sessions each year is only one of the many cooperative activities which the Textile Section carries on in behalf of its members, and for the benefit of accident prevention work in the textile industry generally. The Section gives guidance in the preparation of a great variety of technical and educational material useful in the day-to-day safety programs of textile plants. The activities of the Section are under the direction of its Executive Committee, the members of which are listed at the close of this volume.

You Must Create Interest in Safety

By W. BRATTON WILLIAMS
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Every year in the United States approximately 18,000 people are killed while at work. At the same time approximately 2,000,000 people receive some form of injury while at work. During the first year of the Korean war, we had approximately 9,000 men killed in action, while our total casualties killed, wounded, and missing in action totalled about 78,000. Also, during that first year here in the United States, in all forms of accidents, there were approximately 10,000,000 injured and 95,000 killed. According to these figures, it is safer to be on the Korean front than it is to be living within the peaceful bounds of the United States.

Only last week I read in the papers, and this came from the National Safety Council, there were 3,560 people killed in motor vehicle accidents in the United States during the month of August. This is the highest monthly toll on record for any one month with the exception of August, 1941, when almost 3,900 were killed. Highway safety has become one of the most serious problems facing us today. Will our killed and injured continue to increase in number or will we become better educated in safety?

You must create interest in safety. You must educate your people in safety.

Why should we be so vitally interested in accident prevention? "Am I my brother's keeper?" The two basic reasons for accident prevention are the humane reason and the economic reason. We do not like to witness physical human suffering, therefore, the basic reason for accident prevention is the humane basis.

Accidents don't happen, they are caused. Then the way to eliminate accidents is to discover and eliminate the causes. We are taught in safety engineering that all accidents fall under three causes: 1. Unsafe conditions; 2. Unsafe acts of persons; and 3. Acts of God. The first two causes are man-made and can be controlled by man and 98 per cent of all accidents fall under the first two causes or a combination of both. The third cause, Acts of God, are responsible for about 2 per cent of our accidents such as lightning, floods, tornadoes, and over these we have no control. What, then, is your part in accident prevention? Recognize and eliminate unsafe conditions and unsafe acts of persons. The second cause, unsafe acts of persons, is far more difficult and far more important.

It is too late to eliminate unsafe acts of persons after the unsafe act has been performed and the accident has occurred. It is far more important to train your people to be safety conscious and accident minded so that they will anticipate and not perform the unsafe acts.

What is safety education? According to one expert, it is the process of imparting knowledge of safe and unsafe conditions and of safe and unsafe acts of persons.

Men in industry have responsibilities for production, cost, quality, waste, etc. During the past few years, men in industry have assumed another responsibility, that of safety. This is becoming more and more important and I am glad to see more emphasis being placed on safety than ever before in the history of the country.

Thousands are being born every day and these same thousands as they grow up, must receive public school education and training if they are to grow up to be useful citizens in this great land of ours. Public schools throughout our country teach health education. The purpose of this is to help eliminate sickness and death from diseases. Likewise, I believe that it is just as important that public schools and colleges throughout the land should teach safety education. Is not this just as important as health education?

You have heard of the three E's of safety: Engineering, Enforcement, and Education. You cannot create safety by mechanical guarding or by enforcing rules. You must educate for safety. You must create interest and enthusiasm for safety.

One of the first jobs of a successful teacher, regardless of his subject, is to create in the minds of his pupils an enthusiasm for and an interest in that particular subject. Likewise, if you are to educate your people in safety, you must create in their minds an enthusiasm for safety. You must make them want safety. When you have done this the safety program in your plant will have become fairly well established.

How are you going to get your people interested in safety? Certain of us have sensitive spots that are easily touched. These may be called motivating characteristics and some may be appealed to in one way while others may be appealed to in other ways. Some methods of appeal are as follows:

First, you may appeal to a majority of people with emphasis on the idea of self preservation, or fear of personal injury. This is the strongest motivating characteristic and will touch the majority of people.

Second, you may appeal to some with the idea of personal or material gain, such as bonuses, personal gifts, days off, etc.

Third, others may be appealed to through their sense of loyalty to their foreman or to the company for which they work; such as, effect of accident frequency on the foreman's record of cost, production, etc.

Fourth, others may be appealed to through their sense of responsibility. Man is vain. Therefore, when you place responsibility on him it also appeals to his vanity. The placing of an indifferent individual on the safety committee will often win him over and convert him to the importance of plant safety.

There are many ways by which you can sell safety to your employees. It is your job and your responsibility to analyze your own cases. Don't give up the struggle, even though the perfect goal will never be reached. Accident frequency can be improved in your plant. It has been improved in many plants. It is being improved in many plants today.

As a safety director in your plant, I believe you should be interested in the safety of your employees outside the plant as well as in the plant. You should give them instruction and talk highway and home safety to the individual and to groups. This, I believe, from the humane standpoint, is as important as safety within your individual plant.

Anthrax in the Textile Industry

By DR. ROGER CONANT

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Anthrax is primarily a disease of cattle and is transmitted to man by contaminated hides, hair and wool. It is caused by a microorganism which can be identified under the microscope and belongs to a family of spore forming bacilli. In cattle it produces death by blood poisoning. In man the disease takes several forms, the skin or cutaneous form being the most common, resulting in death by blood poisoning if left untreated.

In man, it is believed that the organism gains a foot-hold in the skin thruough an insignificant cut or scratch. At the end of a few days, called the incubation period, a typical lesion develops.

At first there is a pimple; then a small blister is formed on the top of it. This is surrounded by a slightly reddened area. There is no pain, but it itches. At this point the patient is apt to squeeze it, a very hazardous undertaking because it precipitates spreading of the infection. No pus will be obtained upon squeezing, but there will be a small amount of clear fluid exuded from the pimple. This fluid contains millions of anthrax bacilli.

In a few days the blister breaks down and a crater is formed, the center of which becomes black. This blackened area is dead skin, killed by the poisons liberated by the anthrax bacillus, and more blisters are formed around the edges of the crater. At this stage there is a slight swelling around the base of the blister.

By this time, the patient is apt to complain that he doesn't feel well. He may have a fever, headache, and chilly sensations.

The locations of these anthrax lesions are usually on exposed portions of the body. When the lesion is above the nipple line there is apt to be such a rapid spread of the swelling that within 24 hours the swollen face and head appear to merge with the chest, with little or no neck outline visible.

At this stage, treatment is exceedingly difficult. Absorption of penicillin is impeded; respirations become rapid and labored; toxicity increases; and a vicious cycle starts which, if not immediately broken up, will be fatal.

Occasionally the lesion will develop in a most unexposed portion of the body.

Complications such as menengitis or pneumonia may develop. Local complications and permanent disability are rare; but one man ended up with a disability of the shoulder due to scar formation of the chest muscles, which cost the company $5,000.00.

The anthrax organism belongs to a group of spore-formers of which lock-jaw and gas gangrene are members. This means that when environmental conditions for its growth and propagation are unfavorable, it will change its shape to a round globular organism, highly resistant to temperature changes and to bacteriological chemicals. It is the spore form which is present in contaminated wool, goat hair, bristles, hides and skins, which, under favorable conditions of moisture and body temperature, will change back to its vegetative or bacillary form and produce the disease.

In laboratory experiments the spore can be killed if it is exposed to live steam at 212° F. for 2 minutes. In actual practice however, if the organisms are placed in a bundle of bristles, 2½" in diameter, and the bundle placed in a steam pressure vessel at 15 pounds pressure resulting in a temperature of 250° F., it will take 10 minutes to kill the spore. The reason for this apparent discrepancy in the killing power of steam is that considerable time is wasted in getting the steam to penetrate the bundle.[1] This time lag is a very important element in the processing of wools to render them safe for handling.

During the 10 year period between 1939 and 1949 a total of 764 cases of known anthrax were reported in the United States. The Hair and Wool Industry accounted for 479, Hides and Skins 106, Agricultural 97, others 63, and nonspecified 213. A breakdown of the figures showed that 82 per cent of the industrial cases occurred in industries processing hair, wool or both.

In the Hair industry the chief offender was goat hair in 74 out of 82 analyzed cases. The origin of most of the hair in these cases was in India and Pakistan. A few came from China and South America.[2]

The Carpet Industry contributes by far the majority of anthrax cases which occur in this country, and the incident rate for the past 10 years has increased threefold. The industry uses coarse wools obtained mainly from the primitive areas of the world, such as North Africa, India, Pakistan, and Western Asia.

The Apparel Industry is singularly free from industrial anthrax at the present time. An analysis of 365 cases showed that none occurred in the apparel industry. It uses wools much finer in type, size 40 and above, obtained from sources where the art of sheep husbandry has been developed to a high degree. Most of the wools used in the apparel industry come from South Africa, Australia, New Zealand, and some parts of China. However, it must be remembered that Argentina during the past 10 years shipped both coarse and fine wool to this country in the ratio of 3 to 2.

Wolff and Heimann concluded after an exhaustive epidemiological study of industrial anthrax that the degree of anthrax risk falls into four categories, namely (a) very dangerous; (b) dangerous; (c) not without risk; (d) without risk, and suggest consular labeling of this type on bales of wool.

We feel that such classification is only relative, of no value to the carpet industry, and such certification may often be unreliable. No peasant sheep herder in the far East is going to be too particular concerning the cleanliness of the wool he offers if the buyers are eager and the price is right. The temptation is too great to keep from salvaging the remains of an animal killed by anthrax. One infected carcass can contaminate a whole shipment of wool. Dr. Simpson treated a case of anthrax in 1930 in which the patient told him that the lesion developed at the site of a scratch, sustained on the wire fastening the consular certificate to the bale of wool.

The mortality of anthrax in animals runs 75 to 100 per cent. In our experience that mortality in human anthrax was 14 per cent prior to the advent of penicillin.

1. SCHNEITER, R. and KOLB, R. W., "Heat Resistant Studies with Spores of Bacillus Anthracis," U. S. Public Health Service. Supplement No. 207, Public Health Service Reports, June 1948.

2. WOLFF, A. and HEIMANN, H., "Industrial Anthrax in the U. S.," American Journal of Hygiene, 53:1, January 1951, 80-109.

Since 1943, at Mohawk Carpet Mills, 46 cases of anthrax developed and all were treated without a fatality.

A word about treatment: We have not felt confident enough to treat these patients on an ambulatory basis. They are all placed in the hospital as soon as the direct smear of the lesion is reported "suspicious of anthrax." This is usually within an hour or two of the patient's first appearance in the dispensary. A culture must be taken before treatment starts in order to further identify the organism. We have found in several instances that repeated cultures taken of the lesion after 24 hours of treatment are sterile and no growth on culture media can be obtained.

Penicillin in large amounts given hypodermically and intravenously is administered so that he will receive upwards of 1,000,000 U of penicillin the first 24 hours, by vein. This is continued until the second day and longer if necessary. Second, wet penicillin packs 1:3000 solution are applied continuously to the lesion. There is no further local treatment used. Needling, incision and drainage, cauterizing and manipulation of the wound are to be condemned.

We have discontinued the use of sulfa drugs, and have used the anti-anthrax serum in one case since 1943. The serum cannot be procured any more in this country. We have not felt it necessary to use streptomycin and aureomycin as our results have been satisfactory without them.

The usual hospital stay has been 7 to 10 days and the lost time from work averages about 2½ weeks. The average hospital cost exclusive of medical care amounts to $200.00. Permanent disability is mainly due to facial disfigurement and contraction of scar tissue around the lesion. Such contraction is infrequent.

The prevention of anthrax may be grouped under three main headings: Environmental control and plant hygiene, personal hygiene, and preventative medicine.

It would seem very simple to control environment when one knows that unprocessed, imported wools are the only source of infection in this disease, by sterilizing the wools at the port of entry. This would completely eliminate the hazard.

England adopted such a procedure in 1921 and the United States was invited to participate, but at the time it was decided that the incidence of anthrax in the United States did not warrant adoption of the plan. The procedure consists of:

1. Removal without human contact, the covering of wool by machinery completely encased and equipped with a dust extractor which breaks up the bale.

2. Two washings, followed by a formaldehyde soak.

3. Drying in hot air at 160°.

We have experimented with a modification of this procedure but discarded it because of the excessive ventilation necessary to disperse the fumes and the hazard of formaldehyde dermatitis.

The procedure of washing and scouring at Mohawk Carpet Mills since August 1950 is as follows:

a. Three successive washings in soda ash with a pH 10-11 at 120°-130° F.

b. Two successive rinses, first—110°-120° for 1¼ minutes, second—warm water for 1¼ minutes.

c. Drying in hot air for 3¼ minutes at a temperature 82°-260°F. During this drying period the wool is exposed for 1 minute at a temperature of 194°-260° F. We feel that this high temperature is an important factor in lowering our incident rate since that date.

Dr. Henry F. Smythe, chairman of the committee of Industrial Anthrax, Industrial Hygiene Section of the American Public Health Association, in his 1943 report made a strong plea to the United States Public Health Service for the establishment of a disinfection plant in the United States. Industrial anthrax had increased 365 per cent, due mainly to the importation of wools and because the cost of individual plant disinfection of this type was prohibitive, especially if a competitive mill did not follow suit.

Relatively little interest was taken by the United States Public Health Service in a previous recommendation and they suggested appropriate industrial hygiene measures in the industries involved, with no further amplification of what measures to use. In 1945, one million out of a population of five million sheep in Iran died of anthrax. This report did not come to the attention of the public until 1947.[3] Since

3. DELPY, L. P. and KAWEK, M., "Anthrax in Animals and Man," Archives Inst. d'Hessarek. Teheran, 1946, 4:3 (Abst. Bull. Hyg., 1947, 22-117).

that time, two articles have emanated from the United States Public Health Service, one entitled "Heat Resistance Studies with Spores of Bacillus Anthracis," by Schneiter and Kolb in 1948, and "A Report of Industrial Anthrax in the United States," Wolff and Heimann in January 1951.

Although the frequency of anthrax is greatest in the picker house, no department can be considered a 100 per cent safe area. The last case of this disease occurred in a milling machine operator who was making a new part for a ventilator fan from the Picker House undergoing repair. The fan housing and screening rested on the floor about six feet from the machine. The anthrax lesion developed on his forearm several days after he inadvertently scratched it on a piece of screen.

We have considered the use of ultra violet radiation over the blending tables but have been unimpressed with the statistical data offered by a leading manufacturer for several reasons:

1. The equipment is designed primarily for air sterilization, and we feel that the infectious material is the unprocessed wool, itself, where penetration of the germicidal light is exceedingly limited.

2. The efficiency of the ultra violet light tubes diminished very rapidly as dust collects on the tubes, thereby requiring frequent cleaning.

3. The total amount of ultra violet radiation to be effective for air sterilization would introduce another hazard, that of dermatitis and irritation of the eyes.

Plant construction plays a definite role in plant hygiene. All floors, walls and elevators and stairways should be of such construction that they can be readily cleaned by wet sweeping or vacuum cleaning. Dry sweeping should be prohibited. Recently we have used a method of sterilizing walls, pillars, staircases, pipes etc. by spraying an antiseptic paint on these areas at regular intervals and actually burying and killing the bacilli and spores on contact.

Wool processing should be conducted at the maximum temperature compatible with the process.

The following is an outline of protective measures which can be employed to prevent anthrax:

a. Isolation of all pre-scouring operations to prevent cross contamination of other parts of the mill. This means that all trucks and dollies used in the department should not be used in handling the washed and disinfected wool.

b. All burlap wrappings should be sterilized before re-use.

c. Adequate ventilation of all dusty procedures; either vacuum type with wet sludge receptacle, or exhaust to the outside air so that dust does not re-enter the mill.

d. Prevention of "build ups" of local areas of high bacterial concentration which may develop along the processing line and spread infection to relatively clean unwashed wool, or even to the finished product itself.

e. Sterilization of all dust, dirt and lint recovered in the pre-wash operation before disposing of it.

f. Provide separate lockers or places for hanging up street and work clothes.

Individual Hygiene—This includes indoctrination of all personnel upon hiring of the necessity to:

a. Report all cuts, scratches, abrasions or sores promptly to the foreman and doctor or dispensary attendant for treatment. No employee with any such lesion should handle unscoured wool unless the wound is carefully bandaged by a dispensary attendant.

d. Enforce washing of the face, neck, arms and hands before leaving the mill. Hot water, liquid soap, nail brushes, and paper towels should be provided.

c. No lunch boxes should be permitted in the working area of the picker house and no eating should be permitted while employees are at work on the picker house floor or in the bins. Washing of the face and hands before eating should be enforced.

d. Cotton trousers, shirts, gloves and caps should be worn on dusty operations. Shirt sleeves should not be rolled up. Such clothing should be laundered at least once a week, to prevent a build-up on contamination.

e. Furnish and require the wearing of approved respirators by all employees engaged in handling or sorting unscoured or scoured wool.

Medical Control consists of the prompt treatment of all cuts, scratches, abrasions or sores by competent medical personnel. In all cases of infection where anthrax is suspected, smears of the lesion should be taken, and an immediate preliminary report obtained. If the preliminary report is "suspicious of anthrax" the patient is hospitalized, a culture taken, and treatment instituted without delay.

Handling Solvents in the Textile Industry

By ROGER M. L. RUSSELL
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Science may some day produce a universal solvent capable of dissolving anything. This would both simplify and complicate its use in industry, simplify the problem of providing adequate safeguards, but complicate the problem of developing means of holding such an universal solvent. Until such a solvent is found, we must safeguard the handling of hazardous solvents whenever, wherever and however they are used.

Virtually every liquid is capable of dissolving and acting as a vehicle for one or more solids. For purposes of this discussion, only the handling of solvents which are hazardous, by virtue of their combustibility, will be considered.

When the textile industry was limited to the production, weaving and finishing of yarns produced from vegetable and animal fibers such as cotton, flax, wool and silk, the use of hazardous solvents was also very limited. Found essentially in dyeing and finishing, even then hazardous solvents did not appear in large scale production until the early thirties. With the ever increasing development of and demand for synthetic fibers, hazardous solvents now are to be found in most synthetic fiber production, which depends upon the use of one or more solvents. The solvents are many and the degree of hazard varied.

Without attempting to discuss the chemistry or technic of synthetic fiber production, it will suffice to point out that carbon disulphide makes possible viscose, acetone the acetates and vinyl resins, acrylonitrite the acrylic resins, etc., all too numerous to mention.

Only through complete knowledge of the characteristics of solvents which make them hazardous, can proper measures be prescribed and taken to neutralize or at least minimize the potential danger attending their usage.

If a liquid remained a liquid, the problem of providing adequate protection and safeguards would be elementary. Little or no ventilation would be needed; explosion-proof and vapor-tight electrical equipment would not generally be needed; flame arrestors on storage facilities could be omitted; grounding against static would be unnecessary.

Unfortunately liquids vaporize and the vapor can be more deadly than the liquid, in that at least the liquid is visible and burns only when the surface is freely exposed to air. Though vaporizing and burning close to the surface, solvents in the liquid phase can be controlled or subdued by time tested fire fighting technics, well known to all of us. Without in any way underestimating the fire potentialities of combustible liquids, nor the speed with which a small fire can become an uncontrollable inferno, given favorable conditions, which exist more by nature than by circumstances, there is at least one vital factor on the side of fire control. That is the element of time.

There is time to summon assistance from inside or outside the property when a small fire occurs involving a flammable liquid. There is time to shut off pumps, circulating fans that may accelerate combustion, time for vacating a building if the emergency requires and time to put into operation various systems and attack procedures, set up in advance to cope with the hazard.

All of this is true if the hazardous liquid or solvent is burning freely, whatever vapor escaping at or above the liquid surface being consumed in its entirety.

However, the type of solvents herein discussed and commonly found in the textile industry, continue to throw off vapor under conditions of usage, the rate of vaporization being a function of boiling point of the liquid, the surrounding temperature, and to a measure the atmospheric pressure and relative humidity. As the boiling point drops and as the surrounding temperature increases, the rate at which solvent passes from liquid to vapor phase increases.

Unless special shadowgraph equipment can be used to study the path of travel of solvent vapors, they can be considered virtually invisible. Practically without exception they are heavier than air, and normally fall at ordinary temperatures. It is therefore possible and probable that a hazardous concentration can exist near the floor level, even to a considerable depth, without knowledge of the condition existing.

If there are trenches, tunnels, sumps, elevator pits, depressions in the floor to accommodate process equipment or floor openings down through which such vapors can travel into basements or shallow underfloor areas, there may these vapors come to rest. This vapor accumulation awaits only a source of ignition, then to release in a fraction of a second great quantities of heat energy or explosive force capable of reducing to rubble the confining structure.

This insidious property of solvent vapors, namely that of producing an explosion, instantaneously and virtually without warning, provides no time whatsoever to seek safety or to reduce the extent of damage when the peril strikes.

It is a well known fact, established over years of loss experience, that more damage both to lives and property can take place in the wink of an eye at the time of an explosion, than can occur by many, many hours of an active fire taking place in the same structure.

Specifically a substantial, reinforced concrete building of heavy construction can withstand a severe fire from within for at least four to five hours without serious structural failure, even in the absence of automatic sprinklers. The extent of damage and the ultimate time of failure depends upon the extent, nature and distribution of combustibles within the structure and the effectiveness of hose streams. With effective automatic sprinkler operation, designed for the occupancy hazard, such a building will stand as long as the sprinklers are supplied with water.

If the real peril is that of an explosion such as flammable liquids can produce, total confinement by use of concrete and masonry should be avoided. The experience with explosions has established that the violence of an explosion is generally in proportion to the degree of its confinement. It logically follows that the resulting damage may likewise be a very definite function of this confinement.

While it is possible to build a vessel capable of confining an explosion initiated in a solvent vapor-air mixture at atmospheric pressure, it is neither practical nor possible within the sphere of intelligent, justifiable construction engineering to erect a usable building, capable of totally confining a solvent vapor-air explosion. This is because an internal explosion may produce upward of 100 lbs. per sq. inch or more than seven tons per sq. ft. against the walls, roof and floor of a structure.

In view of the foregoing, it is entirely understandable why explosions in the past involving solvent vapors, occurring under conditions of confinement as in basements or below ground areas, without any means of explosion relief venting, have resulted in total collapse of heavy structures and wholesale death to occupants trapped therein.

Thus, the reason why jurisdictional authorities protest against locating hazardous solvent handling operations in the basement, must be very, very obvious. For the same reason such authorities object to piping handling flammable liquids being run in tunnels, plate or slab covered trenches.

The key in designing structures or choosing locations to house solvent handling, is that of providing adequate explosion relief venting facilities, at the same time using either adequate detachment or substantial explosion resisting construction in not more than three party walls to prevent an explosion communicating into an adjacent structure.

Adequate detachment or isolation from important structures is the best protection against explosion damage. Lacking space, if solvent handling must be done in a building addition, a heavy masonry or concrete blank wall separating the area from the main structure should be effective. If adequate explosion relief venting is provided in the remaining walls, suitable use should be made of additional blank wall construction, where there is angle exposure.

Should it still be necessary that a solvent handling area be integral with a main structure, the corner of the building, entirely at grade, would be the next best spot to choose. Thus both party walls can be built to resist possible residual explosion pressures while the other two exterior walls are constructed to relieve explosion pressures to the outdoors.

A fair degree of protection against severe structural damage from an explosion can be accomplished by having three party walls of concrete or heavy masonry with the fourth wall of light construction, this, the exterior wall, with just as much explosion venting as can be obtained.

If this single exterior wall is the narrowest of a rectangular room, not too much can be expected from explosion venting facilities. If this exterior wall is the longest of a rectangular room, considerable value can be obtained.

Choosing a hazardous solvent-handling area inside of a large structure with no exterior walls whatsoever, is the ultimate in unsafe engineering. Some authorities, however, might consider the arrangement tolerable, providing the roof of an interior area is specially designed for explosion relief, using lightly secured aluminum roof deck, large special window venting facilities in skylights, monitors or carefully engineered hatches or panels.

Actually the effectiveness of so-called light roof construction and hatches may be questionable. First, these must be capable of resisting damage or dislocation during high winds, which requires some degree of securement. Next, if such light construction is loaded with a heavy snow, or freedom of movement is impaired even slightly by ice, friction or corrosion, the confining walls may be expected to fail before the roof venting facilities let go.

Inertia plays an important part in explosion relief venting. Any reluctance of venting facilities to function almost instantaneously, has the effect of allowing the pressure of an internal explosion to rise almost instantly to a point many times above that which might otherwise be reached, if the venting facilities let go or at least get moving at the instant of the explosion.

This is even more noticeable, if a solvent vapor-air mixture is an optimum or perfect mixture, when the pressure developed and the rate of pressure rise are at a maximum. This we have seen to be the pattern of many vapor explosions inside of industrial ovens which have been provided with special explosion relieving doors, equipped with self-releasing latches or hardware.

If the doors are too heavy or they bind or the self-releasing latches are dirty, corroded or otherwise poorly maintained, the doors may be blown as a unit clear off their hinges, and carried a considerable distance down through the production area. Thus the inertia was so great as to defeat effective operation.

Therefore, in choosing construction materials to relieve a room explosion, every effort should be made to use light materials, light fastenings with minimum inertia, remembering that explosion venting from one area should not be directed so as to expose another.

Next, let us study some of the methods of handling hazardous solvents, both in storage and in process.

Except for large scale users, handling and storage of hazardous solvents in drum lots is a common problem. Having constructed a suitable area for drum storage, detached if at all possible, automatic fire protection consisting of sprinklers on extra hazard schedule for small to moderate drum quantities or automatic water spray or automatic sprinklers in combination with automatic carbon dioxide for large drum quantities, should be proivded, the amount of protection depending upon the degree of hazard and of exposure.

There is now available a mechanical foam suitable for use on both water soluble and non-water soluble liquids, which in special spray sprinklers may provide very effective protection.

It is vital that a fire in solvent, having escaped from a drum, be extinguished rapidly, if a more serious fire is to be avoided. Otherwise, with low boiling point solvents, brief exposure to a surrounding fire will likely cause internal vapor pressures to develop, a drum to let go, so spreading burning liquid about the area that other drums of similar materials explode in fairly rapid succession.

Mechanical ventilation to prevent the accumulation or pocketing of vapor from one or more leaks is likewise most necessary. The amount of ventilation will depend upon whether drums are stored unopened or whether solvent is drawn off from a drum rack in the same area.

Remembering that solvent vapors are heavier than air, mechanical ventilation should be taken from just above the floor level, probably a couple of air changes an hour will be adequate if drums are not opened, but if flammables are transferred to other containers to any extent, a complete air change at least every five minutes is a good practice. Further, the electrical equipment should conform to the National Electrical Code for Class I locations, which, incidentally, permits the use of squirrel cage induction motors, without arcing attachments, if no drums whatsoever are opened in the area.

Wherever possible, solvents should be stored in tanks, preferably buried, but at least substantially detached above ground. Again, detachment distance is a function of the largest tanks, the type of material and the degree of protection for the tank form.

Suitable use of dikes, favorable ground terrain, and fixed foam protection, not forgetting grounding against static and lightning, are necessary. Incidentally, bulk transfer of solvents from tank car or tank truck to storage facilities should be detached at least 100 feet from important buildings, the probability of fire during such transfer being greater than when such material is in storage.

Special grounding prior to and during unloading operations, against static hazard, is exceedingly important. Isolation of track from siding and main line is also important, especially where the railroad is electrified, against stray currents, commonly associated with D.C. electrification.

In transferring solvent from tank farm to a process area, such as in the dissolving or reacting of raw stock, as in synthetics, or in the preparation of dyes, mildew proofing or other similar mixing or preparation areas, gravity flow should definitely be avoided. Likewise transfer by use of compressed air can be exceedingly dangerous, and is not considered a safe practice.

Many common solvents vaporize so rapidly that the concentration above the liquid surface in a tank or vessel is too rich to support combustion. Introduction of compressed air as a means of moving such liquid can readily produce a highly explosive vapor-air mixture in the container. Static or a flake of hot carbon from the compressor may be all that is needed to ignite the mixture.

Carbon disulphide is one of these liquids which absolutely cannot be transferred with compressed air because, with an autoignition temperature of about 212° F., the heat of compression alone is sufficient to explode a vapor-air mixture.

Normally liquids should be transferred by direct pumping methods, whenever practical the piping draining back to storage facilities. Further, so-called "dead man" control is recommended, whenever it can be used, this consisting of an arrangement whereby solvent must be dispensed through a spring loaded or weighted discharge device or nozzle with the transfer pump operated by a momentary spring loaded push button; or a mechanism combining these functions in a single simultaneous operation. Should a fire occur during the dispensing procedure, the operator upon leaving the station or draw off point, causes the flow to stop instantly.

Liquids may also be transferred by water displacement, if they are absolutely nonmiscible with water. Carbon disulphide is one of those which absolutely must be transferred by water displacement or by use of a specially designed inert gas system.

In the process area, specially chosen and constructed for the purpose, care should be given to the selection, arrangement, installation and maintenance of the automatic fire extinguishing system best suited for the hazard. Again, this may consist only of extra hazard automatic sprinklers.

If the hazard is one where a great deal of equipment must be kept cool to avoid severe damage or rupture from a bad floor or spill fire, deluge fine water spray, engineered and installed by a competent vendor, may be the best answer. This is particularly so, if the solvent is highly volatile and not miscible with water.

Automatic carbon dioxide, particularly double shot, is highly effective in extingushing solvent fires. Many authorities, however, require sprinklers to provide the cooling necessary for structure and equipment, so that reignition possibilities are reduced, when quick extinguishment by carbon dioxide has been effected.

The use of foam, particularly mechanical foam, provides another means of protection so long as the foam selected will not break down in contact with one or more of the solvents used. There is foam now available to handle practically any type of solvent.

While some solvents, particularly in the synthetic fiber industry, may enter into the reaction of fiber or filament production, the general purpose of a solvent has been served, when it has either dissolved a substance or acted as a vehicle for carrying a dissolved substance or a pigment.

The process of driving the solvent from the product is one creating some severe problems in extraction, drying and recovery. When conventional ovens or dryers are used, the provision of adequate safety ventilation, properly interlocked with stock conveyor travel and fuel input, is a special field of its own, requiring the very best that can be had in engineering talent.

A dryer or oven, handling a solvent, virtually can be considered an explosive gas generator, which by the application of suitable temperatures will produce from 1500 to 3000 cubic feet of a highly explosive mixture per gallon of solvent at 70° F. In the case of carbon disulphide one gallon evaporated will produce over 5400 cubic feet of an explosive mixture.

Thus the engineering of adequate safety ventilation within such an infernal machine is necessary if an explosion is to be avoided. When it is realized that one cubic foot of vapor at 70° F., doubles its volume at 600° F., the maximum temperature factor likewise is vital in figuring adequate safety ventilation.

It has further been established that the lower explosive limits of many solvents decrease rapidly with a rise in temperature of the vapor-air mixture, in some cases it being necessary to increase further the quantity of safety ventilation for ovens by another 40 per cent to compensate for this phenomenon.

Solvent recovery is attracting more and more users and it very obviously involves a type of equipment which should be precision engineered and carefully installed only by a competent vendor, carefully choosing the areas where such equipment is to be housed, using the same discretion as previously discussed for locating a process having an inherent explosion hazard.

The generous use of continuous operating and properly interlocked combustible gas analyzing devices, will go a long way toward maintaining a reasonably adequate safety factor, without having to move more diluting air than is necessary.

You, Too, Can Prevent Off-the-Job Accidents

By THOMAS J. BERK

Assistant Director of Safety, Metropolitan Life Insurance Co., New York

I made a study of the off-the-job safety effort by industry several years ago, and at that time included in my survey about 400 representative industrial organizations in the United States and Canada, asking them specifically what they were doing in the way of "off-the-job" safety.

Out of those 400 companies there were only 43 who claimed they were doing anything about it. Out of those 400 companies I could count on the fingers of my two hands, organizations who were really doing something to alert their employees to the dangers of accidents while away from work. And yet all of these 400 companies had someone who was responsible for accident prevention activities among employees.

This information is offered as an indication that something should be and will have to be done if the safety engineer is to hold his place in these United States.

As you know, New York has become the fourth state to give official recognition to the problem of off-the-job accidents through enacting legislation on employee disability occurring off the job. It is my understanding that the State of Washington also has such a law pending.

In the United States, there are over 140 million people who are watching and waiting to see what the 5,900 members of the American Society of Safety Engineers are going to do about providing adequate safety education for about 60 million workers when they are not in the plant.

There are also those who are waiting and, although not properly trained or equipped, would welcome an opportunity to step into the field of accident prevention, particularly if the job that is required is not being adequately performed by us. They are watching for a chance to point out where the safety engineer has been lax in his accepted duties of preventing accidents wherever they occur.

You cannot afford to confine your safety activities to our plant. You must become more active in community projects that are designed to reduce accidents. There always will be a place for an accident-prevention specialist on community welfare committees.

If we are to be successful in preventing accidents wherever they might occur, we must adjust our methods and approach. The safety engineer must change with the times.

Any law that affects accident prevention and the work of the safety engineer is a part of the off-the-job safety program. Accordingly, you must as individual safety men, as a member of the Textile Section, National Safety Council, as well as citizens of your own home town keep informed regarding any legislation that might affect you, those whom you love, and your jobs as a safety engineer.

While it has been proved that production is affected by the possibility of an accident, up to now that area of possibility has been restricted to our place of business. Now those encompassing circles caused by the rock thrown into the millpond have extended beyond our plant into the street, into the home, and even out of the home. They continue to follow our employees throughout 24 hours of the day.

We can no longer concern ourselves only with industrial accidental injuries; we must prevent all accidents wherever they may occur. In addition, we may have to conduct a program of health education that goes far beyond the scope of duties previously demanded or expected of a safety engineer.

The job we have before us in controlling accidents in and out of the plant is a stupendous one. The challenge has been flung at us by disability benefits laws now becoming so popular. In the past, an epidemic or catastrophe has not necessarily affected the industrialist's insurance premium, even if some of his employees were involved. But, now such occurrences will, particularly if any of his employees are implicated.

From this aspect we can look upon the new disability law as a blessing. I sincerely believe that real business men and business organizations are going to support to a greater degree community safety and health campaigns. They will find that such projects will in the long run be beneficial to them because of safer and healthier citizens in the community. They are going to appreciate to a greater degree such organizations as the National Safety Council and its various sections.

Up to now we have had to consider safety only as an established by-product of industrial procedures. From now on it will be an around-the-clock interest, and we will have to walk outside our plants into the streets, into the homes, into the play areas, and instill safety in the minds of everyone; not only in the minds of our present employees, but in the minds of potential employees as well. And this includes the students in our schools.

Our schools are doing a great deal more in accident prevention education than they ever did, but we still hear the cry that there is not enough room in the curriculum. Our economic well-being in the years to come is dependent on the school child. Safety and health must be accepted as part of our daily life from the cradle to the grave.

Unless we take this attitude, an increasing number of persons will fill our graves and hospitals unnecessarily through accidents.

Too many safety men have been complacent about off-the-job accidental injuries incurred by employees under their surveillance. Some have been promising to do something about this problem. You have no choice now; it has become essential for you to include in your industrial safety program activities that will effect the elimination of off-the-job accidents.

Management has had its attention drawn to the seriousness of the situation by state disability benefits laws. Management will demand action on your part in the prevention of off-the-job accidents and rightfully will require you to show results.

The Disability Benefits Law offers the best opportunity the safety engineer has ever had to demonstrate that he can successfully perform the functions of providing protection from off-the-job injuries. Those safety engineers who have a well-established program are in an enviable position because experience has shown that the fundamentals necessary for eliminating accidents are the same whether the attack is toward the prevention of industrial accidents or off-the-job accidents.

In plant safety, many organizations are prepared to offer suitable educational materials on accident prevention in the home, on the streets and highways, and in recreation areas. You will need to have facts concerning the causes of accidents to your employees. Such data can be collected through reports from employees concerning their disability. But the efficient accident-prevention specialist knows that it is too late to prevent an accident after it occurs. He will want to put into effect a program of prevention before the occurrences of an accident.

The situation faced by all safety engineers who are required to prevent off-the-job accidents is similar to the one that exists in the prevention of industrial accidents. They know that the more serious accidents will be publicized and that definite action will be demanded. The greatest problem, as you well realize, will be with those accidents where the lost time incurred is of short duration.

We have been doing something to reduce the thousands of lives lost in industry, now let us do something to reduce the fatalities occurring to our workers off the job. Until recently, the employer had not been in any way financially liable for accidents to employees while they were not at work. Now he is, and as a safety engineer, you have much more to offer management in this important problem than the fact that off-the-job accidents, as well as industrial accidents, seriously interfere with normal production and may deprive the employer, either temporarily or permanently, or the services of valuable employees.

During last year, 32,000 American workers were killed in off-the-job accidents. Industrial management can and does exercise a certain degree of control over the occurrence of accidents on the job. Generally, management is not in a position to exercise comparable control over off-the-job accidents, but experience has shown that activities can be developed as a supplement to industrial accident prevention activities to stimulate employee interest in the prevention of accidents in his home, on the street, and elsewhere.

The management of many organizations has recognized the effect of off-the-job accidents on output and morale, but due to schedules of production and lack of personnel, the broadening of an existing safety program to include employee safety while away from work has been sacrificed in order to direct attention to circumstances easier to control—industial accidents. These become easier to control because normally only one-third of a day is spent within the confines of the plant.

In our approach to the problem, we must not overlook the tremendous effect off-the-job safety training will have on the families of our employees. Such activities will help to eliminate the suffering caused by accidental injuries to many persons besides the employee. Because of the nature of the problem, the approach to the employee must be sufficiently broad in its appeal to arouse his interest in preventing accidents to those he loves.

Suggestions and programs will have to be presented in such a manner as to make the worker receptive and to encourage his resourcefulness in practicing thinking safety.

We shall have to realize, and make our workers realize that accidents which occur off duty are of concern to both the employee and the company. We shall have to accept the fact that management has no direct control over the behaviour or the practices followed by an employee when engaged in his own personal activities. In setting up and maintaining a program, this fact must be given proper consideration.

One approach to the employee is to emphasize the personal losses that result from an accident. Certainly, we cannot tell a father that he must not lift his young son up on his shoulder while playing, but we can tell him how and what to lift when he is under our supervision and guidance and where we can observe and correct.

There should be no distinction between preventing accidents that occur on or off the job. If employees are properly educated in safety consciousness, they will use safe practices at all times.

Because off-the-job safety benefits every person concerned—management, employees, the families of employees, and the community—the program must be a coöperative one, backed by a labor-management committee if one exists, top management, and the labor organization.

In the last analysis the success of an off-the-job program depends upon the efforts of the individual employee, upon the members of his family, and the general public. Industry is not the only one that benefits from off-the-job safety, the greatest beneficiaries are the employees and their dependents, since they suffer directly from accidents on or off the job through physical injury and in some instances a long-term or complete loss of earning power.

My first study of off-the-job accidents was made several years ago; at the present time, I am collecting further information and shortly will prepare a report. Among the conclusions I have derived from a review of these studies is the fact that any type or size organization can effectively carry out an "off-the-job" accident prevention program. I realize, of course, that the type of the organization and the policies of the management will determine the procedure best suited to a specific safety program.

According to my findings the following are considered essential for creating and maintaining an off-the-job safety program.

First—The program must have the interest and approval of management and the designation of a department or individual who will be responsible for off-the-job safety activities.

Second—Such a department or individual should establish information and statistical data on the subject for the purpose of determining the activities required to combat and solve the problem effectively. Forms for reporting and recording the infomation of value in planning the necessary program will be needed.

Third—Regular reports should be prepared on the company experience and sent to interested parties. The cost factor should be included in such reports.

Fourth—As part of the reports and records, a comparison of the on-the-job and off-the-job experience should be given, although some may prefer to maintain separate records.

Fifth—Special programs designed to solve the particular problem should be conducted. A good idea is to study or learn what the other fellow is doing to stop off-the-job accidents. In addition it is well to solicit the assistance of safety councils and other safety-minded units, and use their offerings as a basis of assistance in your own program.

Sixth—As in industrial accident prevention, an active and continued program to maintain the interest of employees in safety off the job will be needed. The type of material used in the program should be selected so that the message will be educational and suggestive rather than mandatory. The use of the proper method and program, the correct materials, and the continuous recognition of the existence of the problem will result in conducting a worthwhile and effective off-the-job safety program.

No doubt all of you when you were youngsters threw rocks into water, a pond, a lake, or even a river. Some, the "scalers," used to skip here and there, touching the surface of the water every so often and finally sink without leaving a trace. Then there were the other kinds of stones—the solid kind, the kind that left something that you could see, something you could almost feel when you threw them into the water. The concentric circles from the center spread out across the surface until the effect of that rock entering the water was felt for quite a distance.

I should like you to consider your own safety programs in a similar fashion. There is that of the "scalers"—a hit or miss sort of an affair; that where though the stone travels further, it has failed to cover the whole surface, and many do not receive the safety message. Finally, we take the solid safety program, the one that has a good foundation, that is well-planned, that reaches everyone everywhere.

Then I should like to have you visualize the center of that solid rock as the plant safety program. From that center the effect of employee safety education emanates. Think of the first circle as covering pedestrians within the plant area; the second, traffic safety within the plant area; the third, pedestrians just outside the plant; the fourth, traffic safety outside the plant; the fifth, safety in the homes of the employees; the sixth, employees outside activities and so on as each circle encompasses another employee activity.

When we have that solid type of safety program we shall have accomplished something worthwhile. And unless that is the type of program we have, we are not doing our job as safety engineers. Unless we do that job this challenge of off-the-job accidents will not be met, and management as well as the public will call us on our inability to meet this challenge—a challenge that is not a challenge, but a check-up on something that should have been of vital interest all the time—off-the-job accidents.

Too many are working "at safety" rather than "for safety." If we are to continue to do the good work of accident prevention that we have been doing, we shall have to apply ourselves more diligently to the job of preventing off-the-job accidents.

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