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Current Safety Topics in the

GLASS AND CERAMICS INDUSTRY

as presented in sessions of the Glass and Ceramics Section at the 40th National Safety Congress

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New Approaches . . .

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

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 1952 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 GLASS AND CERAMICS SECTION

This volume is a record of the sessions held at the 1952 National Safety Congress by the Glass and Ceramics Section. The conduct of these Congress sessions each year is only one of the many cooperative activities which the Glass and Ceramics Section carries on in behalf of its members, and for the benefit of accident prevention work in the glass and ceramics 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 glass and ceramics 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.

Opening Remarks

By J. C. DITTMER
Chemical Eng., National Lead Co., Brooklyn, N. Y.

Six of our member plants have completed the entire past year's work without a lost time accident, while operating almost four and one-half million man hours.

If they can do it, others can do it too; or, at least, they can make progress toward that goal.

The flat drawn glass division reduced its accident rate twenty-seven per cent. The ceramics and tableware division, and the machine and mold shops division, reduced their rates three per cent and five per cent respectively.

Six new members have been added to the glass and ceramic section of the National Safety Council.

Apparently the time has arrived when we must expand our executive committee to more adequately meet the specific needs of our ceramic industry members as well as those in the glass industries. For this reason the executive committee is recommending the creation of a new office—that of vice chairman for ceramics.

There are many small companies to whom we can be of service through the trade association memberships. We can help them to reduce accidents in their plants. It is recommended that a new committee be formed which may be designated as the association's committee. Mr. H. F. Reinhard of the "Small Business and Associations Committee," of the industrial conference of the National Safety Council, announced at the June 5, 1952, conference "that more sections have set up association liaison committees and recommended that all sections do so."

It has been our custom in the past to relegate our past or ex-general chairman to work on the program committee. As this committee grows it may become unwieldly in point of numbers. I might suggest that a new committee be formed which may be called the advisor's committee and this committee would consist of the ex-general chairmen.

The Newsletter committee has done an especially fine job in getting out an interesting and helpful Newsletter regularly each month.

The engineering and health committee has been working on the publication of engineering data sheets. A number of the engineering data sheets have been, or soon will be, published. Among them are, "Furnace Rebuilds," by H. V. Gardner, "Radiant Heat Control," by William Hazard, "Ventilation on Ceramic or Brick Power Saws," by Fred Kriger, "Furnace Room Fire Protection," by H. Waugh, and others.

The general chairman attended all of the meetings of the Industrial Conference, on December 5, 1951, in New York; on March 31, in New York; on June 5, in Washington, D. C. With several of of the members of the executive committee, the chairman attended the President's Conference in Washington, D. C. on June 2, 3, and 4. The aim of the President's Conference in collaboration with all of the organized safety movements in the country, is to do whatever is possible to reduce accidents. The President's Conference on Industrial Safety was organized by the department of labor in 1948, at the President's request.

The first full scale President's Conference was held in March, 1949. This brought together 1,200 representatives of labor, management, federal and state government officials, educators and leaders of private organizations. The Conference was set up with seven technical committees to study and recommend action in the fields of accident records, analysis and use, education, engineering, research, labor-management cooperation, laws and regulations, and programs and services.

The executive committee of the glass and ceramics section met on April 3 and 4, at the Corning Glass Works, in Corning, N. Y. There were fifteen in attendance at this meeting. This was the largest attendance and the most interesting of our meetings. There was a tour of the imposing Glass Center as well as the glass blowing operations of the Steuben Glass Works Division.

Grinding Wheel Safety

By RALPH N. S. MERRITT
Product Safety Eng., Norton Co., Worcester, Mass.

Grinding is *not* a dangerous occupation. The hundreds of thousands of grinding wheels in daily use with only occasional accidental breakage prove their safety.

Physical nature of grinding wheel: The strength of a grinding wheel is limited by the grinding operation which it must perform. No grinding wheel manufacturer can make a wheel with greater strength than is required by the grinding operation on which it will be used.

Technically, the bonding agent must be just strong enough to secure the exposed layer of abrasive cutting particles until they become dulled beyond further use, and then must break away, from increased "drag" to relieve the dull grains and present a new layer of sharp grains. This process is progressive and continuous. A stronger wheel would not break away and would be useless as a production tool.

This limitation results in the development of relatively weak grinding wheel structures for certain critical grinding operations, such as tool grinding. At best, it places a strength limit on grinding wheels which requires care in their use.

Regulations for safe use: The excellent safety record in the use of grinding wheels is no accident. It is based on 60 years of research, exhaustive tests, experience records, and extensive education of the operators. This important program has resulted in a safety code now published by the American Standards Association and sponsored jointly by The Grinding Wheel Institute and The International Association of Government Labor Officials. This is the "Safety Bible" of grinding. It is the basis of most state codes.

If grinding wheels are used as directed by this ASA safety code, injuries from accidents will be prevented. Every operator should be familiar with all provisions of the code as it affects him for his own protection.

Instructive film: One of the aids for use in the education of supervisors and grinding operators is a motion picture film showing the basic problems and illustrating common dangerous errors and their correctives. It is the most effective method of approaching the problem of using grinding wheels safely and will be the basis for developing the subject further by discussion after the film.

Importance of Safe Use: Of course the prime reason for safety in America is the protection of the individual worker. Our aim is a safe place to work. However, if there is a temptation to neglect strict enforcement of safety rules, such as allowing portable grinders to operate without guards, recent damage suits with generous awards as high as $150,000 for a single accident should be sufficient reason for strict compliance to the code.

Responsibility. Three major agencies are responsible for maintaining conditions to assure the safe use of grinding wheels. All three must co-operate and accept co-ordination of action as necessary. These responsibile agencies are:

1. The grinding wheel manufacturer.
2. The grinding machine manufacturer.
3. The grinder operator and his employer.

Grinding wheel manufacturer's responsibility: The wheel must be properly made, tested, and packed for shipment by the wheel manufacturer. The record in the past is excellent proof that the wheel manufacturers fulfill this responsibility. Every wheel is carefully inspected for a variety of physical and chemical characteristics and finally speed tested sufficiently over the operating speed to provide an ample factor of safety as provided in the safety code. Only certain smaller diameter wheels (exempted by the safety code) are not individually speed tested since the strength is known to be ample for normal operating speeds.

Each wheel is then labeled with the specification and marked with a maximum operating speed which must not be exceeded under any condition. The wheels are then carefully packed for safe shipment.

The grinding machine manufacturer's responsibility: The grinding machine manufacturer must furnish suitable equipment for the operator. Since machines are designed in accordance with our American Standard Safety Code, and double checked by wheel manufacturers before wheels are furnished, the machine design is usually adequate unless alterations have been made.

The grinding wheel user's responsibility: The grinding wheel user is a very important link in our safety chain. His duties and responsibilities are many.

1. *Handling, Storage and Inspection*

He must inspect the shipment on receipt to be sure the wheels were not damaged in transportation. Each wheel must be carefully lifted from the container and inspected visually for cracks or other defects.

A "ring test" should be used to detect possible cracks which are not visible. A sound wheel will give a clear mechanical pitch if properly tapped with a non-metallic implement like a wooden screw driver handle. This test should be repeated when mounting wheels.

Suitable safe storage facilities in a dry place should be provided until wheels are to be used. Racks for storing straight wheels are recommended. Wheel specifications should be plainly marked on the rack and the rack should be sub-divided to minimize wheel handling when selecting wheels for use. Thin organic wheels should be stacked on a flat surface to prevent warpage. If good storage facilities are not available, possibly wheels should be left in original shipping container. A section in the ASA safety code gives details on safe storage and a Grinding Wheel Institute booklet on handling, storage, and inspection of grinding wheels develops the subject thoroughly.

2. *Condition of Machine Equipment*

The machine design is usually satisfactory as originally supplied. However, conditions of operation and use can introduce factors which may be unsafe. Thirty-five per cent of wheel failures can be directly traced to improper mounting which introduces high internal strains in the wheel. This is the largest single cause of failure.

There are several important factors to constantly check on equipment. The arbor or pilot must be correct in size within close limits to allow the wheel to slip over without excessive clearance or "play" and without forcing or "wringing."

The weak zone in a rotating wheel is the hole, so that mounting stresses must be applied as far away as possible.

Flanges must be at least 1/3 the diameter of the wheel (if a small hole is used) and designed with proper thickness and relief to comply with the ASA safety code. Flange design and condition is important. If these are not exactly the same diameter, with the proper relief to apply pressure uniformly around the periphery of the flange, dangerous cross-bending strains are set up in the wheels. Resilient washers or blotters under suitable flanges will distribute the pressure safely.

Flanges should be checked frequently even when they were satisfactory originally. Warpage or excessive wear can concentrate dangerous mounting pressure too near the hole.

Extreme care must be used with equipment and mounting procedure when wheels with large holes are used. All conditions of wheel strength and application of mounting pressure are more critical to prevent dangerous stresses from accumulating at the hole.

Because of the importance of care in mounting large hole wheels, The Grinding Wheel Institute has issued a booklet of instruction for sleeve mountings. Special instructions on care of flange and sleeve equipment to prevent use of warped or worn equipment, as well as use of minimum torque in tightening the mounting screws in a designated order are here explained. Fifteen foot pounds torque is generally sufficient. Greater torque increases the mounting strains unnecessarily and often dangerously.

Each operator should know the exact speed of his wheel spindle to check against the maximum authorized speed of the wheel before mounting. This is particularly important when variable speed grinders are used or when changing wheels to different bonds or softer grades which may be much weaker.

3. *Mounting Procedure*

The new wheel should be again carefully examined for cracks or signs that it may have suffered from handling. The spindle speed must be within that authorized on the new wheel.

The operator should examine the mounting spindle and flanges to be sure that they are clean and not nicked or damaged. The flanges should be equal in diameter and large enough to meet minimum code requirements and properly recessed with flat bearing surfaces. A single new blotter larger than the flange is used on each side of the wheel under the flange. The nut should be tightened snugly but not excessively. The driving pressure at speed is low, and excessive tightening can strain the wheel and warp the flange, resulting in breakage.

All grinding operations should be fully guarded to protect the operator from accidental breakage. The ASA code provides complete technical details for suitable guards for all operations. The operator should adjust and secure the guard before starting his machine. He should then stand out of line of the newly mounted wheel and start the machine, allowing it to operate for a full minute before approaching the wheel. Breakages resulting from damaged wheels, mounting abuses, or over-speed usually occur immediately after starting for the first time.

Now the operator need only observe the normal rules of grinding concerning moderate feed with minimum side pressure. Excessive heating or loading of the wheel face requires a review to establish a better and safer wheel specification.

4. *Protection in Accordance with ASA Code*

It must again be emphasized that all grinding operations must be properly guarded to protect the operator from accidental wheel breakage. This requirement must be enforced particularly on portable wheel grinders. A major portion of the personal injury accidents occur from portable breakages used abusively without guards. The resultant high damage awards from this violation will force the use of guards which are easily obtainable.

Education: Every plant using grinding wheels should have a key man or organization who knows the requirements for safe grinding as established by the ASA safety code. Every foreman and operator should know these safety rules and be required to observe them.

Beside the ASA code, The Grinding Wheel Institute provides safety booklets on special fields in grinding as follows: Safe speeds, handling, storage, and inspection, high speed wheels, portable grinding, sleeve mountings, mounted points, and discs.

The safety code, The Grinding Wheel Institute booklets, and the safety film are available on request without charge. Personal advice and instruction on any and all grinding wheel safety problems are gladly furnished. This assistance is beneficial to both the manufacturer and the user.

Investigation of breakage: A grinding wheel should never break except by pure accidental abuse. Even a so-called harmless breakage should be promptly investigated to correct the cause and prevent a possible serious breakage later. The operator should be encouraged to call a competent investigator to check all equipment and conditions to establish the cause of the breakage and correct it. Too often we find that a personal injury accident occurs after a previous breakage which was ignored. All such breakages should be studied carefully and conditions corrected.

Conclusion: Grinding is a *safe* occupation if the ASA safety code be observed in all instances. If the operator and others are educated in the safe rules which must be observed concerning inspection of the wheel, safe speeds, safe mounting equipment and procedure, and safe operating technique, only very rare accidental breakages will result.

Even these occasional breakages can do no damage if suitable prescribed guards are used on all grinding operations. And these rare breakages should be carefully investigated immediately to correct any possible causes.

The ASA code and The Grinding Wheel Institute booklets are the key to your grinding wheel safety problems. Use them freely to remove all danger of accidents.

Chemical Hazards in Glass and Ceramics Industries

By JOSEPH A. HOUGHTON
Industrial Hygienist, Liberty Mutual Insurance Co., Chicago

Exposures to mineral dusts have been and still are the important exposures in the glass and ceramic industries, and the causes of the greatest losses both in time and in money. The pneumoconioses, particularly silicosis, resulting from the inhalation of these mineral dusts have been described and discussed in many papers and no attempt will be made to go into detail on the classical exposures.

There has been an increasing tendency to make compensation awards for all types of pneumoconioses whether the individual has typical clinical symptoms or not; the main criterion for making these awards has frequently been whether the individual has been exposed to high concentrations of a dust (any dust) and whether it has appeared to aggravate a coexisting bronchial or other lung condition.

Many dusts have been considered to be nuisance dusts in the past and not serious health hazards but it is becoming necessary for industry to attempt to control all types of dust whether the dust contains free silica or not. This applies to all dusty industries and not just to glass and ceramic industries.

Strictly speaking, all materials used in glass and ceramic industries are chemicals, for minerals have definite chemical compositions or they are mixtures of materials that have known compositions. The discussion of dusts will be limited to those materials which have physiological effects associated with a particular element in their composition, with particular reference to the metallic elements.

Any chemical misused can cause physiological disturbances and these may result from contact, from ingestion, or from inhalation. Some materials have greater physiological effects than others for a given dosage, but with any chemical it is a question of quantity in the exposure, how it is used or misused, and the length of time and frequency of exposure. There is a standard answer in our company that is given to engineers who send in a sample of material with the question "Is there anything toxic in this?", without giving any information as to what it is used for. The answer is always "yes," for if a particular mixture was used as an ingredient in salad dressing for example it could be quite toxic or at least cause serious gastric distress. Conversely there is no material used in industry which cannot be handled safely.

Arsenic, as the trioxide, is probably an outstanding example of a very toxic material which is handled safely in the glass industry. It is a material that can be toxic by any route for it can have serious effects on the skin and can be quite poisonous when ingested or inhaled. It is one of the oldest poisons used for homicidal purposes.

Engineers who see the open barrels of the arsenious oxide in glass manufacturing plants are generally quite worried about the condition when they see it for the first time. But experience has indicated that there is apparently no cause for alarm for there does not seem to be any cases of arsenical poisoning in glass manufacturing. There probably are small amounts of arsenic inhaled by men who handle this material, but the quantities are small and are not great enough to cause any difficulty.

The well advertised reputation of arsenic as a poison is probably the main reason why there is so little trouble from the handling of compounds of this element and there are many other materials which need as much publicity. There have been arsenical poisoning cases in other industries, mainly from arsine gas, but this gas would not be expected in glass and ceramic industries for its formation requires reducing chemical conditions.

Considering some of the other highly toxic materials used, lead is still probably the one most widely used although other materials have been substituted for lead in low melting glasses and glazes. We seldom hear of the advanced classical symptoms of lead poisoning which occurred in the past and it is becoming common usage to refer to cases as lead intoxication where only the minor symptoms are present. In the batching of ceramic and glass mixes it is necessary to handle the lead compounds carefully, such as the oxide and carbonate, for these dusts are readily dispersed and inhaled. In general, control at this type of operation is good throughout the industries, but as a practical matter it is impossible to control all such dusts completely under all conditions and employees may absorb some lead dust.

It has been argued that the lead silicates which are formed during firing are not toxic for they are completely insoluble, but unfortunately this is not true. The lead silicates are not as readily absorbed as the lead oxide or carbonate, but over a period of years enough may be absorbed and stored in the body to cause clinical signs and symptoms. These clinical signs and symptoms are not the classic ones of the lead line in the gums nor the wrist drop, but minor symptoms such as gastric disturbances or the colic and a tiredness or lassitude. These symptoms may be minor, but over-all they can effect the work performance of the individual and his general feeling of well being.

Our medical division has listed about 29 signs and symptoms of lead intoxication, any one of which can appear to be a sign of some other bodily disturbance and they can only be interpreted on an over-all basis in conjunction with an evaluation of the work exposure.

Whenever there is a continuous exposure to any lead compound or to any lead working operation such as a heavy soldering operation it may be necessary to have both engineering and medical control.

If visible dust or fume is present around lead working operations then an engineering survey is indicated to determine what controls are needed.

Control of Exposures

To digress a moment to discuss what we mean when we mention controls, the main object is to prevent or to lessen the exposure of individuals to the material that may cause trouble. The exposure may be from contact with the skin in handling and controls may require such things as automatic handling, or material handling equipment, or protective gloves and other clothing, or perhaps better work practices with careful handling, and frequently good personal hygiene with regular washing and change of clothing. Exposure may be from ingestion of the materials, which may require such things as better work practices to prevent contamination, eating areas away from the working area where the toxic materials are handled, and careful personal practices.

Exposure may be from inhalation of dust and this is generally the most serious exposure. This is the type of exposure where enclosure and exhaust ventilation are needed and the object is to prevent the dust from escaping into the workroom atmosphere where employees can inhale the dust. The general methods of control of dust are: a. isolation, for example automatic weighing and batching equipment controlled from a remote station, b. keeping dusty products moist wherever possible, for the dust will not be dispersed, c. complete enclosure, where dust is confined or just vented from the enclosure to the outside, such as a completely enclosed blender or grinder, d. exhaust ventilation, where an exhaust hood is close to the point where dust is dispersed; a local exhaust hood at a belt transfer point or a dumping station can be much more effective than a fan placed in the wall to provide general room ventilation, e. substitution of a less toxic material, such as the use of bismuth instead of lead in low temperature frits and, f. respiratory protection using approved respirators, but respirators should be used only where all other methods fail, for respirators will not be worn continuously and should be reserved for short time exposures only.

With the engineering controls listed, a good medical control is essential particularly with the highly toxic materials. Engineering controls alone are not always satisfactory for there may be an exposure which escapes notice or which is not entirely controlled. Medical controls alone will not be satisfactory, for it is not economical to have medical checks just to determine when an individual needs treatment or removal from an exposure. Engineering controls and medical controls must work together to be effective.

An engineering investigation will indicate to the doctor just how comprehensive the medical control should be. If the exposure is comparatively small then the medical checks do not need to be as frequent or as extensive; but if the exposure is large then close and extensive medical controls may be needed. The doctor can be of particular help in convincing employees of the need of better work practices, careful handling of harmful materials and the need of good personal hygiene practices.

Individuals will pay better attention to advice from the doctor or the nurse than they will from any arguments or advice from lay individuals on these matters. The doctor can also detect signs in individuals to help point up exposure points that may have been overlooked.

And with the engineering controls mentioned for individuals in the plant, consideration must also be given to the possible damage to neighbors or the public from dust or gases discharged. Exhaust ventilation can take acid fumes from a pickling operation and discharge them through the roof which will protect employees, but will these acid fumes be discharged at a point where they may corrode a transformer station near the plant, or damage employee's cars parked nearby?

Or will the dust discharged from open handling contaminate foliage and perhaps harm a fruit orchard nearby?

Or will dust enter a neighbor's factory and damage bearing surfaces on machinery?

All of these require an engineering investigation (which is mainly careful observation and some common sense) to determine the potential harm which may be done. Air sampling to determine the magnitude of the exposure generally requires special equipment and techniques and may be dust counting, chemical analysis of the material sampled or special meters.

To come back to lead and other exposures, a standard of 1.5 milligrams of lead per 10 cubic meters of air has been set as a standard for continuous exposure in a work room atmosphere. It must be realized that many individuals can stand exposures in excess of this without any harm and that this limit has been set to try to protect the more susceptible individuals. If air sampling shows concentrations in excess of this limit then engineering controls are needed. If exposures are around this limit there is a chance that some clinical signs and symptoms will show up in a few individuals and as soon as any work room exposure starts to approach this MAC then a medical control program is advisable. The more severe the exposure the greater the need of medical control. It is not always practical to install complete engineering and environmental controls and in these cases medical control is a must and must be worked in conjunction with the engineering controls.

Beryllium and its compounds have limited use in the glass and ceramic industries and it is mainly used for the preparation of certain types of refractory crucibles and certain types of porcelain. This material is comparatively new in the industries, but its adverse effects have been widely advertised, although the reasons for these physiological effects are not known. The maximum allowable concentration for this material in workroom air has not been definitely set although it is known that the figure must be very low and the AEC uses a standard of .02 mg/10 cu. m. Exceptionally good engineering control is necessary when this material is handled and the engineering controls must be tied in with medical control.

Other highly toxic materials such as selenium, cadmium and antimony are used in comparatively small quantities as colorants and decolorizers in glass and enamel manufacture. The handling of these materials requires close engineering control wherever they are used whether in the batching of mixes or in the spraying of frits containing these materials. Selenium is probably not the bad actor in industry that it was in the past for most of the selenium now available is quite pure. The malodorous body conditions from the use of selenium apparently came from small amounts of tellurium which was associated with it, but at present most of the tellurium is removed for other purposes.

There are other materials that are highly suspect although not as well advertised as toxic materials. Barium compounds, particularly the more soluble compounds, are potentially serious. The sulphate being the most insoluble of the ones in common use is probably the least harmful and it is regularly given internally as a radio-opaque material which will coat the intestines for an X-ray examination. The horrible looking and tasting suspension which the doctors give to their patients is given without any physical harm although some barium may be absorbed, but realize that this is given only once or twice to a patient and that the patient does not have a continuous daily exposure to this material. The sulphate is used as a flux in a few types of glasses and enamel and there probably is very little difficulty from its use. Inhalation of barium sulphate dust and other insoluble barium compounds can result in radio-opaque deposits in the lungs, just as well as the intestines when the compound is swallowed, for this is a high molecular weight element which has good stopping power for X-ray.

The X-ray shadows from barium deposits in the lung can simulate those of discrete nodular silicosis and although these deposits are of little consequence as far as the health or disability of the individual is concerned, the lung markings may have a bearing in the case of any claims. Also, with the widespread use of mobile X-ray units we know of several very alarmed individuals who received notices that they had a serious chest picture which needed follow-up.

Any employees who are exposed to dust from barium compounds should be advised of this possible complication for it would be impossible for a physician to diagnose the condition without knowing the type of exposure. And it would need some very expert advice to be able to tell the man that it is a benign condition which would not cause any disability. I know of one recent case that occurred where the man was using molten barium chloride for heat treating of parts and inhaled the fumes as parts were removed from the hot salt, over a period of years. He felt perfectly well and had no disability of any kind until he had a routine X-ray picture taken and the first alarm of the physician had him greatly worried. Although they have since tried to assure him that there is nothing seriously wrong he is naturally worried about the chest condition. The use of other barium compounds such as the nitrate, fluoride and carbonate is increasing in enamels, glass and pottery and these can be potentially serious if absorbed into the body by ingestion or inhalation.

Although cases are few from these comparatively soluble barium compounds we know enough of the properties to know that they must be handled carefully. Barium carbonate is the toxic agent in some rat poisons and we have a number of dead cows to pay for where barium carbonate dust was spread around the countryside and the animals ate the contaminated foliage.

The fluorides such as apatite, cryolite, fluorspar and the soluble fluoride compounds are another group that are suspected of being potentially harmful. Large tonnage quantities of the minerals have been used in the ceramic and in other industries apparently without serious harm, but it may be that the full clinical picture has not been described. This suspicion has been created by the large number of cases of damage to animals where they have eaten foliage contaminated with fluorides.

This is a problem which has been quite serious to the aluminum industry and one that was serious enough to be discussed in the British Parliament during the past year. In the British discussion the connection with the ceramic industries was pointed out for any of the ceramic bodies which contain fluorides will discharge fluorine compounds during the firing. The fluorine compounds discharged may go off as hydro-fluoric acid or as fluorsilicates and any green foliage will readily pick up even minute traces of these materials from the air and concentrations in the foliage will be built up. Whenever there is a firing of vitreous enamel or other ceramic bodies containing fluorides then close attention should be paid to the possibility of contamination of pasture land within several miles of the plant.

The fact that fluorides have been known to poison animals does not mean that the employees in the plant causing the damage are going to be poisoned, for employees will be exposed to much lower concentrations of the gas and are not ordinarily accustomed to eat foliage unless there may be some truck gardens in the vicinity or perhaps some fruit orchards which could accumulate and store the fluoride. Fortunately, the accumulation of fluorides in most edible plants will show some damage which may make them unfit for profitable sale and the chances of human consumption are small. However, men are exposed to fluoride dusts and gases in the ceramic industries and it is necessary to control these contaminants.

Cryolite has a low solubility in water but even with this low solubility it is an excellent insecticide and in large quantities can do serious harm to men as well as to insects. It is advisable to keep dusts from all fluoride compounds down to a minimum and this applies to frits which might be sprayed as well as to the batching and transfer of the original mixes. Apparently the tolerance of humans for such insoluble fluorides as cryolite is fairly high and mathematically this would work out to about 50 milligrams of this dust per 10 cubic feet of air which is a fairly large quantity which would be visually considered to be a heavy dust concentration.

Also, whenever there is any nasal or eye irritation present around the firing of ceramic bodies which contain fluorides then it is advisable to look for leaks from the furnace or oven. There have been several cases where an acid irritation present in the work room was attributed to pickling operations conducted nearby when the real cause were the fluoride gases discharged from the firing of a vitreous enamel.

The increasing use of lithium minerals and salts in the manufacture of glass, glazes, enamels and whiteware bodies may occasion some concern. The serious cases of lithium poisoning have come from the use of lithium chloride as a substitute for salt in certain medical conditions and the effects have been quite severe. It is not known just what the cause of the condition is, but it is possible that it is an upset in the sodium-potassium balance in the body caused by the chemical similarity of the lithium.

In the medical cases it would appear that the effects of lithium are not accumulative for the lithium was not stored in the body and the patients rapidly recovered when the lithium salt was removed from their diet. The use of lithium carbonate would be the most suspect and high concentrations of dust from the handling of this should be avoided. The minerals such as lepidolite and spodumene probably are not soluble enough in the body fluids to cause the acute effects of lithium poisoning which require fairly high amount of the ion.

Other elements that are suspect and which are used in small quantities in the glass and ceramic industries are antimony compounds, cobalt compounds and germanium oxide. Antimony sulfide has been used in conjunction with resinoid binders and has been suspected as the cause of trouble in an isolated instance. Cobalt has been suspected in the tungsten carbide tool manufacture as a cause of a chemical pneumonitis. Germanium oxide is close to arsenic in the periodic table but experimental evidence with animals would seem to indicate that it is much less toxic than such metals as lead.

This discussion does not indict all unusual exposures for there are a few materials which seem to be practically non-toxic. For example, titanium dioxide has not shown any serious disability either in animal experimentation or in the various other manufacturing uses such as in the paint industry. Cerium oxide is becoming more commonly used particularly as a polishing agent, and animal experimentation and use in industry would seem to show that this is almost harmless. Cerium resembles aluminum in its pharmacological action as well as in chemical properties and fairly high doses of the oxalate have been given as a drug. There are a few of the more soluble cerium compounds which have shown some clinical signs on use.

Contact Hazards

Skin hazards and exposures in the glass and ceramic industries will come mainly from acid and caustics. Arsenical compounds can cause a severe dermatitis and in some industries have been indicted as a cause of cancer, but a recent study points out that arsenious oxide is not a serious carcinogen in the ceramic industry and with care in handling these difficulties should not be encountered. Nickel salts have a limited use in the ceramic industry and can cause allergic reactions in a few very susceptible individuals, and when this type of reaction is found it will be necessary to remove the individual from any contact with nickel compounds.

With the acids and caustics there is a fairly long list which will include the alkaline carbonates and the three main acids used—hydrofluoric, sulfuric and hydrochloric. Accidents will come mainly from improper methods of handling. The hazards and precautions for handling these acids and alkalis have been thoroughly covered in publications of the Manufacturing Chemists Association and in the data sheets of the National Safety Council and it should not be necessary to discuss them here.

There are two points to emphasize and one is the desirability of using an inhibitor in the pickling of iron with sulfuric acid before application of frit. Recent animal experimentation would seem to indicate that the mist from sulfuric acid baths can be more harmful than we had previously believed and it is advisable to keep concentrations of the mist down to the point where they are just barely detectable by the nose. This can be accomplished by local exhaust ventilation, but this requires an expensive installation which needs frequent renewal and repair.

Experience in a few plants seems to indicate that the proper use of chemical inhibitors in the sulfuric acid pickle will help considerably in keeping down the amount of hydrogen formation and the consequent escape of the mist into the work room atmosphere. Also, a lower pickling temperature will help considerably in keeping down the amount of escaping mist.

Both the use of the inhibitor and the lower temperature will lengthen the pickling time and in some cases it is necessary to have additional facilities in order to accommodate production, but a few plants have found that the cost of the additional facilities has paid dividends in the long run. There is some objection to the use of the inhibitors in that more thorough rinsing is needed before coating, but this is not a difficult procedure.

The most effective inhibitors are toxic and they are complex organic compounds. The various ingredients of commercial compounds are not available but examination of a list of inhibitors which have been tried would seem to indicate that the greater toxicity the better the inhibitor appeared to be. However, the toxicity of the inhibitor is not a serious objection except in handling of the concentrate and adding it to the bath. With the dilute solution the inhibitor should not be hazardous.

The other point is the proper method of handling highly caustic compounds such as the strong alkaline cleaners and de-enameling compounds. When strong alkalis like caustic soda are dissolved in water the reaction is exothermic, that is it gives off heat, the alkali must always be added to the water, not the water to the alkali for the consequences can be serious. If a drum of flake caustic is added to an empty tank, the water will react with the surface and with the heat and dissolving there will be a slight cementing and solidification on the surface; some water will penetrate the pile of caustic and the heat generated in the interior will be great enough to generate steam and the pile of caustic can erupt violently. The same thing can happen if an employee tries to take a short cut and upend a drum of caustic cleaner into a tank of water.

This type of accident is infrequent, fortunately, but we have cases of this nature regularly; it is the type of accident that you wish had never happened for the burns are very serious and painful. The caustic must be added slowly to the tank of water, a shovelful at a time, so that the water will have a chance to absorb the heat generated, and the heat will be dispersed through the water instead of being localized in one spot.

Solvent Exposures

Solvents have a somewhat limited use in the glass and ceramic industries except for some metal cleaning. But in most every plant there will be solvents used by the maintenance department, and in particular they will use carbon tetrachloride for cleaning electric motors.

It is not possible to tell maintenance men that there are satisfactory substitutes for tetrachloride for cleaning electric motors. There are other solvents that will clean the motors, but carbon tetrachloride is still the easiest to use and it is the most effective. None of the substitutes can do the job as well. With carbon tetrachloride, the electrician can place a small motor in a bucket of this solvent and go on with his other work knowing that he can return at his convenience, complete the cleaning and it will dry rapidly. With others like trichlorethylene, perchlorethylene, stoddards solvent and mixtures of these with other solvents he is not always sure that there will not be an attack on the winding or other insulation in the motor. These solvents will attack and swell (if not dissolve) some types of insulation and there is no way of telling beforehand. A number of motors have had to be rewound from this cause.

But carbon tetrachloride is a dangerous solvent from its toxic action and we have a list of seven deaths from improper use of carbon tetrachloride which were reported to our company within the past year and a half. We do not have a tabulation of individuals who have been made ill from its use, but the chances are good that there have been many.

Substitute solvents for carbon tetrachloride can be used, even for motor cleaning, if they are properly used. For electric motors, the motor should not be permitted to soak in the solvent for more than a few minutes and a little extra elbow grease may be needed.

If carbon tetrachloride must be used then it must be used under controlled conditions—covered containers for the solvent, used out of doors and not in a confined corner in the maintenance department and kept under lock and key to prevent unauthorized use and to prevent employees taking some home for a little dry cleaning or spot removal, and the use of a charcoal type respirator when using the solvent. It should be possible to use another solvent such as stoddards solvent (naphtha safety solvent) for preliminary cleaning followed by carbon tet and thus to limit the exposure to carbon tet. Give this solvent the reputation that arsenic has—it is a valuable solvent that can be used safely but it can't be used indiscriminately.

Don't Bet Your Life

By CLYDE R. POWELL

Public Relations Dir., Lehigh Safety Shoe Co., Endicott, N. Y.

Mr. Powell entertained and instructed the audience with a demonstration of some of the parlor magic tricks with which he has been entertaining enlisted men at USO clubs.

He demonstrated his hypnotic powers, using five men from the audience who volunteered to cooperate. The five were put through some hilarious stunts.

Maybe all that seems a long way removed from the subject of "safety," but thoughtful analysis of the deftly worded running patter with which Mr. Powell accompanied his performance reveals considerable substance with significant points these sleight-of-hand tricks served to emphasize.

In effect, he put over these *thoughts*: "We're playing the game of life for keeps. We don't get a second chance. One instant of thoughtlessness or inattention can be fatal. Safety has to be sold. It can be sold by reiterating its principles over and over, as the hypnotist does with his subject, until they become so deeply engraved on the subconscious mind that they automatically act to protect us in the moment of danger."

It was a decidedly new and different way of preaching safety and it is quite certain that no one who saw and heard this unusual but effective "lecture" will ever forget its lessons.

Ventilation Problems in the Glass and Ceramics Industry

By W. G. HAZARD
Dir., Industrial Hygiene, Owens-Illinois Glass Co., Toledo, Ohio

(*Note:* A film on "Industrial Ventilation," produced by the Michigan State Department of Health and American Air Filter Company, Inc., Louisville, Kentucky, was shown. This was followed by a demonstration, with discussion and questions.)

The film "Industrial Ventilation" clearly brings out an important feature of local exhaust systems—but one over which there is still much confusion. Many people assume that because you can squirt a jet of air from a compressed air hose so its effect is felt many feet in front of the nozzle, you can "suck" air into an exhaust pipe from regions several feet away from the opening. This is perhaps the commonest pitfall of design when an inexperienced person lays out a dust exhaust system.

To emphasize this point, we constructed a simple model, not unlike the more elegant apparatus you saw in the movie, to drive the story home visually to our own plant people.

It consists of a two-foot section of ordinary sheet iron duct, six inches in diameter, mounted horizontally on a tripod. Inside the pipe is a small propeller-type fan which, when we turn the current on, draws air in one end of the pipe, and blows it out the other. Obviously, all the air that blows out, has to have entered through the other end.

At each end of the pipe we have mounted rods extending about two feet beyond the ends. Pieces of tissue paper are hanging at six-inch intervals along the length of the rods.

You can see that the pieces of paper are blown almost horizontally by the air coming *out* of the pipe, but not even the piece of paper hanging nearest to the inlet end of the pipe (six inches away) is disturbed by the air *entering* the pipe. By using a smoke tube, we can trace the air currents even better. Just a few inches from the inlet end, air is stagnant, but the smoke is violently agitated several feet beyond the outlet end.

Thus it's impossible to "pick up" dust, or dust-laden air, more than a few inches away from an exhaust pipe. It has no magical power to reach out and suck in air from a local dust-producing operation. Air is not drawn from that isolated point to the exclusion of other points. It is drawn from the entire half sphere in front of the pipe, and from most of the half sphere behind the pipe. The velocity at any single point on this sphere is extremely low.

Dallavalle, Silverman and others have worked out equations for finding the velocities along the centerline of a hood at various points out from the hood face. As an example, if we have an eight-inch round pipe with air flowing into it at a velocity of 4,000 feet per minute, the velocity at a point six inches away from the open pipe will be only about 500 feet per minute. A flange around the pipe opening keeps air from being drawn needlessly from in back of the opening, and permits the air flow rate to be reduced by 20 to 25 per cent of the open pipe requirements.

A simple rule of thumb is that when *exhausting,* the velocity at a point one diameter away from the pipe is 10 per cent of the face velocity; and when *blowing,* the velocity falls to 10 per cent of the face velocity at a point 30 diameters away from the pipe. Thus if our model (six inches in diameter) has air passing through it at 4,000 feet per minute, the velocity at a point *six inches* from the "sucking" end will be about 400 feet per minute, and the velocity will be 400 feet per minute at a point *15 feet* from the "blowing" end. Hence, it is extremely important when exhausting dust from a local source, that this source be surrounded just as much as possible by the hood, baffles or a booth—for otherwise the contaminant won't get into the air stream and won't enter the piping.

Not related to dust exhausts, but to ventilation used for improving comfort in the hot industries is the control of radiant heat. Mancooling fans, and removal of hot air by diluting it with cooler outdoor air, are limited in their effectiveness when there are sources of radiant heat present.

This subject was discussed at the meeting of this section last year. It is so important that some new developments should be mentioned. At least four exhibitors are showing *heat reflective* clothing. It is made of aluminized fabric, and finds use when working around hot furnaces. We also have a film loaned by Minnesota Mining and Manufacturing Company, which illustrates how this type of material withstands radiant heat much better than ordinary non-reflective fabrics.

Ventilation Problems

Round Table Discussion of Ventilation Problems

Discussion Leader—W. G. HAZARD, Director, Industrial Hygiene, Owens-Illinois Glass Co., Toledo, Ohio. Local exhaust systems are not always well designed. Sometimes the plant is too busy with production. The plant engineer may lack experience. Duct systems are sometimes "out of this world."

Principles involved in exhaust venting were shown by a film produced by the American Air Filter Co., in cooperation with the Michigan State Department of Health. Part One dealt with "Laboratory Experiments" and Part Two with "Practical Applications."

A demonstration with simple apparatus showed the comparative effectiveness of suction and blowing. It was shown that it was possible to blow smoke across the room but suction was effective for only a few inches.

One trouble with ventilating systems is adding too many hoods to the original system.

A motion picture produced by Minnesota Mining and Manufacturing Co. showed the uses of aluminized fabrics for protective equipment. Clothing and shields of this material have a high fire resistance but are still not too durable. Their present uses are for rescue work rather than for general industrial use.

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