1951

Current Safety Topics in the

GLASS AND CERAMICS INDUSTRY

As presented in the Sessions of the Glass and Ceramics Section at the 1951 National Safety Congress

Volume 12
Transactions
39th National Safety Congress

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NATIONAL SAFETY COUNCIL
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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 GLASS AND CERAMICS SECTION

This volume is a record of the sessions held at the 1951 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.

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Medical Programs in Glass and Ceramic Industry and Small Plant Progress

By W. J. McCONNELL, M. D.
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The growing importance of the field of industrial health and hygiene is evident in the larger glass and ceramic plants generally throughout the nation. Considerable progress has been made in the elimination or control of environmental contaminants and in the provision of creditable health programs. These health conservation services touch the lives of hundreds of thousands of industrial workers whose good health and efficiency are most vital to the organizations they serve.

Less progress has been noticed among the smaller plants, although from a public health viewpoint extension of health services to include small plants is of great significance because an overwhelming majority of the industrial population is employed by the small organizations of the country. The management of a small concern is inclined to defer provision of a health service, much as one may be desired, because he believes it difficult to supply the required amount of services economically. This belief can no longer be substantiated.

Different groups of individuals and organizations have repeatedly demonstrated that it is practicable to provide a joint health service. This can be accomplished by grouping a number of small plants together and supplying medical supervision to each. The cost is not out of proportion to that which large plants pay. The employment of medical services used jointly with other industrial plants is not an unusual departure from accepted methods, since common services are given proportionately.

I had the opportunity, beginning in 1925, of directing a demonstration of cooperative health services to groups of small plants in Philadelphia under the auspices of the Philadelphia Health Council and Tuberculosis Committee. For administration purposes a unit of small plants with about 25 to 500 employees each, located reasonably near each other and making a total of 1,000 employees were grouped together. Each plant sharing a unit service provided a first-aid or clinic room with necessary equipment. It was supplied with medical and nursing services, first-aid instruction, health talks, and sanitary supervision.

A registered nurse with industrial nursing training was assigned to each unit. She divided her time among the plants according to a definite schedule. Not less than three hours of health work for each 100 employees was done in each plant each week. A physician experienced in industrial medicine and hygiene was assigned to a group of two units, giving half his time to each unit. These units were turned over to the plant managements for administration when they became sufficiently organized and were capable of continuing the service without supervision by the Council.

The medical supervision of these plants and others added from time to time was admirably directed by Dr. Glen S. Everts for over a period of twenty years before he turned them over to a successor.

The Health Committee of the Chamber of Commerce and of the Board of Trade of Philadelphia has fully endorsed these services. Only a few years ago this Health Committee prepared a pamphlet entitled "Why Plant Industrial Medical Service Should be Adopted." It gives in question and answer form many of the facts which businessmen want explained. These include What is the scope of a good medical service for a small plant? Will a medical service decrease time lost due to accidents? Will a medical service decrease man-hours lost through illness? Many other facts are discussed.

In recent years other areas in the country have developed similar plans to meet the medical needs of the small plant. These are comparable in scope and effectiveness to those in the larger plants. O'Connor[2] clearly summarizes four essential requirements for success of a small-plant medical program as follows: "1 The medical personnel must be truly interested in developing a real industrial health program; 2 The medical service must come into the plant; 3 The program must have the interest and support of management; and 4 The primary aim must be the good of the employee."

He points out that one small plant of about 700 employees near Boston with a part-time service had $10,000 returned to them one year and $16,000 the next year through reduced compensation losses. Reduction in absenteeism was reflected in approximately 50 per cent reduction in their group insurance losses. One large company in New York City reports that its medical department has saved approximately $100,000 per year in reduced accidents alone during the past four years.

There are thousands of instances indicating the monetary savings and reduction in time lost from work through adequate health services. William B. Given, Jr., President, American Brake Shoe Co., so aptly said in his keynote address on "A Better Place to Work" a few years ago at the annual meeting of the Industrial Hygiene Foundation: "It is not a question of whether a company can afford an industrial health program, but whether it can afford not to have one."

Speaking more specifically of the glass and ceramic industry, I need not call the attention of this group to the complexity of the industry. It produces glassware of all kinds and descriptions, refractory bricks, electric and chemical porcelain and stoneware, sanitary ware, china, dinnerware, drain tile, sewer pipe, floor and wall tile, porcelain, and a host of other important products made entirely or chiefly from materials of an earthy nature.

In past years workers were exposed to many toxic metals, including lead, arsenic, cadmium, manganese, chromium, beryllium, irritant acids and alkali, and toxic solvents of many kinds. Sand, the silica base which makes up a great part of the batch particularly in glass, pottery, and electric porcelain mixes, presented an important hazard of silicosis, particularly from the dust in the mixing, cutting, grinding, and polishing operations.

Throughout the industry, carbon-monoxide was of importance because of the rather ill-exhausted flames which were so numerous. Many bad burns resulted from hydrofluoric acid used in etching of glassware. Lime burns occurred frequently. Glass blowing processes and work at the furnaces had their own peculiar hazards, including infections, strains, burns, eye injuries, heat exhaustion and heat cramps, rheumatism due to dampness and extreme changes in temperature.

To the great credit of the industrial leaders of the industry many of these hazards have been controlled or eliminated. Processes have been modernized so that many of them are now done entirely by machinery. Automatic mechanical methods have reduced the above hazards to a minimum.

Low solubility lead is now largely used in glazes. Mechanical handling equipment has been substituted for manual handling. Many of the dusty operations have been enclosed and ventilated. Bottom-dumping railway cars are used for bulk shipments. Many other improvements have been made.

However, as you are no doubt aware, these improvements are confined largely to the newer and larger plants. Even in these plants, adequate maintenance of equipment is essential. Best results are obtained where the engineering, planning, medical, and safety departments fully cooperate in detecting and controlling unhealthful exposures throughout the plant.

If management is fortunate enough to have a trained industrial hygiene engineer, he should be part of, or closely associated with the medical and engineering departments, and be responsible for the detection, evaluation, and control of health hazards throughout the organization.

Although the need for industrial hygiene services depends largely on the nature of the operations, rather than on the size of the plant, small organizations and others may obtain the necessary engineering services through state departments of industrial hygiene, through private organizations, and through consultants.

An industrial health program, to be most effective, must be tailored to serve the needs of the particular plant. Generally, the medical services should include, but not be limited to, the following:

1. Prompt and efficient medical and surgical treatment of all occupational injuries and occupational diseases to reduce disability to a minimum.

2. Treatment of minor non-occupational injuries and illness in an effort to enable the employee to complete his shift, thereby reducing lost time. In the event continu-

ing care is required, workers should be referred to their personal physicians .

3. Preplacement physical examinations to all applicants for employment to insure physical and mental fitness for work. Workers should be assigned to tasks according to capabilities so that they will not be a hazard to themselves or others. To fit the applicant to his job the examining physician should cooperate closely with the personnel and safety departments so that he is well informed with respect to the processes carried on in the plant, the materials with which the worker comes into contact, and the environment under which he works.

4. Health examinations of all employees and executives should be made annually, as far as practicable. Such examinations are the basis of a diagnostic service of health education for the plant personnel. The findings should be carefully discussed by the physician with the person examined, and made the basis of any indicated correctional program.

5. Special periodic examinations, including necessary laboratory work, should be given to employees with special responsibilities, and to those who are exposed to toxic or hazardous processes. The frequency of these examinations is best based on individual plant experience, and may be changed from time to time. Persons found to have evidence of disease or of chemical intoxication should be removed from their work and placed under close medical supervision. Attention should be directed immediately toward controlling the hazardous exposure so that other employees will not be affected. Similar examinations should be made at the termination of employment.

All employees leaving the job because of injury or illness, and those returning to work following absence resulting from injury or illness should be cleared through the medical department to insure fitness to work safely and efficiently. This practice will also minimize the possibility of introducing communicable diseases into the plant.

6. Complete individual medical records for each employee should be kept in the medical department. These should include records of preplacement examinations, periodic physical examinations, medical and occupational injuries. Information regarding occupational injuries should be furnished promptly to the safety and other interested departments. The clinical information contained in the medical records should be confidential. General statements concerning physical fitness and classification of the worker should be furnished other departments upon request. Monthly summaries should be prepared. These would indicate the scope of the several activities of the medical department, the incidence and nature of various injuries and illnesses occuring in departments of the plant. This report should contain any pertinent recommendations for the correction of conditions causing an undue amount of sickness or of excessive injuries.

7. Other activities of a plant health program include the inspection at frequent intervals by the medical director or his representative of all operations and shops. These inspections are to detect working conditions and practices inimicable to health and efficiency, to become thoroughly familiar with the nature of the various tasks and potential health hazards associated therewith, and to observe unsanitary conditions.

8. The medical department should conduct a progressive program of health education for the employees. Plant physicians and nurses should utilize every opportunity by personal contacts, posters, pamphlets, news articles, lectures, and motion pictures to instruct employees in personal hygiene, nutrition, sanitation, and disease prevention. These activities should closely parallel the educational activities on safety. Finally, the medical department should maintain friendly and cooperative relationships with local health authorities and private physicians in the interest of maintaining the health and efficiency of plant employees.

Comprehensive industrial health services having for its objectives the reduction of accidents, illness and the promotion of optimum health among the plant employees can make its presence felt in industry by positive results. Its existence is justified to management in money saved by reduced accident costs, less absenteeism and improved quality of work.[1]

[1]*An Analysis of Existing Types of Small-Plant Health Services in Northeastern United States.* R. B. O'Connor, M.D., A.M.A. Archives of Industrial Hygiene and Occupational Medicine, January 1951, Vol. 3, pp. 73-80.

The Cost of Public Accidents to Industry

By W. GRAHAM COLE
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Summary of Remarks

Poor public relations result from accidents caused by neglected physical environment of plants or commercial vehicle operation or in the use of an industry product such as utilities.

Employees' accidents off the job are not covered by compensation and result in production time loss. Accidents to employees' family and friends are a source of worry to an employee and also causes susceptibility to accidents with resultant production time loss.

Two out of three deaths and three out of five injuries are the result of off-the-job accidents. While on-the-job accidents have caused four to five million hours of lost time, off-the-job accidents have caused 60,000,000 hours of lost time.

Industry has a definite interest in off-the-job accidents because it results in curtailment of production and the loss of the employee's services. A valued employee makes the cost considerable. In a particular case of six off-the-job accidents, three were due to traffic, two to home accidents, and one on a farm.

There is an additional cost of hiring and training replacements for injured employees. As far as costs go, it does not make much difference whether an employee was injured on-the-job or off-the-job. One firm found a ratio of 14 off-the-job to one on-the-job accidents. All are an economic and a social loss, the ultimate cost being paid by the consumer of the product.

Industry owes to itself and the public the exercise of its know-how to prevent accidents and to provide leadership to the community and to develop interest in the prevention of accidents. This will result in good will for the company.

There is a need for getting facts upon *off-the-job accidents*. It is important to get employees to think about safety all the time, which will benefit the employee as well as the employer.

Off-the-job safety activities can be integrated with our industrial program for on-the-job safety and can be the means of stimulating interest in various local meetings of the chamber of commerce, plant foremen, etc. Strong action should be taken in preventing off-the-job accidents.

Shielding for Radiant Heat in a Glass Plant

By KARL L. DUNN
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Until comparatively recently the high temperature industries have depended almost entirely upon convective or induced convective cooling to promote comfort in the work areas. Although direct radiation from hot surfaces was recognized as a major source of discomfort in the glass plants, only very sketchy work was attempted to reduce the intensity of this radiation.

About fifteen years ago it was called to our attention that over 50 per cent of the heat loss from surrounding tank furnaces was in the infra-red spectrum. Following this considerably more attention was given to radiant heat than had previously been given to it, but it was only after the organized study of several large glass industries under the direction of the Industrial Hygiene Foundation in a quantitative determination of heat sources that any real logical engineering work was attempted.

In review; the first thing to be done was to familiarize ourselves with the basic laws of radiant heat. This is probably best explained by the Stefan-Boltzman equation. This equation says simply that the total radiant flux is proportional to the fourth power of the absolute temperature of the radiating source. We have assigned a value of 1.0 to the emissivity, or the ability of the body to radiate. The Stefan-Boltzman constant is merely a factor to reduce the final radiant flux values to gram calories per square centimeter per second.

Assuming we have a furnace operating at 1,000° absolute, we find that we have a total radiant flux of gram calories per square centimeter per second of 1.35. If we increase the absolute temperature of this radiating object to 1,100°, the temperature increase has been increased by 10 per cent. The interesting fact, however, applying the Stefan-Boltzman Law, is that the radiant flux has increased 44 per cent.

To further illustrate the extreme importance of radiant heat in high temperature industry, we again increase the temperature to 2,000° absolute where we find a temperature increase of 100 per cent and striking increase of radiant flux of 1,500 per cent. These simple calculations impressed us and others with the importance that radiant heat plays in discomfort in workers of the high temperature industries.

After this review of the principles of radiant heat, we were then faced with the fact that the problem of heat in our plants and work spaces, if it were largely radiant heat, was one not primarily of convection or thermodynamics but rather one of optics, recognizing that infra-red obeys all the optical laws common to visible light. Interposition of opaque objects between the radiating source and the man seemed at first the simplest solution to the radiant heat problem.

This is true for short term exposures in which the opaque object does not rise in temperature to that of the surroundings. If the opaque shield is of high emissivity or conversely of high absorptivity, the opaque screen will eventually arrive at a temperature where it begins to reradiate itself, and if the shield or screen is closer to the man than the original radiating object, merely serves to intensify the problem. It seems then, that the correct approach to this problem of materials for opaque shields was to select an economic material which had an emissivity low for the infra-red and high in reflectivity.

Most metals have a high reflectivity to the wave length 2.0 microns which was selected as being about median in the temperature range that we were experiencing in the high temperature locations. Materials such as gold, silver and platinum were immediately abandoned because of the cost angle. Aluminum seemed, after an exhaustive search of materials, to be the ideal material for one to use for several reasons, the major one being the fact that aluminum oxidizes very slowly and the thin oxide coat retains most of the initial reflectivity.

Aluminum paint is only about 50 per cent reflective and was abandoned early in this study as a material suitable for reflective shields. Asbestos paper is extremely low, having its value primarily as an insulating material in convective heat problems. White paint, or white lacquer, again has an extremely low reflectivity to the infra-red, and conversely these three materials would have a high absorptivity to the infra-red and, in a short time, after being exposed to high radiant sources would tend to reradiate.

After considering this problem theoretically, we then decided to review the entire heat problem as far as the glass trade was concerned. We will attempt to illustrate the various steps through which we have passed in the glass trade in coping with the heat problem. First is the typical glass plant. A centrally located furnace supported upon pylons at the second floor level has as its only means of losing heat direct radiation and air flow or convective flow through an annular space which extends around the periphery of the furnace. The roof is constructed in a simple monitor form, allowing the heat and generated gases to escape by gravity from the open windows. For a great many years this was the only system used and the only one we could depend upon for cooling air within the plant walls themselves.

The next stage was that in which portable fans were used to circulate the air to keep the air in motion around and about the work spaces. Here we found the beginnings of opaque shielding. Materials such as wood, asbestos board, black iron, etc., were used. A great disadvantage of the portable fan was the fact that they tended to circulate air over the hot surfaces and multiply the problem in hot weather by recirculating and moving the super-heated air over the workmen.

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

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

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

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

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

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