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GLASS and CERAMICS SESSIONS

ESSENTIALS OF SAFE GLASS PACKAGING

By NELSON H. THUESEN
Manager, Packaging and Material Handling, PPG Industries, Inc., Pittsburgh, Pa.

PEP is the bi-word for essentials in safe glass packaging: "People—Equipment—Package." In order to get the job done correctly and safely, you must have:

1. Properly trained people.
2. Proper handling equipment.
3. Properly designed packages.

People. Probably the most important ingredient is people. People can think. People can respond, and most people can be taught to use judgment. In our business, as in most, people must be properly trained to handle the product, sold on the need for safety, must develop good safety habits, and must wear the proper safety equipment.

Equipment. The type of equipment used for handling packages in the glass industry may range from a small caster to a ten-ton crane. Therefore the equipment must be properly designed to handle the multitude of packages produced, the employee must be trained in the proper use of all pieces of equipment, and the equipment must be properly maintained on a continuing basis.

Package. Before being declared ready for use by production the package must be properly designed to protect the product, provide a means of handling, and protect the people doing the handling. The package must contain properly selected materials and must be sufficiently tested and evaluated in the packaging laboratory (incline-impact test, vibration test, drop test, and materials test in the analytical laboratory). The package must be put through the paces by in-plant testing. It must be assured of good workmanship in its assembly. Finally, the package must be "trial" shipped to selected customers.

With the above in mind, it is obvious that a packaging engineer's approach must be with a balanced attitude. He must keep in mind not only that the package or package system must work well and must be economically feasible, but he also must take into account the human beings that come in contact with the system. The solution to any package or package system must include the factor of safety.

For packaging to function properly, there must be free communication up and down throughout the company. This is particularly important from a safety standpoint when new or test packages are being developed, prepared for shipment, or finally loaded and shipped.

It is imperative that the packaging engineer and the plant safety director work together closely. These men should maintain the closest kind of liaison in respect to safety in packaging. The packaging engineer must keep the safety director up to date on all of his plans for packaging changes, innovations, tests, etc. The safety director in turn, after hearing all of the facts, can be quite helpful in assisting in selling the new package to the production employee. The worst possible thing that can happen is to have the two men (packaging engineer and safety director) act like spoiled brats waiting for the other guy to tell him "something." While the packaging engineer has responsibility for discussing plans for testing new packages with the safety director, the safety director should not in himself have veto power over the proposed package. However, there should be provisions for the safety director to take the matter to higher authority, who may ultimately stop fabrication of the package. Never should the safety director put himself and ultimately the company in the position of agreeing with production employees that a package is unsafe before he has gotten all of the facts.

In the complicated function of sale and distribution of glass products, packaging plays a most important part. Our product must reach the customer in an undamaged condition and meet his handling and production requirements. To help us do this we regularly meet with plant production people, sales and marketing people and, most importantly, with customers in their shops. We attempt to keep abreast of competitive packaging and try to anticipate future customer needs in packaging. We also concentrate on handling systems because this is also a part of our responsibility and also involves serious safety implications.

Much effort and money goes into the making of our products. The time, effort, and money to make these products is wasted if, after being properly packaged, they are mishandled.

The serious consequences that can stem from mishandling the glass product obviously make it mandatory that we require a high reliability in our packages and in our packaging standards. We believe that the very nature of the glass product justifies or even demands the safety factor of overpackaging. That is to say, we package with people in mind.

A desirable offshoot of such a policy is the reduction in customer complaints. We must keep in mind that every customer complaint has the potential of costing the company plenty! For example, a customer may take his business elsewhere; the word may get around and you lose a contract here and there; you could get involved in a liability suit, or the price of your insurance may go up.

While safety is paramount in package design and construction, it has to be tempered with customer demands, competitive conditions, plant and customer handling systems, and cost considerations. In other words, the package as finally developed may be the result of a series of compromises. This may leave some ruffled feelings along the way because each group, such as safety, accounting, purchasing, production, or packaging, most likely had to modify their original thinking. But the facts of life are that if it's unacceptable to the customer, you may go out of business trying to maintain some rigid standard that you consider sacred.

Some of the more recent steps taken to provide better and safer packages are as follows:

1. All cases exceeding 2,600 lbs. are banded vertically with two steel bands.
2. Developed a handling and unloading procedure for cases shipped LTL.
3. Converted many shipments from wood cases and pallets to steel returnable racks.
4. Increased the width and thickness of wood case and pallet members.
5. Increased the size and number of nails in constructing pallets and cases.
6. Standardized materials and construction specification at all plants.

Unfortunately, even with the best laid plans, we, like most of you, still encounter problems of one kind or another. These problems quite often involve safety and must be quickly resolved before endangering our own employees or, ultimately, the customer's personnel. Many problems stem from carelessness or human failures. These are troublesome and difficult to keep under control, but this is an area where the safety director, production, and packaging engineer should work together for a satisfactory solution.

MAINTENANCE HAZARDS OF THE FLOAT PROCESS

By ROBERT BRINTON
Supervisor, Engineering & Planning Section, Glass Div., Ford Motor Co., Dearborn, Mich.

The glass industry has progressed a long way from the days when glass for glazing was a product of the skills of the glass blower. The evolution of this industry through the many stages such as rolling, drawing, grinding, and polishing to the current float method has been long and involved, as have the changes in maintenance procedures necessary to meet the demands of the developing industry. Hazards to health and welfare of personnel involved in glass making have always been of concern; but here, too, safety has general kept pace with the changing t

The float process, of course, encompasses the entire scope of glass manufacture, beginning with the receiving and batching of raw material and continuous through melting, forming in the float bath, annealing, capping, and packaging, ready for shipment to customers. Throughout these many stages of the operation, hazardous conditions can develop if proper precautions are not taken. In this respect, the operation is no different from any other manufacturing process. As in most manufacturing facilities, accidents frequently result from a mental lapse, the desire to get the work done quickly, carelessness, or some unexplainable reason. Based on this, the best defense against injury is still a concerted effort on the part of all involved to keep safe practices foremost in the minds of all personnel. Regular training programs, whether of a formal nature or of an informal nature, at the foreman-worker level are a must in any manufacturing facility.

The raw material receiving and batching facilities normally involve the use of remotely operated conveyors, elevators, etc., and generally require only a minimum of operating personnel. In areas such as this, the maintenance forces must be doubly certain that they follow established practices of using lock out devices and notifying operating personnel of the work to be performed. Since the batch system operation is crucial to the entire system, it receives what may be a considerable amount of attention during a down, but no more so than the other areas of this chain of continuous operation.

In addition to the potential hazards of maintaining such equipment in remote locations, a batch facility is a prime source of dust which brings inherent health problems. Maintenance practices in this area must place a high priority on keeping dust control devices in top operating condition, and any servicing of the units must be done quickly during periods of scheduled downs. In some instances, duplicate equipment or alternate means of handling the dust for short periods is provided to permit servicing without curtailment of the dust collection system. When repair problems necessitate working under dust laden conditions, face masks or similar devices are provided and used. In addition to dust conditions, ear shake out equipment is also utilized in this area, and operators are provided with the ear muff type ear protector.

The melting furnace constitutes problems primarily in the area of working conditions, in that the high temperature of the process make any work in the vicinity extremely uncomfortable and may result in heat exhaustion if over exposure is permitted. Burns are also a common injury even though protective equipment is used; however, the burns are generally superficial. Maintenance work around the melting furnaces is related directly to the age of the furnace; as the furnace campaign progresses, the maintenance workload grows. As the furnace ages, refractory wear becomes a persistent problem, particularly at the metal line. Water cooled jackets are installed at this time to prolong the furnace life. The installation and replacement of these water cooled devices requires the maintenance men to work under severe temperature conditions and, generally, in confined quarters. Special equipment is provided to protect the workman under these extreme conditions. Protective suits with self-contained air conditioning units are available as are the conventional reflective suits, headgear, and face shields. The air cooled protective suits, however, are cumbersome and their use is restricted to areas where working space is not a consideration.

In general, maintenance tasks under extremely trying conditions are performed by teams of personnel to minimize individual exposure. Sufficient numbers of personnel are assigned to the work and adequate supervision is provided to insure that the work is performed in a safe manner and on a reasonable time schedule. Where possible, temporary shields are provided to minimize the effects of the radiant heat and man cooling fans are utilized to reduce the ambient air temperature.

The operating temperatures found in and around a glass melting facility contribute a great deal to making one conscious of the potential hazards; consequently, work in this area is performed in an inherently cautious manner.

Work on the furnace crown to repair expansion joints, service thermocouples, or to adjust miscellaneous cooling devices is generally accomplished from open cat walks

provided for that purpose. These walkways provide some protection from the hot crown surface and provide a reasonable work platform to perform the required service. Again, adequate relief or relief time is provided to personnel engaged in work of this nature to insure that their exposure to extreme work conditions is kept to a minimum.

In the terms of the licensing agreement, a great deal of the information regarding the float bath operation is considered to be of a proprietary nature and, consequently, cannot be discussed at this time. However, we can discuss the operation in general terms and convey the problems which may be unique or at least out of the ordinary in the glass industry.

The float system basically involves the "floating" of a ribbon of glass on the surface of molten tin. The resulting glass surfaces are exceptionally parallel, a result of the equilibrium established between the forces of surface tension and the forces of gravity. In this process, the surfaces of the glass retain the highly desirable fire polished finish which resists staining and is exceptionally smooth as opposed to the microscopically pitted surfaces which are present in polished plate glass. Glass thickness is controlled within limits by the differential between the rate at which it is introduced into the bath and the rate at which it is withdrawn.

Since the under surface of the glass is in contact with the tin, any imperfection in this surface would be imparted to the glass. Therefore, some means was required to prevent the formation of oxides on the surface of the tin. This is accomplished by blanketing the bath with an oxygen-free atmosphere. This atmosphere is normally produced by cryogenic systems, but it can also be manufactured with exothermic generating units. In either system, all necessary precautions are taken to insure a safe and controlled operation. Maintenance procedures are established to be certain a high quality product gas is produced.

On the atmosphere units, approved safety devices are incorporated in the design to automatically shut down the equipment if malfunctions occur. Since float glass production is a continuous operation, extra capacity in atmosphere producing facilities is provided to allow for periodic maintenance shutdowns without affecting the overall operations.

To get back to the float bath proper, the molten tin is possibly the major hazard in the system. Tin leaks, although not common, can occur; when they do, they are extremely difficult to stop. Molten tin and water can form a dangerous combination. Consequently, efforts are made to prevent any free water from standing in the area surrounding the bath. This is not as easy as it may seem, since a bath requires numerous water cooled devices and water discharges are not always controlled. Adequate drainage facilities are provided in the area to insure the rapid removal of any water spillage. Drain lines are frequently checked to be certain they are free from obstructions.

Another area of concern is the possibility of the accidental discharge of water into the bath from defective water cooled devices. In an effort to prevent this type of occurrence, the devices are inspected regularly and replaced when their condition becomes questionable or after reaching an established operating life.

Flexible hose is used to connect the water cooled devices to the water source and drain lines. These hoses are necessary to facilitate the installation and removal of the devices; however, they provide a potential source of trouble through pinching, which may reduce or completely restrict water flow. The hoses also can become obstacles to personnel working around the bath. If several devices are used, precautions must be taken to insure that a unit in operation is not inadvertently turned off. Adequate means of identifying the hoses is mandatory to prevent such an occurrence.

A closed loop cooling tower system supplies the water for these cooling water applications. Such systems are quite reliable and generally operate without too much trouble. However, since the water is used in equipment operating at extremely high temperatures, water flow is insured by an interconnection with the building process water supply. This interconnection provides sufficient flow to permit continued operation or, if necessary, would provide ample time for the devices to be removed from the furnace or bath without endangering the operating personnel or the process.

With the possible exception of the tin and the requirements for water cooled devices,

the float bath involves no special hazards and can be serviced by normal maintenance techniques. Drive components, controls, and instrumentation are of a type used throughout industry. Monitoring of operations with closed circuit TV is utilized in both the furnace and the bath. This reduces exposure of operating personnel to potential hazards while permitting constant observation of the process.

The servicing of these controls, instruments, etc., generally takes place within the control room, which enjoys excellent working environment. Replacement or repair of sensing devices on the furnace, bath, and related equipment must, of course, be performed at the point of installation; but it is often accomplished by replacing the entire device, then performing the necessary repair at a more suitable location.

The next step in the process following the float bath is the annealing lehr. The oven provides controlled cooling of the glass to prevent the establishment of stresses which would make cutting of the glass difficult. The glass is conveyed through the lehr on soft surfaced rolls whose speed is precisely controlled to provide the desired glass thickness and to prevent the rolls from scrubbing the finished surface of the glass. To provide the versatility necessary for the operation, solid state powered D.C. drives are used with digital speed control. Aside from the sophistication found in the drive controls, the lehr is a relatively straightforward device. Heat is supplied to the glass through gas fired furnaces which are equipped with all the necessary safety controls. Again, the necessity to maintain continuity in the operation requires major repair work to be accomplished during scheduled downs. Minor adjustments, of course, can be made while the lehr is running. Servicing of the heating equipment is often made during operation, as the equipment is readily accessible.

Surface temperature of the lehr constitutes one of the major hazards to the personnel working on equipment in this area. The discomfort associated with working in high ambient temperatures is also of concern.

Once the ribbon of glass leaves the protective enclosure of the annealing lehr, it becomes a factor which must be given serious consideration from the aspect of safety. The conveying system is primarily an open roller conveyor with the glass fully exposed. The edges of the ribbon are inboard of the conveyor frame to protect both worker and glass. Conveyor drive units are placed outside of the conveyor to allow maintenance to be performed without endangering the worker. However, some components such as bearings are located under the glass and can only be serviced when glass flow is stopped.

The areas under these conveyors is purposely kept as free as possible of equipment, conduit, piping, etc., to permit glass breakage to be cleared away without difficulty. This arrangement helps greatly in housekeeping while offering improved accessibility to the serviceman. The loss in floor space adjacent to conveyor and the costs of in-floor trenches for conduit, piping, etc., is considered to be more than offset by improved housekeeping and serviceability.

The glass cutting equipment is normally located above the ribbon and can be safely serviced from walkways provided for that purpose. Temporary cutting devices are provided to permit extended servicing of the cutting devices without appreciably affecting glass output. The glass trim resulting from the cutting operation and rejected glass pieces are disposed of via an under-floor conveying system. Large pieces of glass are reduced to reasonable size by glass breaking devices before being deposited in the pan type conveyors.

Service to these units is made possible by diverting the scrap glass to tubs for disposal, using industrial trucks. Since these under-floor conveyors are located in covered trenches of reasonable size, a great deal of the required servicing can be accomplished without interference to the cutting and packaging operation being performed above.

In review of the items touched upon today, it becomes apparent that the introduction of the float system has caused changes in operating procedures, but to an extent appreciably less than what might be expected. The injection of the float bath, and the resulting elimination of the plate glass rolling with its requirement for grinding and polishing, appreciably reduced the operations, equipment, and personnel. The float system, then, has resulted in an improved operation from the standpoint of both operational safety and product quality.

GLASS FURNACE REBUILDS—HAZARDS AND PRECAUTIONS

By EDWIN C. DACUS, JR.
Chief Engineer, Glass Projects, Ball Corp., Muncie, Ind.

The organization of the accident prevention system in our company has changed considerably during the few years that I have been associated with Ball Corporation. The system as I knew it a few years ago was a system based on a policing policy by a staff safety group. Now there is more involvement by each plant to the extent that our corporate group assists in providing the initial training in accident prevention supervision before each furnace rebuild. Then the plant supervisors implement the accident prevention program within their own plants. This has been made possible by the organization of a well operating corporate safety staff, which has organized a very effective accident program within each plant.

When I started working for Ball nine years ago as a junior engineer having just graduated from college, I was privileged to spend six months on construction of a new glass container plant in the Chicago area. Having no prior construction experience and no major responsibility on this new job, I was free to observe the construction from one end of the plant to the other. The purpose of my being on the job was to learn the detailed construction of a new glass furnace. I had ample time to nose around the plant and still follow the furnace construction progress. It was interesting for me to view the techniques used in the different phases of construction of the plant. Some of the techniques used by individuals in the construction trades made a lasting impression. I was most impressed by the ironworkers who rode the ball of a crane to the top of the batch house rather than climb up a ladder. I was impressed with the ironworker superintendent who refused to wear a hard hat during erection of the furnace support and binding steel while brickmasons were working around and above him. He now jokingly remembers how the first brick which accidentally hit his head only slightly creased his scalp. The second brick placed a one inch dent in the top of his new aluminum hard hat. He has never worked without a safety hat since then. I was also impressed with the way the ironworkers could shinny up and down building columns without using ladders. I was impressed by how deep an object could penetrate the ground when dropped from the top of a water sphere.

There were many other situations which could be added to this list. At that time I did not know these were violations of commonly accepted safety practices. I was naive enough to believe that all these people were being careful, since their livelihoods depended on their ability to be on the job the next day.

At the time of my first furnace rebuild my knowledge of industrial safety practices was limited to common sense practices, and even that was lacking in scope. Our company safety supervisors underscored this when they reprimanded us project engineers for such acts as: storing gasoline inside a building; operating a gasoline driven water pump inside a building; forgetting to secure oxygen and acetylene cylinders used on the job; failing to observe that brickmasons and laborers frequently ignore hard hat and safety glass regulations; failure to insist on proper barricades to isolate danger areas where guard rails are removed, holes cut in floors, etc.

In those days our staff safety directors met with our plant supervisors and plant personnel before our rebuilds and discussed the safety standards to be followed on the rebuilds. There was some effort to include the outside contractors, but by and large the project engineers on the job were responsible for seeing that the contractors followed company safety standards. The good Lord must have been helping us, since we completed our jobs without any serious injuries. We had a lot of smashed fingers, mashed toes, cuts, scratches, burns, and bruises but, fortunately, no disabling injuries. I thought that we were doing well, but our corporate safety director and staff

frowned on injuries of any nature. Through succeeding furnace rebuilds more and more emphasis was placed on a system of safety responsibilities within the plants, rather than policing from a corporate staff.

Now, rather than the staff trying to maintain full responsibility for safe practices and working conditions during rebuilds, they give special training to the plant personnel who are involved in the rebuild work. Each plant has a plant accident prevention supervisor. This job is a permanent responsibility. It is interesting to note that the plants take seriously their records of consecutive days of no lost time accidents. Any lost time by plant personnel incurred during a rebuild counts against their continuing record, regardless or whether the plant is in production or not. To assist the plant accident prevention supervisor during the rebuild, several assistants are appointed by the plant. The overall temporary program is set up as follows:

Before Rebuild

Organization

The plant has a permanent plant accident prevention supervisor. Several rebuild accident prevention supervisors are appointed for the rebuild.

Training

The rebuild accident prevention supervisors are given training prior to the rebuild covering the hazards that are most probable in this type of construction. Past experience indicates the more common types of accidents, the causes, and the preventive measures necessary to minimize the accidents.

Duties

Enforce safety rules. Check to see that proper safety equipment is worn. Make recommendations to eliminate any unsafe working conditions. Keep a constant check on fire hazards. See that all Ball employees directly involved with the rebuild are furnished hard hats and other equipment necessary to insure their protection. Make a report on any accidents that might occur. Carry out instructions of plant accident prevention supervisor. Work closely with the corporate accident prevention supervisors who provide the orientation and training, and who periodically check on the activities within the plant during the rebuild.

Equipment

The supervisors are oriented in regard to distribution and use of gloves, hard hats, safety glasses, and other needed equipment.

Literature

A list of minimum safety standards prepared by the corporate accident prevention services is distributed for discussion and familiarization. This list includes warnings and precautions against potential dangers involved in draining, demolition, rebuilding, and heating-up of a furnace such as:

1. Wearing of protective equipment.

2. Checking for properly installed and inspected furnace drain hoses, vented drain pipes, properly installed standby drain water systems, and properly operating booster pumps when required.

3. Locating of water booster pumps and gasoline storage outside the buildings.

4. Notifying local fire department of furnace drain in case of glass leaks while draining, but educating them in proper procedures for controlling leaks or containing fires next to a hot furnace. We have had difficulties in restraining local firemen when they come into our plants as a standby precaution during a touchy hot repair job or similar hazardous work or a prolonged power failure, all of which could result in a glass or furnace leak.

5. Securing of oxygen and acetylene cylinders whether empty or full to prevent them from being bumped and turned over. Recently an ironworker, requiring a replacement cylinder of either oxygen or acetylene for his cutting torch, turned over a cylinder and rolled it with his foot approximately 75 feet to a stockroom, only to find upon arrival at the stockroom that he was rolling a full cylinder of gas. Someone had already made the replacement without telling him and he failed to check the contents of the cylinder. We are all familiar with stories of one type or other of the gas cylinders which propel themselves when the valves are damaged.

6. Instructing fork truck drivers regarding dangers and care required in lifting and transporting heavy refractories. We have witnessed several fork trucks being tipped over by inexperienced drivers who attempted to remove the top pallet of refractories from a two or three pallet high stack when the fork truck did not have the capacity. We once had a driver attempt to drive a fork truck up a 25° inclined concrete ramp from a machine floor to a furnace charging floor. He drove three-fourths of the way up and the tires hit an oily spot. To keep from crashing into a glass forming machine at the bottom of the ramp, he ran the forks into a guard rail, almost tipping the truck over. A heavy winch truck was required to safely remove the lift truck.

7. Removing containers of combustible trash, oily rags, and such debris from the plant on a daily basis.

8. Instructing the plant and contracting personnel of the dangers of handling large chunks of glass from the remains left in the furnace after draining. One of our assistant plant managers severed a tendon in his left little finger while handling barehanded a large (and quite beautiful) chunk of glass removed from a furnace bottom. The glass cracked without warning, exposing a razor sharp edge which caused a cut requiring two operations to restore only partial use of the finger.

9. Instructing plant personnel in the dangers of handling large refractory blocks. One of our laborers pulled a side wall block over on himself while attempting to assist a brickmason. I happened to glance into the furnace to see a skinny little kid lying on the floor with a 1,200 lb. block perfectly balanced on his body. Fortunately he suffered only a couple of bruised ankles.

This list can go on and on and on. To the newcomer to this type of work, these precautions are valuable guidelines for a safe job. For the experienced, they are a reminder of the past, plus a key to a successful safe completion of the job at hand.

After the pre-rebuild training meetings with plant accident prevention supervisors, these supervisors hold meetings with the plant labor force, grouping these people according to the areas in which they are scheduled to work. Those destined to work with the furnace rebuild crews are briefed on the particular hazards related to the type of work they will be doing. (Our company policy is to allow all company personnel to work during a plant rebuild; therefore, these people are assigned to work where their talents are most suited.) The group of company personnel most susceptible to injury generally is the group which is assigned to assist the brickmasons in refractory and steel demolition, hauling of debris, handling of refractories, and general cleanup of the furnace area. These are the people who are exposed to cut and mashed fingers, mashed toes and feet, burns, bruised ankles, eye injuries, etc.

The procedures required in case of an accident are outlined. A qualified nurse is on duty during the day shift and supervisors trained in first aid are available at all times. A company doctor is available within a few minutes drive from the plant.

The plant and corporate staff accident prevention supervisors hold meetings with each contractor's representatives and job superintendents to instruct them in safety precautions expected from them while working in our plant. The same safety rules applying to our own people generally apply to the contractors working on the job. These people are made aware of the particular hazards related to rebuilding a furnace and of the hazards related to so many people working together in such a small space with so little time to do a job. We made every effort to organize the work so as to minimize the danger of each tradesman in regard to the others working around him. We require all outside help to wear safety hats and protective glasses, just as our own people do.

During Rebuild

The plant accident prevention supervisor with his assistants provide around-the-clock surveillance of the work in progress in all areas of the plant. Any unsafe act or violation of standard safety practices is immediately brought to the attention of the persons responsible for the work in progress. Repeated violations result in a cessation of the work until the violation is corrected. Most of the violations are the result of carelessness and/or hurriedness for completion of the job. During a glass tank rebuild, time is precious and time is money. All personnel are made aware of the necessity of completing their work within a carefully programmed schedule. Perhaps in

many instances time is overemphasized to the point of encouraging carelessness.

In case of an accident, immediate treatment as required is administered. After the needs of the injured are cared for, an accident report indicating the time, nature, causes, and steps taken to prevent a recurrence is prepared.

After Rebuild

When the rebuild has been completed, the accident prevention supervisors review the safety program for the rebuild in regard to total accidents, near accidents, and injuries, and then determine the necessary corrective measures which should be followed during the next rebuild. The list of do's and don'ts grow longer each time. Who knows? Perhaps these efforts have prevented loss of sight, loss of limb, loss of mobility or, even more important, loss of life.

It is a sobering sight to see a man lose a finger on a table saw, or see a gash requiring 25 to 30 stitches. It would be more sobering to see a man crippled for life or even killed. We tend to think of these things as happening to someone else and never to us. When our rebuild projects are completed and we evaluate the success of the projects in terms of completion within the budgeted time, completion within the budgeted costs, and completion with a minimum of problems, we suddenly realize that there is an additional measure of success: That is the completion without any serious injuries to the personnel whom we are depending on to physically do the work, for without them the jobs could never be completed.

SAW SAFETY IN THE BOX SHOP

By W. FRED SHAVER
Safety & Security Supvr., PPG Industries, Inc., Fresno, Calif.

Anytime box shop saws are mentioned, most safety men in the glass industry can give a personal account of a serious injury that has occurred in the box making area of their plant. I can't recall a year when PPG hasn't recorded some type of injury involving box shop saws. In an overwhelming number of these accidents the saw being used was the universal type circular saw. The circular saw is the most useful and at the same time the most dangerous of all woodworking tools. It causes more permanent disabilities than any other machine. Serious cuts, amputation of the fingers or hand, and death are far too frequent.

One four year study conducted by the California Division of Industrial Safety showed that amputations occurred in 65 per cent of all cases investigated by their engineers. In this study the work being done at the time of injury was: ripping—62 per cent; crosscutting—26 per cent; removing material from alongside the blade—12 per cent.

Saw operators are most frequently injured when their hands slip off the stock while pushing it into the saw, holding their hands too close to the blade during the sawing operation, or removing scrap or finished pieces from the table while the blade is idling.

To reduce these injuries, we must look at the design of equipment used in our box making operations and at the type of shipping containers being fabricated.

Container Design. Most containers are built to standard widths and contain varying amounts of glass. Box lumber is purchased pre-sawed to the required thickness and width and is furnished in various lengths. This gives us a small amount of sawing required to fabricate standard and special containers. General purpose universal saws are seldom needed in box making.

Equipment Design. In today's labor situation we must consider that the operators will include young people, women, and inexperienced men. The safe saw is one where it is basically impossible for the operator to get his hands into the saw and yet have the capacity to cut standard widths and thicknesses of lumber.

Box Shop Operations

The box shop area is laid out so that bundles of lumber are brought into the building on four wheel carts and marshalled to the right of the saw equipment. The material flow is from right to left. Ample aisle space is provided to permit moving the longest lumber used without interfering with other machines.

The lumber is first cut to the required length. To accomplish this we use air operated cut-off saws. Each saw is operated by a two man crew, with one man sawing and one man off-bearing and stacking the lumber on a cart to be moved to the next stop in the flow process. The saws are designed for maximum safety, with the saw blade housed against exposure to the operator's hands and sight.

In order for the saw to function, a board must be placed under a clamp, so that when the saw is actuated a clamp comes down and holds the board in position. The travel of the saw is such that it is cutting into the back of the machine. This eliminates any chance of kicking the board out and endangering the operator. With the saw blade in the down position and the guard clamp assembly up, the saw is ready for the lumber to be positioned for cutting. The length is determined from a work sheet and a stop pin inserted into the saw table. The lumber to be cut is bucked up against the pin. When the lumber is in position a knee switch is activated. The guard clamp lowers on the material. The saw blade starts going up as soon as the guard clamps the lumber. After the saw blade cuts through the lumber, the blade retracts and the clamp releases. The operating cycle can be adjusted and can attain production speeds of 90 cuts per minute.

The rip saw is power fed and has a hardened steel race and feed chain. Feed speed is variable from 60 feet per minute to 180 feet per minute. Maximum stock thickness that can be processed with an 18 inch diameter blade is 4¼ inches, minimum thickness of stock is 1/8 inch. The minimum length of lumber to be ripped is six inches, maximum length is limited only by box shop lay out.

The stock to be ripped is held securely by a pressure head assembly. A series of eight rolls provide uniform pressure on each side of the cut. Pressure head adjustment can be locked at any desired position. The adjusting hand wheel is conveniently located and is fast operating.

Emergency stop switches are located on the operator's panel to the right of the blade and also under the saw table (which can be operated by the knee). The emergency stop switches stop both the feed and arbor motors. The anti-kick back fingers adjust automatically with the pressure head for any thickness.

Ripping speed is determined by the offbearer's ability to accumulate the lumber. A solid flow of lumber can be processed through the saw if the offbearer can keep the table clear.

We have tried to completely eliminate the general purpose table saw. Special saw equipment is available for most Box Shop operations where standard containers are fabricated. We know the right tool for the right job is always better and safer.

AN APPROACH TO ACCIDENT PREVENTION IN THE GLASS INDUSTRIES OF MEXICO

By J. HERNANDEZ-OSUNA
Coordinator General de Seguridad e Hygiene, Accion Social Regiomontana, A.C., Monterrey, N. L., Mexico

In Mexico, as in so many countries, industrial safety and industrial growth are highly correlated. Mexico's gross national product's rate of growth in the last decade has never been less than six per cent a year, a rate spearheaded by the manufacturing sector. Growth, however, affects the structure of a country, and particularly its population structure. The kind of people you get in industry today is widely different from the kind of people of 10 or even five years ago. For example, 10 years ago only 25 per cent of the population in Mexico participated in the economic life of the country. Today, the dynamic growth of the cities has changed all that. Rural-urban migration is at its peak. Most of the jobs in industry, particularly at the bottom of the organization, have been filled with former peasants devoid of knowledge about the city and the complexity of the industrial organization. We have had to be prepared for a host of psychological differences which make it hard for the peasant to cope with the problems of adaptation to urban modern environment.

We also had the severe problems posed by peculiar behavioral patterns. It is in the rural areas of Mexico where we still maintain intact a number of traditional Latin values now in process of modification in the cities. Some of these values are:

1. Individualism, defined as the belief in the priority of the individual over the group. This value in its most elaborate form turns into *machismo*, or the need to prove all the time and beyond question one's virility, even in front of the boss.

2. Fatalism is another peculiar value. It is the belief that all happenings are predetermined by an invisible hand. This value has two interesting effects: one is the apparent risks taken beyond the situation at hand by workers; second, once a mistake is made or an accident happens, it does not create feelings of guilt. The accident or error is due to the inscrutable ways of fate.

So, our problems 10 years ago were almost impossible to solve. The people we worked with had almost never seen a machine. When they injured themselves they didn't care very much and didn't feel any guilt, and few had enough schooling to even spell the word safety. The authority of their supervisors was not a sufficient incentive, especially since, although you might encounter some supervisors who were a little above the workers, mainly they had been in the same position one or two years before. Safety as an organized function within industry was not born yet.

This was the general situation for all Mexico. In 1960, for example, the I.M.S.S. reported that each injury produced 14 days of disability and, on the average, 0.88 out of 100 persons affiliated with the I.M.S.S. suffered at least one injury a year. Unfortunately, we do not have frequency rates for these cases. It is also necessary to note that 99 per cent of the injuries reported to the Social Security clinics for treatment resulted in lost time cases.

In solving the safety problems, however, our labor laws did help some, especially by putting pressure on the employer. The law has the following aspects of safety:

1. It defines "job related accident" as every injury or functional perturbation arising from the job, from the moment the worker leaves his home to his return.

2. It typifies clearly the illnesses that according to the law are presumed to emanate from the job or the conditions under which it was performed.

3. It states that the compensation to be paid on temporary total disabilities is 100 per cent of the salary, from the moment of the accident to the declaration of permanent disability or return to work.

4. It includes, among other things, the term "inexcusable fault" of the employer in case of accident due to known unsafe conditions.

5. It has two regulatory sets of rules on working conditions and hygiene. The Social Security laws have another set of regulations on safety. The Social Security Institute is the compulsory accident insurance agency for all industry and other activities. The rates are paid by the employer based on its frequency and severity rates for the last three years of experience, according to a set of five classifications of risk and three rate levels. This means that even if the accident rates of a company are below those permissible for that classification it must continue to pay the minimum rate for the classification, which does not provide enough incentive to reduce the accident rates below a certain point.

The I.M.S.S. in turn provides the employers and their workers with the following services: medical care for the injured, compensation for all types of disabilities, rehabilitation for the employee and disability and death pensions.

Even though Mexico has had this type of legislation since 1924, there were problems of enforcement. It was not until 1950 that special interest was placed on the enforcement of the legal measures to protect employees from industrial hazards, and only in the last 10 years has the general public become aware of the program and its implications. More and more, both at the federal and state levels, we sense a growing commitment to safety. The current U. S. and world wide trend focusing on air pollution, safety off the job, etc., has acquired intensity in Mexico, and this is true of the glass industry.

We know that some companies had in operation some sort of safety program before 1960, but this was mainly due to the interest of one particular person in the organization and only to comply with some of the legal requirements. A.S.R.A.C. is a service company established by a group of glass manufacturing companies around 1947, originally to provide them with employee benefit programs. In 1959, our company decided that its members could benefit from a well organized safety program and that a coordinated mutual assistance and external consulting services was what they needed. In 1960 a Safety Department was formed at A.S.R.A.C. to implement such a program.

The first step was to review what each of the 10 companies was doing and recommend the organization of their safety programs under the following basic principles:

1. Management should accept the responsibility of accident prevention.

2. Safety should be recognized as part of the overall activities of the different departments within the company.

3. A safety department should be organized to coordinate the efforts and plan the general programs at company level.

4. A standard system of investigating and reporting accidents should be established following the recommendations of A.S.A. Z16.2 and the Mexican Federal law where applicable.

5. All efforts should be made to provide the workers with a sound and safe environment while at work.

6. Medical facilities should be provided above and beyond those provided by the IMSS.

7. Motivation campaigns should be made to create a safety conscience among the workers and supervisors.

To implement these recommendations the Safety Coordinator began a series of yearly inspections of the plants in which recommendations were made for improving the working conditions, leaving the acceptance and implementation to the individual plants. The coordination department, together with the safety men at the companies, developed general safety programs, providing the companies with materials and technical know-how, visual aids, and a program of recognition of advance. These programs were based completely on techniques and know-how from the United States, trying to adapt them to our conditions.

For example, to motivate the workers we decided to organize a yearly safety poster contest, where employees presented their ideas for safety posters. The 10 best were awarded cash prizes and the posters printed in full color and distributed to the companies for their use.

Every two weeks the safety men meet with the coordinator at one of the companies to exchange experiences, discuss mutual problems, and visit one of the departments of such company.

Each safety man makes an informal inspection of the department visited and later presents his recommendations to the industrial relations manager of the company. Every year we hold a safety seminar where, together with some general managers and industrial relations managers, we review our experience and try to create a series of joint recommendations for the coming year.

In general, we have been creating a safety conscience among the different people, improving the working conditions and training supervisors and workers in safety.

What are the results of our program? 1962 is the year that statistically we can use as a base. The frequency rate for that year was 60.75, and an all injury rate was 146.63. By 1969, the frequency rate was down to 29.95, and the all frequency rate to 95.47. These rates may seem high to you, but take into consideration that for 1969 the Mexican Social Security has set a frequency rate for all industry of 40.87 and that in England in 1967 the Glass Manufacturers Federation was reporting a frequency rate of 33.00, so we are not far off. Not all the world has had the experience and worked so long for safety as the U.S.A.

We have had, of course, some exceptionally good performances. One of our companies for the last 10 years has had a frequency rate of less than 7.00. On two occasions they have worked one million hours without a lost time case. Their average hours worked are 600,000 a month. Another company has reduced its frequency rate from 273.87 in 1962 to a mere 42.92 in 1969.

We have also achieved a change in the causes of accidents by concentrating on unsafe conditions. In 1969, 78 per cent of the accidents reported were caused by unsafe acts.

Our rates are down 68.83 per cent by concentrating mainly on safe working conditions. We know that this is no different than what you did many years ago; on the other hand we have created, we think, a good safety conscience in our people that will enable us to reach our goals more rapidly in the future.

To test some hypotheses about our safety effort, we made a sample survey of a universe of 5,000 employees. The survey was designed to measure the safety conscience of our workers. The results were established by a range of low, medium, or high degree of safety conscience. Following are the results:

1st Hypothesis: Workers with more than six years with the company should have a higher degree of safety conscience than the new ones. This hypothesis was sustained by the data: 54 per cent of the workers with high safety conscience had been with the company more than six years.

2nd Hypothesis: Workers that have received some training within the company must have greater safety conscience. Also sustained: 94 per cent of such workers had high safety conscience.

3rd Hypothesis: Workers from outside the metropolitan areas should have less safety conscience than those born in the metropolitan area. This was also sustained by the data: 63 per cent of those with high safety conscience were born in a metropolitan area.

4th Hypothesis: Workers with more schooling should have more safety conscience than those without schooling. Here we find some interesting data: 89 per cent of the workers with six years of schooling had high safety conscience. Thirteen per cent of the workers that finished technical school had high safety conscience, while 32 per cent of those with high conscience went only to primary school.

This data gives us some guidelines of behavior for the future. We could say that in Mexico industry should, in order to reduce their frequency rates, place high priority on training within industry, hire only workers that have finshed primary school, and give preference to those born in metropolitan areas or cities with more than 100,000 inhabitants.

Those that do not meet these qualifications but have other vainable qualifications must receive special attention, such as providing them with means of finishing primary school at least, and motivating them through training within the company. This can be done and has already been done in some of our companies. This also does not mean that we will not hire people without the basic qualifications, but that we should make every effort to make every one of our employees, new or old, meet them.

Where are we going? In November of last year, at the Ninth Annual Safety Seminar, the general managers and those meeting with them made the following recommendations:

By 1971, our goal is to have a frequency rate of 13.70. Our future growth should be planned considering the newest developments in ergonomics, safety, and hygiene. Each company should form an executive committee to solve the current and future problems related to safety. In summary, we have concentrated over the last 10 years on reducing the unsafe conditions of work. We think that we have been relatively successful. Starting in 1971, we will concentrate all of our safety resources on reducing the incidence of unsafe acts through training.

The startling conclusion of our survey is that a worker naturally achieves a high safety conscience after a certain number of years of being exposed to an industrial situation. Then what will happen if we can accelerate the process of learning, improve our recruiting and selection processes, make better use of our human resources? A.S.R.A.C. is now in the process of recommending to the companies a new five year program tending to implement this approach and, possibly, to allow the companies to implement by 1975 programs such as "Zero Defects."

In general, our program makes use of information gathered in our small survey and will use information coming from a computerized accident information system and human resources inventory system. We will try to implement it starting in 1971 to find out which of the management functions carried out by supervisors and managers is failing to accomplish the objectives of the general program. We will, of course, use as much technical information and know-how from the rest of the world as may be useful to us.

RUBBER and PLASTICS SESSIONS

SAFETY IN PLASTICS PROCESSING MACHINERY

By NEIL J. HENRY
Vice Pres., Red Sherman Associates Div., USM, East Orange, N. J.

The plastic machinery industry, numbering among its members manufacturers of injection molding machinery, extruders, thermoset and thermoforming equipment, as well as a wide list of scrap granulators, refrigeration units, cutters, heaters, and all types of auxiliary support equipment, has grown in rapid advances in both units produced and sold, as well as an ever increasing number of people employed in its mills and factories. It has become an ever more important facet of the American economy and its future appears even bigger and broader. Yet an industry in all its growth has seen fit to pause and safeguard its biggest asset—the people who run its machines. For, after all, these people are the ones who will create the future of our industry and who have a right to careful safeguarding and help of all kinds.

In line with these thoughts, the machinery division of the Society of the Plastics Industry in 1964 saw the need for a special machinery safety committee and at its annual meeting established this committee with representatives from each of its sections. This is not to say that the Society did not have an already established Safety Section, for such a section had been in existence for many years. This section had shaped many important handbooks and publications in the S.P.I. and had worked very closely with many different agencies for better safety. The Machinery Division, however, with its rapid growth, saw a need for a more definitive safety program attuned to plastic processing machinery. The need for a central machinery safety committee, composed of the leading United States manufacturers of plastic processing equipment striving for uniform safety procedures and the pooling of safety ideas, became very apparent.

Consequently, it was decided to set up the following program:

1. Immediate writing of a proposed safety code by which all members of the machinery division would abide. Members of the various sections were appointed by the safety committee to write and edit their sections and have them agreed to and confirmed by the section membership.

This proposed model code was not easily accomplished nor easily agreed to, but finally the first draft was written, approved by the membership and put into publication, not as the final word, but as the first of a continuing reappraisal of machinery safety—a never ending task. This code was printed as a proposed model code and circulated throughout the country and the world, to state labor departments, insurance companies, machinery users and manufacturers, individual machine operators, and to just about anyone who would listen.

2. The immediate hiring of safety consultants as advisors to the S.P.I. and all of its safety committees. These consultants would be composed of individuals who would not only be versed in plastic processing machinery and the plastics industry, but also people who had devoted their working lives to the study of safety of all types. In line with this thought, a tandem was retained for the machinery division, with one side of the sword a gentleman who had spent over thirty years in plastic processing and had learned about safety first hand, as a user of plastic processing machinery of all types. The other edge of the sword was an equally capable gentleman who had spent thirty years as a safety expert in major U. S. corporations. Not only had he set up all types of safety programs, but he had experienced first hand safety problems besetting our working force today. Together, acting as consultants, these men began to forge the safety programs that are beginning to evolve in our industry today.

3. An immediate program was laid out to establish on the staff of the Society, based in New York city, a full time safety manager responsible for safety in our industry. This man, once retained, would work in con-

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3. An immediate program was laid out to establish on the staff of the Society, based in New York city, a full time safety manager responsible for safety in our industry. This man, once retained, would work in conjunction with our two consultants until such time as he became versed enough in our industry to carry on a never ending safety program. This was accomplished, and with his employment the first full time staff safety manager in the history of the Society of the Plastic Industry became a reality. His duties are simple enough—to make certain that our industry is the safest in our economy.

4. Safety sections of manufacturers' instruction books and manuals were expanded so as to go to even greater lengths to assure compliance with the rules of safety as it applies to plastic processing machinery. Signs in various languages, in different colors, in caricatures, and in any form possible to attract the attention of the machine user have been studied and re-studied, prototyped and reprototyped, always with an eye to protecting the individual machine operator. Indeed, the billboard problem along our highways is small compared to the number of signs that now adorn our plastic machinery.

These are some of the programs laid out by our committee years ago and a great deal of headway has been made. Now we have a vibrant staff section of our Society concerned only with safety. We have a membership keenly aware of safety and the safe use of its equipment. We indeed feel a great sense of accomplishment. But what of the future? What will we do?

Some of the programs currently underway in our section include the need for getting our message down to the individual machine operator, overcoming all language barriers and educational barriers, teaching that it is important to use equipment and its safety features the way they have been designed. Continuing and aggressive distribution of written materials to all, as evidenced by the safety exhibit which will be part of the National Plastics Exposition in Chicago in 1971, the second biggest trade show in the United States.

Research into the changes brought about by the Walsh-Healey Act. Continued research and cooperation in the areas of pollution and waste disposal. Safety is a never ending project in our industry, which has recognized a need and is doing something about satisfying this need.

But how can we better help ourselves than to get our message through to the individual machine operator? Safety engineers as well as safety inspectors from all types of government and private agencies can help us by getting our message through to your companies and right down to the machine operator.

We, as a Society and as individual members, have complete safety programs and instructions. Our machinery is the safest in the world, and until we are able to make certain that all of the individual machine operators use the equipment as it was designed to be used, the problems will simply grow.

Help us to get our message through!

SYSTEM ANALYSIS APPROACH TO SAFETY

By WILLIAM R. MILLER
Manager, Corporate Safety, Goodyear Tire & Rubber Co., Akron, Ohio

We cannot begin to solve problems in safety until we have gained management's attention. Few accomplishments can be made in safety except from the top down. The problem then becomes one of how to get management's attention.

We are all working for companies that are in business for one purpose, and one purpose only—to make money, to make a profit. This is the name of the game. When we fail to make a profit, that's the end of the game. On this basis, we must look at those factors that inhibit our ability to attain our objectives—making money. The total cost associated with accidents and injuries is one of those inhibitors. It falls in the same category as waste, scrap, absenteeism, poor quality, or poor employee performance. These items are expensive and affect any company's ability to maximize profits. All of these are

cost-controllable items, but unfortunately, too many companies leave safety off their cost-control list.

How does system analysis or systems theory apply to accident and injury costs? How can this theory be used to get management's attention to the need for improving or supporting an effective safety program?

Let's define a system as an arrangement, set, or collection of things connected or related in such a manner as to form an entity or whole. Looking at safety in this manner puts it in the same perspective as any other control system such as process control, quality control, production control, engineering control, etc.

There are controllable and uncontrollable inputs to the working environment. These, in combination or singularly, can result in an accident. Some uncontrollable inputs are: age of employee; experience on job; attitude toward work; attitude toward management; family environment. Some controllable inputs are: work schedule; physical environment—housekeeping, noise, pollution, chemicals, and equipment guarding.

Remembering these two factors, let's examine the problems in safety from another point of view:

Management has permitted over the years a concentration on the physical environment. But we know that 80-85 per cent of injuries result from the unsafe acts of people—not unsafe physical environment. Yet the volumes of safety data that our plants have collected over the years indicate that the plant—that is, the physical environment—is the "big bad bear." The real problem is people committing unsafe acts. I contend that our job in safety is developing the proper attitude. This isn't easy.

A supervisor teaches each employee what the company expects regarding work schedules, quality of work, quantity of work, and company policies and procedures. Safety, the supervisor feels, is the responsibility of the safety department or the safety manager. It is not. It is part of the same bag. It is the supervisor's responsibility to train the employee in safe working practices. The safety manager can provide some assistance and guidance in approach, but his main responsibility is measuring and evaluating safety performance. The same as the manager of QC monitors quality, the production manager monitors quantity, and the finance manager monitors cost. The QC manager has standards or specifications with which to compare. The production manager has orders with which he can compare. The finance manager has market data or product selling price with which he can compare. The safety manager should be no different—he desperately needs some bench mark with which to compare.

Peter Drucker, in his book *The Effective Executive*, states there are two important criteria in being effective: making a contribution, and making an effective decision. If we define a contribution as the utilization of available resources or knowledge, and define an effective decision as one that involves follow-up or feedback, then it is possible to develop an effective safety system, shown in Figure One.

Conceptually, an accident is the product of a process. Safety, then, is a plan to control this process. Thus, the problem becomes one of applying process control theory. Also, by utilizing current knowledge, it is possible to first transform data generated from each accident into a model that describes the accident process and, second, use this model to explore various methods of minimizing accidents.

Control is used in this context to mean regulate, direct, or command. Process is defined as something going on that will lead to a particular result. So, what we want to examine is process control theory as it applies to safety. We regulate this process through systems analysis, which permits us to examine all of the contributing parts to determine what effect or what kind of product (safety performance) we can expect.

A process is controlled through a correction program or strategy that is activated by information generated by the process. Conceptually, process control is the utilization of process information and execution of effective decisions to obtain processing goals.

At Goodyear, we have added one more step to the control. The addition, shown in Figure Two, is an information retrieval method. In this method, we extract pertinent data from the measurement of safety performance. This data is accumulated and periodically fed as input into the computer. The data is analyzed, compared to defined models, and similarities or variations are recorded as computer reports.

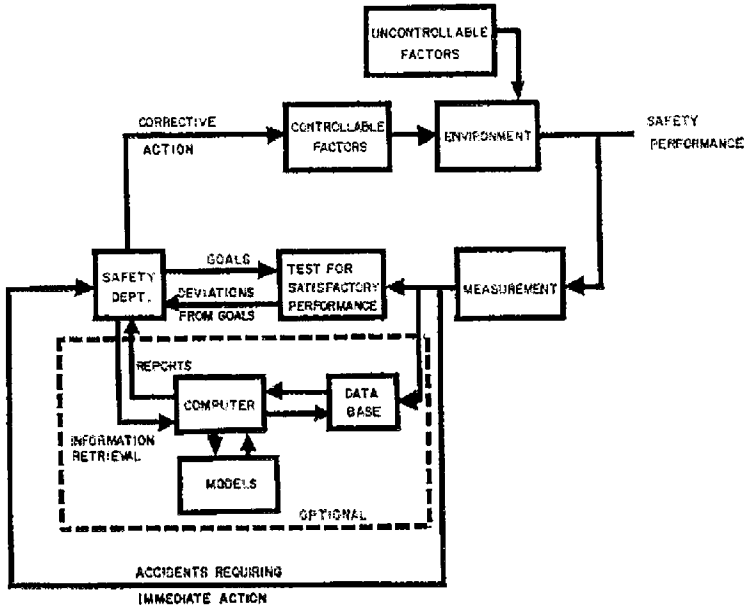


Fig. 1. SAFETY CONTROL WITH COMPUTER ASSISTANCE

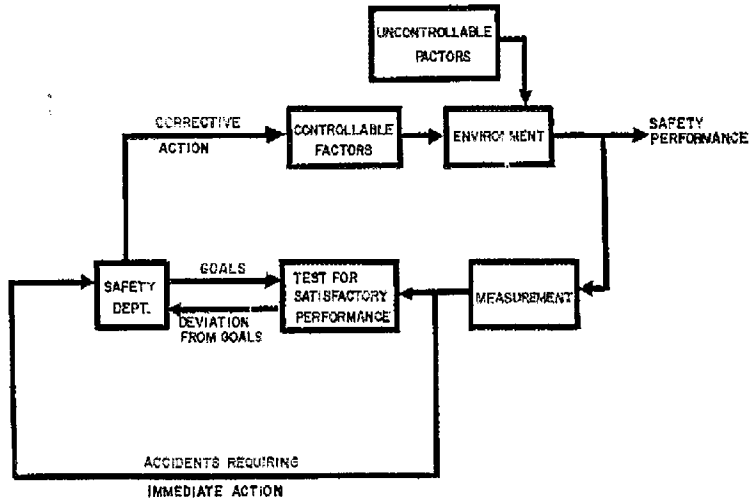


Fig. 2. SAFETY AS PROCESS CONTROL

The computer printout shows the name, department number, average cost, and type of accident of each individual involved in an accident. It also shows whether or not corrective action was taken to prevent recurrence. If not, an area is presented for management to become involved.

The "report on time" column shows the date the accident was investigated and the report submitted. If the date of investigation is different from the date of the injury, the printout will show "No." The justification for this approach is that, if you have a production problem any time during a shift, immediate action will be taken to correct it because production is important. If safety is important and we have an accident during a shift, it will be investigated. We must show the same concern for safety as we do any other function that has been deemed important.

The last column shows the name of the supervisor in charge when the accident occurred. This provides a measure of the supervisor's performance in safety, a criterion that should be used in measuring his total performance. When management evaluates a supervisor, they take into account all the points they believe are important—his production record, the number of grievances, quality, etc. Let's include safety as an item for evaluation.

An analysis of performance by department, shift, and age is made. The department is shown, the number of accidents that department contributed to the total, and the per cent. The best departments will not be shown, because they will not have had an accident. The number of employees is shown under the "labor" heading, and the per cent each department has of the total work force.

It is not enough to say that one department has twice the number of accidents as another. It may have twice the number of people. This is why the accident-to-labor ratio is very significant. Mathematically, if a department is having accidents on a random basis, this ratio should be 1.00. Whenever these ratios increase above one, and the farther they increase, the more serious are the problems in those departments, an indicator of where action needs to be taken.

The cost column is the average medical and compensation cost of the accidents incurred by each department. The same analogy is applied to shift and age groups. Again, another guide for management action.

A summary of the type of injuries incurred during the period measured is a guide to developing relevant programs of corrective action. Still another tool that can be developed in conjunction with the systems approach to provide another benchmark is an annual cost chart. As you can see, we have tried to identify any existing relationships that may exist between medical and compensation costs, employment, and frequency.

I can testify that when we initiated these charts at Goodyear, we gained a great deal of attention from management. This is because, prior to our work, these cost figures were not readily apparent. They weren't hidden, but were spread throughout the year so that management never had an opportunity to see the total picture.

At the beginning, I said we cannot begin to solve problems in safety until we have gained management's attention—the same attention they devote to production, marketing, or finance. I implied that cost was one factor that can be used to gain the needed attention. As you have seen in the previous figures, there are systems capable of analyzing the data most of us have available with a little digging. This data can include cost factors that—if you do your groundwork accurately—should stimulate a great deal of attention.

There is one last point I would like to propose. The function of safety should not be the negative one we see so often—the prevention of accidents. Instead, it should be positive—maximizing productivity by assuring the availability of the total work force.

Maximum productivity cannot be obtained if a per cent of the labor force is incapacitated because of accidents. Thus, the function of safety is to maximize the availability of the labor force for production, and thereby minimize accident costs that reduce profits.

PROPER LABELING OF HAZARDOUS MATERIALS IN INDUSTRY

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For many years the Manufacturing Chemists Association (MCA) has periodically published a revised edition of Manual L-1[1], *Guide to Precautionary Labeling Of Hazardous Chemicals*. The latest edition, the Seventh, was published in 1970. The first edition was published in 1945.

Manual L-1 has become the "Bible" for proper labeling of hazardous chemicals. Indeed, the labeling required by regulations promulgated under the authority of the Federal Hazardous Substances Act, which applies to hazardous household products, are largely patterned along the lines suggested by the MCA *Guide*. The American Petroleum Institute, in its *API Bulletin on Precautionary Labels*[2] also suggests a labeling system very similar to that recommended by MCA.

In recent years, there has been a proliferation of statutes and regulations at the state level. At this time, insofar as can be determined, at least twelve states have statutes on labeling industrial chemicals. Those of California, Oregon, New York, New Jersey, Illinois, Massachusetts, Kentucky, Minnesota, Nevada, and Colorado were discussed recently in an article by McCarl.[3] Since the publication of McCarl's article, Wisconsin and Tennessee have passed labeling laws.

One of the most comprehensive regulations is that published in California's *General Industry Safety Orders*.[4] California and the other states mentioned by McCarl follow the MCA Manual L-1 in general, and several refer to it as the guide which is to be used. We have no details as yet on the Tennessee and Wisconsin statutes.

Contrary to the opinion of many people, there is no Federal statute governing labeling of hazardous industrial chemicals. The Federal Hazardous Substances Act and regulations promulgated thereunder specifically cover hazardous substances intended or packaged in a form suitable for use in the household;[5] the Act does not apply to industrial situations or to industrial supplies taken into the home.

Sooner or later there may be a Federal statute on labeling industrial chemicals. It might supersede those of other governmental jurisdictions, thus attaining uniformity country-wide.

Importance of Proper Labels

In general, there are at least three broad reasons for labeling hazardous substances.

1. *Informs User.* A proper label informs safety engineers, supervisors, and other employees; safe handling procedures and preparation for emergencies can be devised.

2. *Lessens the Likelihood of Third Party Liability.* We are living in an age of consumerism. It is not at all uncommon for an individual to claim he has been injured by a product he uses. This extends beyond household products, and includes those used in industry. After all, an employee can collect compensation from his own employer only as awards are established by schedule in the various states. On the other hand, he can make the distributor or manufacturer (or both) party to a lawsuit. The amount of damages awarded depends on the court. Monetarily, awards often far exceed what can be recovered under workmen's compensation regulations.

3. *Prevent Overlabeling.* Overlabeling is probably worse than no labeling. It is like crying, "Wolf." Soon no one pays any attention to labels at all.

Overlabeling may cause problems in the factory. We know of an instance where workmen refused to use a chemical because of some statements on the label. Investigation of the toxic properties of the substance revealed a clear-cut case of overlabeling. The workmen would *not* accept reassurances that the hazards were not as severe as stated on the label; they did accept the manufacturer's label as authoritative, which it should have been.

It is the first reason—informing the user—which will comprise the balance of this discussion, and on which emphasis is placed.

The provisions of Manual L-1, if followed, result in labels which are proper and which are very informative to anyone who understands the principles involved. If you do not have a copy of the latest edition, it is strongly suggested that you acquire one and study it in detail. Having done so, you will be able to interpret to your employees what labels really mean. In recent years more and more manufacturers are labeling hazardous substances according to this manual, and it appears quite likely, in view of several state regulations already in effect and labeling presently required under the Federal Hazardous Substances Act, that should a Federal law be passed, regulations promulgated thereunder would closely follow the MCA recommendations.

Label Content

As stated previously, if you understand the principles involved, the degree of hazard and precautions which should be taken become clear. Good labels contain the following essential elements:

1. *Name of Product.* The name of the product is important information for the safety of handlers and users. It is preferable that the chemical name be used. If the product is a mixture, those components which contribute substantially to the hazard should be identified. A non-descriptive code designation or trade name should not be used as the only identification of a hazardous chemical. If the complete chemical name is not shown, the label should at least clearly state the type of chemical, e.g., "corrosive acid," "lead compound." In any case, identification should be adequate to permit selection of proper treatment in case of exposure.

2. *Signal Word.* The signal word is one of the most important elements of the label. It is intended to draw attention to the presence of hazard and to indicate the degree of severity. In the order of diminishing severity of hazard, the signal words recommended are: DANGER! WARNING! CAUTION! Degree of severity can be expressed only in relative terms. DANGER! is the strongest of the three words and indicates a severe hazard or hazards. CAUTION! is used for those compounds presenting the least serious hazards. WARNING! is intermediate between the others. The signal word is in capital letters of appropriate type size. A label contains only one of the three signal words. The one to be used is determined by the most severe hazard.

3. *Statement of Hazards.* This statement gives notice of the hazards that are present in connection with the customary or reasonably foreseeable handling or use of the product. Many chemical products will present more than one type of hazard. Appropriate statements for each significant one should be included on the label. In general, the most serious hazard should be stated first. For example: EXTREMELY FLAMMABLE. MAY BE FATAL IF SWALLOWED OR ABSORBED THROUGH THE SKIN. Note that the statement of hazards is also in capital letters of an appropriate size.

4. *Precautionary Measures.* These instructions are intended to supplement the statement of hazards by setting forth briefly the measures to be taken to avoid injury or damage from stated hazards, for example: "Keep away from heat, sparks, and open flame," and, "Avoid breathing dust." In some cases, the total hazard of a product, while justifying one or more precautionary measures, may be of such order as to require no statement of hazard on the label. For example, no statement of hazard is required because of the toxicity of butyl alcohol, but the precautionary measure, "Avoid prolonged or repeated breathing of vapor," is suggested.

5. *Instructions in Case of Contact or Exposure.* The primary purpose of precautionary labeling is to prevent injury or damage. However, instructions in case of contact or exposure may be included in those instances where the results of contact or exposure are severe and immediate treatment is highly desirable, and where simple remedial measures may be taken safely before medical assistance is available.

First aid instructions are limited to recognized procedures based on simple methods and commonly available materials. Instructions for strictly medical treatment should be included when specifically required by law or indicated by special circumstances.

Because of the serious and lasting effects that may result from eye injuries, a recommendation to get medical attention should accompany any specific instructions directed to treatment of the eyes. For example: "FIRST AID: In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse. Discard contaminated shoes."

6. *Antidotes and Notes to Physicians.* Specific therapeutic measures which can be taken before the physician arrives may be presented under the heading "Antidote." Example for Cyanides— "Antidote: Always have on hand a cyanide first aid kit. Break an amyl nitrite pearl in a cloth and hold lightly under nose for 15 seconds. Repeat five times at 15-second intervals. Call a physician."

It may, in certain cases, be desirable to acquaint the physician with an antidote or with a specific form of medical management through a note to physicians on the label. Obviously, such information must be written by a physician for physicians. Example for Soluble Arsenic Compounds—"Note to Physicians: If swallowed, give gastric lavage followed by saline cathartic. Force fluids. In all cases, give dimercaprol (BAL) in recommended dosages."

7. *Instructions in Case of Fire, Spill, or Leak.* Accident instructions should be as simple and brief as possible and should advise the use of suitable materials for control. They should provide persons who handle containers during shipment and storage with appropriate instructions for confining and extinguishing fires and for cleaning up spills or leaks. This information on labels affixed to containers will insure reference and provide opportunity to plan for emergencies that might occur during storage and use of the product.

Such instructions may be used as separate labels or may be a part of the precautionary label text. Examples: "In case of fire, use water, dry chemical, or CO_2." "In case of fire, soak with water." "Flush spill area with water spray."

8. *Instructions for Container Handling and Storage.* Care should always be exercised in handling and storing containers of hazardous chemicals in metal drums, glass carboys, cylinders, fiber drums, aerosol containers, etc., and in removing the contents. Applicable phrases should be used. These may also be used either as separate labels or as a part of the precautionary label text. Examples: "Keep closure up to prevent leakage." "Replace closure after each withdrawal." "Do not drop onto, or slide across sharp objects." "Do not puncture or incinerate container."

Use of "Poison" and Skull & Crossbones

The use of the word "Poison" and the skull & crossbones on a label should be limited to those cases where the product is highly toxic as defined in Manual L-1, or where such use is prescribed by law. When used, this legend should *not* take the place of the signal word.

Summary

In conclusion, let's look at the label for an imaginary chemical synthesized for the purpose of this discussion. The chemical is benzoacetaminocarbonamide. You will see that it is a very hazardous chemical. The following are the eight elements of the label:

1. *Name*—Benzoacetaminocarbonamide.

2. *Signal Word*—DANGER!

3. *Statement of Hazards*—MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH THE SKIN. CAUSES EYE IRRITATION. COMBUSTIBLE.

4. *Precautionary Measures*—Do not breathe vapor. Keep container closed. Use only with adequate ventilation. Do not get in eyes, on skin, on clothing. Wash thoroughly after handling. Keep away from heat and open flame.

5. *Instructions in Case of Contact or Exposure*—POISON—Call a physician—FIRST AID: If inhaled remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Discard contaminated shoes. If swallowed, induce vomiting by sticking finger down throat or by giving soapy or strong salt water to drink. Repeat until vomit is clear. Never give anything by mouth to an unconscious person.

6. *Note to Physicians*—Warning symptoms are blurred vision, nausea, and abdominal cramps. There is no specific antidote. Never give tranquilizers. Treat symptomatically.

7. *Instructions in Case of Fire, Spill, or Leak*—In case of fire, use water, dry chemi-

cal or CO_2. In case of spill or leak, flush spill area with water spray.

8. *Instructions for Container Handling and Storage*—Keep closure up to prevent leakage. Do not drop or slide across sharp projection. Drum must not be washed out or used for other purposes.

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3. McCarl, G. Warren; "Present Status of Labeling of Materials in Industry," *Amer. Ind. Hyg. Assoc. J.* 30:519 (1960)
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THE FEDERAL GOVERNMENT—PARTNER IN SAFETY

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The Federal government is currently more involved in safety activities in this country than you probably realize and, apparently, in the near future is going to be even more involved. We have had, for some time, some considerable interest in safety. We have had the Walsh-Healey Act since 1936. That is not very new. Safety requirements under that Act affect, at any given time, something like 75,000 plants. About 250,000 contracts are awarded annually. The contracts cover, at any given time about 27,000 employees in those 75,000 plants. We have also the McNamara-O'Hara Service Contract Act which applies to contracts for personal services to the government in excess of $2,500. That affects about 25,000 work locations and about 6,000,000 employees. We have the safety and health aspects of the Longshoremen's and Harbor Workers' Compensation Act which covers about 200,000 employees on the waterfront loading and unloading ships; building, repairing, and tearing down ships; and doing various types of construction work on the navigable waters. Since August 1969 we have had the Construction Safety Act, Public Law 91-54, which we estimate will apply at about 200,000 construction sites and protect about 2,300,000 employees. It applies to construction which is financed or assisted by the Federal government. We have the Vocational Rehabilitation Act which [illegible] people in sheltered workshops [illegible] reason or another, are [illegible] or occupation in a [illegible] ment, and the Arts and Humanities Act which is to protect the casts and other people who work on performances financed or assisted by the Federal government. That one is unusual because we are trying to do something about the safety of the performers and stagehands and such. Prior to the Arts and Humanities Act we have had quite a lot of laws and rules and regulations all designed for the safety of the audience. As far as the backstage people were concerned, you dropped that asbestos curtain and let them take care of themselves as best they could.

We have an idea that if we make a regulation under any one of these Acts it should apply equally to the same subject [illegible] when it is regulated by any of the others. In other words, we [illegible] make the regulations [illegible] the present, the [illegible] Walsh-Healey, McNamara [illegible] and Humanities [illegible] Acts are [illegible] Health [illegible]

reasonable question is, "What will those regulations look like?" While it cannot be answered in detail until the Act is actually in effect, some general ideas can be inferred from the philosophy of the Department of Labor about the proper nature of regulations and about who should be the "Partners in Safety." Under a considerable amount of urging, particularly at the 1964 hearings on the regulations under the Walsh-Healey Act, we have decided that, so far as possible, our regulations will embody the voluntary consensus standards, which will make the whole safety community our partners in safety. What that has meant in practice is that we have adopted by reference the safety and health standards of the American National Standards Institute, the National Fire Protection Association, and the American Society for Testing and Materials. As a natural extension of this philosophy, we do and intend to continue to support these institutions as strongly as we can. We participate in the development of many of their safety and health standards as members of technical committees and review boards. We have not made an effort to participate in the management of those organizations. We think that that should be voluntary and not government initiated.

To get standards which will have the maximum possible acceptance where we do not find consensus standards, we have looked at the proprietary standards of technical and professional associations. Under the four Contracts Acts we have adopted the threshold limit values of the American Conference of Governmental Industrial Hygienists. In spite of the fact that it says governmental, it is a private, professional organization and the members are not all employees of governmental units, so the standards are proprietary. We have also adopted some of the standards of the Compressed Gas Association and some of the standards of the Association of Building Commissioners of the United States. When we are about to adopt that sort of material we advertise the fact as widely as we can. We have [illegible] mailing list to which we distribute [illegible] terial directly, and we ask [illegible] again distribute it widely [illegible] ments and criticisms [illegible] we hold a public hearing [illegible] tunity for [illegible] hold several hearings, both formal and informal, in various parts of the country to provide the maximum ease of participation which we can. We have not the slightest compunction about changing a proprietary standard in the course of adoption if the consensus appears to be that it should be changed.

Everyone who has an interest is perfectly welcome and is encouraged to take part in that process. It is not the quickest way of arriving at a set of regulations and I am not sure that it is the most efficient way, but it is the most democratic way which we have been able to devise. We do feel that we must have regulations and I think that almost everyone agrees with that. You can do quite a lot by voluntary action but I don't think that you can do quite as much as the National Safety Council thinks that you can. As Jimmy Durante said about the bee among the flies on his nose, "There has to be one in every crowd who spoils it for everybody." That bee in every crowd who won't behave voluntarily and has to be squelched is the precise reason that we eventually have to come to regulations which can be vigorously and effectively enforced.

We thoroughly agree with both the desirability and the necessity of education as to the necessity for the type of practices we advocate and their social and economic desirability and only add that if they are socially desirable then they must be and can be enforced against the antisocial types. We do not need that enforcement [illegible] as you might expect. With our [illegible] we manage to make about [illegible] tions annually. In about [illegible] inspections, we find [illegible] the regulations [illegible] for those [illegible] those violations [illegible] rected [illegible] [illegible] had regulations for about ten years, we have

a statute which directs the Secretary to make rules and regulations and enforce them and also to engage in educational, training, and promotional activities with the employers and employees. Under that Act we have for the past ten years done about 20,000 inspections per year. We have also conducted training classes for ten to twelve or fifteen thousand individuals per year, classes which vary from a single two-hour session to a week of eight hours per day. We have had a minimal number of legal actions which, under this Act, result in Cease and Desist Orders. The results have been that in the shipbuilding, ship repairing, and shipbreaking industry we have seen a 40 per cent in frequency rate over the ten years, and in the longshoring industry a reduction of about 75 per cent. We have spent about $8.5 million in that ten year period and we have seen a direct cash return to the industry of about $7.5 million in reduced compensation insurance premiums. Perhaps it is a little brash to say that we are responsible for those reductions but it is observable that, in the ten years before our involvement with the industry, there was no such reduction in rates, and in the years over which the reductions have been achieved occupational rates in general have been uniformly rising. We are convinced that if you have a properly balanced program, if you do the training which is necessary to get people going along with you voluntarily (and we are convinced that if you can't get the vast majority of your constituency to go along with you voluntarily you might as well forget it—pack it in and go home), if you do the necessary minimal amount of enforcement, in short, if you do exactly the things which every safety professional has known for twenty or twenty-five years that you should do, and if you work hard at them and really mean it, they will work. We see the results statistically, and we see the results in human terms. I expect that under the new law, when it comes to pass, the philosophy will not change very much and the performance will not change very much.

All of the bills which have been introduced contain some provision under which the states can become "Partners in Safety" and permit each state to maintain control of governmental safety and health activities within its own borders. There are minor variations but no substantial differences. They all say that if the states will enforce standards which are the equivalent of the Federal standards and if they will produce a plan of action which will make those standards effective, then the Federal government will not only not take over occupational safety and health within the boundaries of that state but that it will provide some financial assistance to sweeten the program. We have had some voluntary cooperative plans with some of the states under the Walsh-Healey Act, but we do not have very many of them for a variety of reasons, not the least of which is that many of the states do not want them. Under the Walsh-Healey Act the Department is permitted to enter into such agreements but all that we can really offer the state people is more work with no more remuneration. Many people do not care for a job on those terms.

There has been some complaint in the press that the standards which we have adopted from the voluntary agencies are minimal. Ralph Nader has insisted strongly on that point, and we do not disagree with him. We think that it is not only inevitable in the long run but also desirable that the consensus standards and Federal regulations and state regulations should represent minimum satisfactory performance. We think that these things should represent a floor below which no one should be permitted to go. We do not think that it should ever be conceived or represented to be optimum performance. We both hope and believe that a lot of people will do better in their own self-interest than it would be proper to require by regulation. This is the fundamental difference between the system which is in use in many European countries and the system we have here. The European pattern is that the law says that the employer will comply with the rules and regulations of the Central Labor Authority. The Authority then sets up regulations which spell in detail exactly what he must do.

It is a simple system to administer; once the rules are written all you need do is read the book. The result has been exactly what you would predict. Everyone does comply with the regulations and does not take [illegible] partly because doing more would be a violation, in a technical sense at least, and it don't work very well. It

doesn't work for two main reasons. One is that the regulations have to be written in detail for each operation, so that the inspector with the book can enforce them. As time passes the technology changes, the operation changes in detail, and the regulation does not fit anymore, but it still must be enforced and is enforced because there it is on the book. The more fundamental reason, and perhaps it is another way of saying the same thing, is that in writing that sort of a technical specification it is almost inevitable that you will get so involved with the technicalities that you will lose track of the main objective, which is to protect living, breathing people, not to provide an exercise in technical virtuosity for the writer. We have seen numbers of such regulations—in this country building codes are notorious for this fault—and we have taken the lesson to heart.

We believe that a regulation should not tell you what you must do. It should tell you what you may not do. It should also plainly state what you are supposed to accomplish and provide a quantitative measure of minimum satisfactory performance. Beyond that people should be permitted to go each his own way and accomplish the stated objective, or anything beyond it, each in his own way. We try very hard to write our regulations that way and to influence the voluntary organizations to write their standards that way.

It is not too easy. It requires a pretty clear and detailed visualization of the problem. But when you have accomplished it you have something which will protect the human values with which you are concerned and will, at the same time, not impede technological change. One of our major concerns is to accomplish that protection of people with no unnecessary interference with production processes.

HYDRO BLASTING—WATER AT WORK

By DAVID J. MARIANI
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And God said, "Let the waters under the heavens be gathered to one place." From the beginning of time, man has been dependent on water to sustain life. He is also aware of its devastating deluge, power potential, recreational resources, and cleansing capabilities. Now man is harnessing water again and putting it to work in another fashion. He is combining, literally, the words of Genesis and the laws of hydraulics to arrive at hydro blasting. We gather a quantity of water, force it through a lance into one controlled place where it can unleash its productivity. Obtaining this safely and efficiently is our goal.

The problem of accumulations and unwanted residues that adhere to surfaces of equipment and structures is a source of concern within industry. In recent years, hydro blasting (or high pressure water cleaning) has been used as a mechanical means of removing adhered particles from surfaces. Under tremendous pressure, water is emitted through a jet nozzling device capable of blasting operations similar to sandblasting, but without the uncontrollable mass of sand and dust to contaminate the cleaning area and without the abrasive, cutting away action of sand, shot, and other blast media, rodding, drilling, and air or steam blasting. Since it is common for pressures of 10,000 psig to be used, and range upward to 45,000 psig for some cleaning jobs, safety must be built into these machines when they are manufactured, and a safe operating procedure be developed in writing for each job. The man assigned the job of using this unit, commonly referred to as the operator, must be thoroughly trained in all functions of the operation. Most important, he must be regularly reminded of safety procedures. Any infraction of safety regulations should be severely dealt with. All the safety devices conceivable will not protect the careless worker or one who will purposely take unsafe short cuts. Your best safety device is training a competent man who is in good physical and mental condition.

Let us call the units that gather this water into one place a pump. And for practical purposes, we shall not delve into the lower pressure washers that are on the market in abundance. These use a mixture of lower pressure water, detergents, steam, or abrasives. We shall primarily stay with the larger units in the ranges of several thousand pounds and up. The units themselves are normally portable, mounted on wheels. A few are on skids or even the back end of a truck. These units can quickly be moved from one location to another. The power source can be gasoline, or diesel. The specially built cart has hooks included for hose storage.

A stationary electric unit of 6,000 pound capacity is piped solidly. The feed water passes through a strainer and, in the event of water loss, the pump automatically shuts off. Another control sprays the pistons with water for lubrication only when the pump is energized. The discharge piping is of the hydraulic type, with an electric receptacle and the water connections close together.

After the water is gathered, it must be confined or directed to one spot. This is done with a lance. The lance can include a fail safe water control valve. Additional safety was applied by the user: A flat guard over the handle reduces the possibility of the gun accidentally discharging should the unit be dropped onto its handle. Another form of lance holder uses a tripod arrangement that holds the lance with three chains and clips for quick connection. The main thing for cleaning purposes, as in all cases, is to keep your lance tip close to your work. The proper nozzle, along with water pressure and quantity, should be analyzed for optimum cleaning.

In a plant of our size, encompassing some 25 acres, there are many areas in which hydro blasting can be put to work: cleaning grounds; maintenance of vessels, pipe lines, and cleaning equipment, inside and outside; primarily cleaning vessels such as reactors, one area in which hydro blasting has proven most beneficial. It is much faster to clean with a hydro blaster than the previous muscle power and hand tools. It is safer than a solvent and a less expensive cleaning material.

In order to clean reactors more safely, more effectively, and more efficiently, we have designed a ring that fits on the manhole of the reactor or any other vessel that must be cleaned. Another unit of similar purpose—safety in the use of the hydro blaster—is constructed of chain instead of the solid metal ring. This makes it adaptable to any size manhole. As long as the safety ring is used, the dump valve can be eliminated.

The operator, even though working from outside the vessel, wears his rubber suit to prevent an accidental, rather chilly, bath. The nozzle or business end of the lance is inserted through the manhole. The agitator is then locked out to prevent a confrontation between lance and agitator blades. The safety ring is locked to the manhole opening. Two clips, 120 degrees apart, are slipped under the flange. A tee-handled stud is then tightened to lock the unit securely. No tools are required.

The operator dons his face shield, takes a firm grip on the lance to direct the force of the hydro blast, and has his fingers on the electric switch. With a squeeze of the trigger type switch, he will start to remove the buildup on the interior of the reactor.

Looking over the operator's shoulder, we can see the coagulum buildup that is to be removed safely and rapidly. The use of hydro blasting has reduced the down time. The use of the retaining ring has increased the safety factor and reduced the effort the operator must use to control the lance. The effectiveness of the ring is dramatic. Only one of three chains holds this unattended lance, which is under 3,500 pounds of pressure.

The theory behind the retaining ring substantiates the use of a chain for cleaning floors, pumps, or exterior of equipment. Any reasonable length of chain can be used, with a snap lock connection on both ends. One end is hooked to the lance, the other is wrapped around a solid object. By directing the blast toward the solid object or vicinity, the chain reduces the back thrust of the lance. In this type of application, the dump valve must be included as part of the lance. The properly trained operator will always be found dressed for the occasion.

Tests were conducted by a Houston, Texas, based company, using soft white pine. White pine was chosen because of its softness being in proximity to human flesh. A 10,000 pound unit at 17 gpm was used. With the lance up close, one-half inch to 6 inches, penetration is to the bone, a complete cutting action. From six inches to two feet, one will receive deep cuts and flesh removal. From two to five feet, one would receive surface skin damage. From five to eight feet, you can damage soft tissue; beyond this point, there is no normal surface damage. One merely becomes saturated.

Another hazard on direct contact, would be water infusion. Should a small jet come into close contact with one's flesh, the water could be injected, causing painful swelling. Indirect contact hazards could come from burst hose or pipeline failures, couplings being generally the weakest point. Safety practice should also be adhered to under refueling techniques. Safety training of the lance operators should include these techniques. It is beneficial if he understands the normal operating procedures and also emergency shutdown procedures.

Occasionally in the area of hydro blasting, there may be lights or other electrical cords that could be severed by the cutting action. A circuit interupter is a ground fault interupter designed to protect branch circuits against lethal electrical shocks, fire hazards, and damage to equipment caused by line to ground fault circuits. Water and an electric charge can also be devastating.

Personal protective equipment can be rubber suit, gloves, boots, and a face mask. The most important single personal protection device is a pair of safety glasses as minimum coverage for the eyes. A full face shield keeps flying particles away from one's mouth and protects the face. Should the need arise where conditions are such (there may be chemical contamination or other hazardous ingredients and you want full head protection), you could go to a complete head coverage.

Bridges seem an unlikely prospect for hydro blasting. One in Cincinnati, Ohio was given a rejuvenation after the power of the hydro was put to work. The cleaning and blasting revealed spalled concrete while it prepared the areas for the needed repairs. The steel tie rods were more corroded than anticipated once the dirt and rust were removed from in between the two steel rods.

Expansion joints on highways are similar to in-plant roads that occasionally require maintenance. The expansion joint can be easily cut out with high pressure water. The joint is cleaned without damage to the concrete. Chances are you have guard rails in your parking lot and your in-plant roads. They, too, can be hydro blasted ready for painting by use of high pressure water.

Preventive maintenance is most important in keeping our plant up, and also in keeping the hydro blasters in top working condition. You should inspect your system, your pumps, for vibrations, any leaks, make certain the guards are on and the release systems are properly set to protect your people and investment. For most, it just requires a handful of small parts to keep the equipment in top condition.

In conclusion, hydro blasting is another modern way to safely maintain one's plant and equipment, reduce downtime, and even become part of one's production techniques. This can be accomplished by purchasing well designed equipment engineered to your needs. The foregoing can be calculated and proven. In order to obtain desired results, the human factor is brought into play. Herein lies the problem area. Most accidents are caused by unsafe acts. We must train and retrain the operators that the tools they are using must be treated with respect. As with any tool, it should be used as designed. A well written specification, thorough training, constant reminding, and insisting they become cognizant of their tools will keep the accidents caused by unsafe acts from occurring. Hydro blasting can be as safe as a hammer or as deadly. A thorough physical to determine the man's mental and physical competence should be a prerequisite for any operator.

"And on the third day He created the waters . . ." now, let us put the water to work—safely.

Following the presentation, there was a question and answer period.

Q: When working from a scaffold, what protection is necessary from keeping the scaffold from tipping over because of back pressure from the nozzle?

A: Back pressure is more of a function of gallons per minute than pressure. The greater the gallonage at a fixed pressure, the greater the back pressure. Water blasters are normally low volume, operating between 10 and 20 gallons of water per minute, and the back pressure does not present a problem. However, any time one is working on a scaffold

that is relatively high, it should be tied off for protection regardless of the type of work being performed.

Q: What cleaning media was used on the guard rail?

A: A sand injection system along with the high pressure water blaster was used to clean the guard rail. It was pointed out that water alone cannot compete with sand blasting in certain applications. Wherever sand or the problems associated with the sand, dust, etc. are a problem, then the wet sand blasting can be incorporated.

Q: Are you familiar with reversing pumps or blowing off to reduce pressures?

A: At the higher pressures we are talking about, a 75 hp motor is generally used. Trying to reverse this size motor is asking for problems. There are two ways to reduce pressures safely on other types of equipment. The first is to divert the stream through a large orifice to the atmosphere, which reduces the pressure in the hose and the lance. The second is to divert the stream by recirculating it back through the pump. Other methods, such as allowing the over pressure to bleed off through a relief mechanism, still leaves pressure on the hose.

Q: Is only one method for reducing pressure necessary or should both methods be used?

A: It is only necessary to safely operate with one method for reducing the pressure. However, two safeties are better than one. It depends upon conditions and the type of work being performed which is the safest route to follow. Experience can be the best judge of which is the preferred method.

Q: Can hydro-blasting be used to clean laitances off of concrete after it has set for two or three days?

A: Laitances are an inert substance of low strength that collects on the horizontal surface. This must be removed before additional concrete can be poured. The old method for removing the laitances was sand blasting. Then low pressure 1,500 psi high volume water, 30 gpm was tried. Water caused a flooding problem. Hydro-blasting can be used for cleaning up to seven day old concrete using 7,000 psi. A fan tip nozzle selection was recommended as the proper type to use.

Q: Can hydro blasting be used for cleaning aluminum tire curing molds?

A: Yes, it can be used and has been used very successfully on aluminum molds.

Q. Can this type of cleaning method be used on tread trays to remove cement?

A: The cement on tread trays and also the baked phenolic resins have been successfully removed from tread trays, conveyors, belts, and other types of material handling equipment. This is a scaling job and normally would require low volume, 10 to 15 gpm of water. The best way to find out if you have a specific problem in cleaning is to experiment.

Q: What kind of breathing apparatus is needed for working in a vessel?

A: Every precaution necessary to enter the vessel for any reason should be followed. There is no greater danger in cleaning with a high pressure water gun than there is for entering the vessel to retrieve a fallen tool, as far as breathing apparatus is concerned. Mandatory whenever a man is inside a vessel is to have a safety man stand by at the manway. The safety man should be well versed, as they both should be, in what to do in the event of an emergency. The best air mask that you can get should be used if it is necessary to wear breathing apparatus.

Q: What is the best foot protection for the man on the gun?

A: The best protection is to make certain that the man has been thoroughly trained. Secondly, the lance should be long enough so that he cannot turn the lance onto himself. Another form of protection, should it be required to use a short lance, would be a steel toed rubber boot or the additional metatarsal protection. As for protecting the legs, there is not too much that can be done outside of the relatively light protection afforded by the standard rubber gear. There is also the danger of hitting someone else. When working in pairs, safety procedures must be followed. In cleaning open areas, barricades or posting of signs should be incorporated to warn the unwary traveller. One must have respect for this equipment. Many companies will purchase this expensive equipment and then put an incompetent person on as an operator. Water blasting is a real money saver to the company and should have a competent operator. He must be trained properly to insure optimum results.

Q: How does the noise interfere with communications between operators?

A: The best way to communicate with a man in a vessel is to simply tug on the safety harness. Other visible signs, such as a nod of the head, can be successfully used as a means of communication. If the noise is high enough to cause temporary deafness when working in certain areas, then ear muffs should be worn. Ear protection is a good idea when working in a confined area.

CONVEYORS—PERPETUAL MANTRAPS

By LAWRENCE HARTMAN
Dir., Training and Safety, Firestone Tire & Rubber Co., Pottstown, Pa.

It is my firm belief that the conveyor, in particular the in-running bite of the conveyor, is as great a hazard as there is among the great diversity of equipment used in this industry. That is why conveyors are referred to as perpetual mantraps in the title of this presentation.

I also strongly feel that some of the accidents attributed in the statistics to a piece of machinery are in reality directly related to the conveying equipment associated with the machinery.

Conveyors are so commonly used in great numbers that people are lulled, and respect and caution diminish. This means that a consistent effort must be made to safeguard the employee against a moment of inattention which may put him in a mantrap.

Before we begin, we must also realize that conveyors, like most other equipment, are becoming more complex, more automatic, more sophisticated in the transfer mechanisms and, as a result, require more attention to protection.

Particular attention should be given to the jamming points, the junction where drive and idle rollers meet, the movement of transfer gates, the movement of belts around drive rolls, the bites at belt tensioning units, the controls and movements of timing or hold-back devices, and the change of direction transfers. Perhaps the worst of all is where two drive sections of conveyors move material from opposite directions into a common deposit point.

Also, the stopping devices to help keep injury to a minimum should an accident start should have very close attention.

Whether it be belt, roller, screw, hook, monorail, tow line, or combinations of these type conveyors, we all have some of them and we should all do our best to reduce the hazards of our conveyor—"mantraps." (There followed a series of slides illustrating problem points and corrections.—Ed.)

ACCIDENT PREVENTION IN THE PLASTICS PROCESSING PLANT

By RICHARD D. MONTGOMERY
Safety Coordinator, Standard Oil Co. (Ohio), Cleveland, Ohio

In laying out an active, effective, and continuous accident prevention program, we of course must have objectives: What do we hope to accomplish? What is our goal?

These objectives should cover five main areas of concern. They are nothing new to many of you, and do not relate only to an accident prevention program in the plastic processing plant. They do, however, represent the main objectives of any accident prevention program, regardless of industry affiliation. They should be directed to accomplish the following:

1. To prevent occupational and non-occupational injuries and illness to employees.

2. To prevent injuries and illness to non-employees where company property or products are involved.

3. To prevent accidents resulting in damage to company property, loss of production, and productive capacity.

4. To contribute to the profitability of the business by preventing all accidental losses.

5. To comply with all applicable laws and regulations governing personal injuries, illnesses, accidents, and fire protection.

I am sure you'll agree that these are beautiful objectives, but at the same time, you may question as to whether or not they're realistic, or how can they be accomplished. Although not easy, I firmly believe that they can be achieved through a dedicated report and action, directed towards the implementation of the following eight elements:

1. *Guidance and involvement from all levels of management.* Accident prevention is a control function of management, and must be accepted as such by all levels of management. Because this function affects the health and safety of employees, and can have a significant effect on profitability, every member must consistently and continuously exercise all of the accident control elements available to him in his position in the organization. Specifically, top executives should include progress towards accident prevention objectives by department heads as a standard item at staff meetings. They should discuss recent accidents, injuries, and fires, and must provide leadership and financial support for accident prevention work.

Plant managers should schedule reviews of current accident activities at all general staff meetings, and include a recounting by responsible superintendents of recent accidents, injuries, and fires in their areas, and the preventive measures being taken to prevent recurrence.

At the supervisor level, accident prevention should be included as an integral part of the job of supervising. He should conduct safety meetings, conduct inspections, and observe safety rules and regulations, and be responsible for accident investigations and corrective measures.

2. *Provide and maintain tools, equipment, and facilities.* Without proper maintenance, a safe working environment will not remain safe. It requires constant inspection, replacement, and attention in order to keep it safe. Some of the more important items involved here are: equipment inspections, preventive maintenance programs, inspections and tests of fire and safety equipment, and a good housekeeping program.

3. *Development and enforcement of safe work procedures, methods, rules, and regulations.* Safety must be included in every job method and procedure, not as an added set of precautions but as an integral part of each step of the procedure itself. No job can be considered efficient unless it is safe.

Safe job procedures are developed by studying past experience within the company and industry. Details of accidents should be analyzed to determine the physical hazards involved and the actions that caused them to result in accidents and injuries. Job procedures can then be devised to avoid or guard against these hazards and actions.

4. *Training and education of employees.* The training and education of an employee in safety and many related activities must continue as long as he is employed. The responsibility for most of this training and education rests with the supervisor. He must spend a considerable portion of his time in discharging this important responsibility. This should include not only the training of new employees, but the training and education of transferred and older employees as well.

5. *Provision of protective clothing and equipment.* It should be the policy to provide protective clothing and equipment to protect employees from job hazards. An in-depth analysis of the overall operation will determine the need and type of equipment required.

6. *Create and maintain interest in accident prevention.* Promotional activities designed to maintain employee interest comprise an important part of the total accident prevention program. The objective of this promotional work should be to assist supervisors in keeping employees reminded of safety at all times, and to help motivate employees always to choose the safe course of action.

7. *Thorough accident investigation and prevention action.* The basic foundation of an accident prevention program is the lessons we learn from accidents that have already occurred. The more thoroughly we investigate accidents, the more valuable are the lessons learned. When an investigation defines the cause and positive steps are taken to eliminate the cause, the likelihood of the same or a similar accident occurring is greatly reduced. Therefore, the thorough investigation of all accidents must be an accepted responsibility of all supervisors.

8. *The treatment and follow-up of injured employees.* Any employer has the responsibility to see that every employee injured in the course of his work receives prompt competent medical treatment. On the other hand, it is the individual employee's responsibility to report every work injury and to follow the professional advice and instructions he receives from the physician treating him.

As mentioned previously, these elements are not sacred to any one facet of industry, but can be applied to any and all, including plastics processors. But regardless of the operation, be it injection molding, compression molding, extrusion, scrap grinders, fork lift trucks, hot stamp machines, or sonic sealers, the diligent implementation of these elements in an accident prevention program will produce results.

These are the guidelines we have used, and in the past three years we have gone from a disabling injury frequency rate of 14.89 to a current 6.6.

We cannot and will not accept the fact that all is well, but we will continue to use these guidelines in our accident prevention program, and we are firmly convinced that they will continue to result in a further reduction of injuries, accidents, and fires.

SAFETY RESPONSIBILITY IN THE PLASTICS INDUSTRY

By ALBERT NELSON, JR.
Red Sherman Associates, Div. of USM, East Orange, N. J.

A brief description of injection molding machines will help to develop the safety devices that are now available. The clamp, either mechanical or hydraulic, is simply the method of holding the mold halves together as the plastic is being injected into the mold.

The screw or plasticizer mixes, melts, and measures, by the displacement method, the correct amount of plastic for properly filling the mold. The machine movements are driven by a pump similar to our own heart, and the direction of fluid and the pressures are controlled electrically by valves, solenoids, and timers. The machine is designed to operate automatically once it has been properly set up and adjusted.

Each machine, according to the manufacturer, has built into it an electrical, hydraulic and, in some cases, the mechanical drop is offered as an option. A brief description of each is as follows:

Electrical. Usually a limit switch that breaks a circuit if a guard or safety device is moved. There is one on the front safety gate tied into a hydraulic valve to give a double safety, and a limit switch on the back gate. If either of these circuits are broken while the machines are operating, the machines should stop.

Hydraulic. A valve of some sort, spring actuated, that must be in a certain position to permit fluid to flow to provide machine motion. There is usually one tied into the electric safety on the front gate.

Mechanical. These consist of a mechanical drop bar activated by the front gate. A heavy bar drops between the machine platens when the gate opens and the clamp is open. The action of the gate closing removes the bar from the platen area. These are standard on most machines but some, incorrectly to my thinking, offer them as options.

Guards. Each manufacturer must provide the necessary guards to cover moving parts which could cause damage or injury to the operator.

Production safety is now the key to a complete safety picture. Here is where we get down to the actual accidents and what were the real causes. I break them down into environment, machinery, and knowledge. When I speak of environment, I mean the area around the machine, the floor, the lights, etc. I have already touched upon the machinery. Knowledge is knowing about these so that accidents can be prevented.

Most accidents of which I know should not have occurred, because in each case the individual involved violated safety precautions and sustained some type of injury. Because of this, machinery manufacturers are developing a safety code that will standardize all safetys built into the machine so that knowledge of what they are and how they work will be easily and correctly developed. Even though the manufacturer is keenly concerned with the built-in design, they must band together in the name of product liability to standardize and improve safety.

We are all very much concerned with the safe operation of the equipment we sell and service. Each accident which is prevented by prior design and planning is a direct step in the right direction.

If we can develop correct safety measures for operation and design correct equipment, then we can attempt to educate all concerned and be sure we have done all that is possible to prevent costly accidents.

WORKMEN'S COMPENSATION IN THE PLASTICS PROCESSING PLANT

By SAMUEL J. McGOUN
Vice Pres., Sales Dept., Joyce & Co., Chicago, Ill.

The workmens compensation rate for the plastic processor has been increasing rapidly over the past few years. In Illinois for example, the workmens compensation rate per $100 of payroll in 1967 was $1.85; in 1968, $2.01; and in 1969 and presently, $2.34.

This rate, of course, is the manual rate and can be modified upward or downward based on the experience in your individual plant. But let's analyze this a little further. For each $100 of payroll you are going to pay $2.34 for workmens compensation insurance. Within that $2.34 we have the following items: Losses (65 per cent)—$1.52; Expenses (35 per cent) include engineering (five per cent)—$0.08; loss adjustment expenses (14 per cent)—$0.22; bureau (two per cent)—$0.03; administration and audit (eight per cent)—$0.13; taxes (three per cent)—$0.05; profit (five per cent)—$0.08; commission and/or salaries and expenses of brokers and/or company sales representatives (11 per cent)—$0.17.

My point is if your losses are 65 per cent of the premium you will pay $2.34 for each $100 of plant payroll. If they are less than 65 per cent you will pay less, and if they are more you will pay more. But let's forget the 65 per cent for a moment and concentrate on the other portion of the rate in the 35 per cent for expenses.

Initially, it is logical to assume that, if these expenses are percentages of the premiums, as the premiums go up the percentages in some areas should come down. Take administration and audit, for example; we said that about that eight per cent of the rate makeup or $0.13 per $100 of payroll applies to administration and audit expenses. It would follow that if we issued a policy for $5,000 in premium, eight per cent or $400 would be allotted for administration and audit. If we issued a policy for $50,000, eight per cent or $4,000 would be for administration and audit. And if we issue a policy for $500,000, eight per cent or $40,000 would be for administration and audit. I think we can agree that insurance companies do not need 100 times more money to set up a file to take audits and to underwrite a $500,000 risk as opposed to a $5,000 risk.

Another area is commissions and/or salaries of company sales representatives, at approximately 11 per cent. The actual situation is that commissions decrease as the premiums go up, and this reduction is passed along to you in the form of a premium discount. You should be receiving this premium discount on your present policy. The discount percentages are as follows: first $1,000 of premium—0; next $4,000 of premium—9.3 per cent; next $95,000 of premium—14.6 per cent; over $100,000 of premium—16.1 per cent. Going back to our example on a $5,000 premium the discount would be 9.3 per cent in excess of $1,000 or $372. On a $50,000 premium the discount would be approximately 12 per cent of $6,942, and on a $500,000 premium the discount would be approximately 15 per cent or $77,742.

The point I am making here is that you can save 15 per cent on your compensation costs through a reduction in expenses and an increase in premium discount by buying workmens compensation insurance on a group basis. Group workmens compensation coverage is now available through various trade associations, including the Society Of The Plastics Industry.

This brings us to the other portion of the rate, i.e., the 65 per cent figure mentioned to pay for losses. What can be done to reduce this figure? You must have a safety program. No matter how basic, some program to inspire safety awareness must be operating in your plant. As my colleagues will confirm, you can have the best control and storage of solvents and all the best physical protection, and your industrial accident ratio can be exorbitant because you've forgotten the single most important element in any plant safety program—the human element.

You as management should want an impressive safety record. Not just because of the savings in insurance costs but because it affects so many other aspects of plant operation such as turnover, employee morale, lost time for supervisors and foremen. But you must instill this feeling among your plant supervisory personnel and plant foremen and they must be charged with the day to day administration and responsibility for effective plant safety.

I cannot over emphasize the importance of this fact. It's their job, their success or failure, and it is rightly theirs because they know what's going on in your plant better then you do. They see unsafe acts, they recognize unsafe conditions instantaneously, and they should have the authority and responsibility for correcting them within their sphere of supervision. It's one thing to review accident causes and corrective measures at a monthly safety committee meeting, but it's quite another to correct an unsafe act or condition on the spot—and these are the only people who can do that.

Talk to your insurance broker, talk to your trade association—they can help you set up an effective safety program in your plant.

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Respectfully,

Robert J. Marcock

Robert J. Marcock
Manager, Library

Marilyn P. Pettersen

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