steam inlet pressure and a bucket trap to control the removal of condensate. The sudden discharge of the trap drops the pressure in the exchanger; the heat transfer drops, the steam valve opens, and the pressure goes up too high. This can be avoided by use of condensate receivers outside the exchanger with a level control valve, which is sized to give smooth rates of condensate flow with little effect on steam pressure in the exchanger. This is an expensive set-up but is sometimes justified. It may also be used for control by covering a portion of the surface with condensate. On all condensing units provision must be made to remove the non-condensable gases from the system.

All, and I mean all, heat exchangers should have the piping and nozzles arranged so that the tube bundle and the shell may be removed without disturbing the connecting piping and shut-off valves. (Automobile radiators, for example, are not so arranged.)

It is very desirable to have couplings installed on each inlet and outlet stream for thermometers and pressure gauges. These couplings may not always be used, but it is difficult to cut into a flowing line and install couplings when test data are required, and it is fairly easy to unplug a coupling.

The accompanying Table of Basic Formulas for Film Coefficients summarizes the required information for very elementary estimation of heat transfer coefficients for the most commonly occurring cases. It is difficult, if not impossible, to set forth in a short paper, such as this, more than the most elementary concepts. In almost all cases final design of heat transfer equipment should be made or at least checked by a specialist in the field.

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Accident Prevention in Cottonseed Oil Mills

E. B. FREE, Safety Director, Western Cottonoil Company, Abilene, Texas

THE president of one of the larger aircraft corporations has said, "A good safety record, in my opinion, is the proof as well as the result of competent management." Management can have the kind of safety record it wants. In order to have a good record it is necessary to interest management first. If everyone under management is not interested, difficulties will be encountered. One disinterested person in an organization can tear down interest faster than several others can build it. It has been our observation that an employee cannot be forced to be safety-minded. If he cannot be sold on the idea, it is far better to replace him with someone who can be sold.

The following data have been taken from *Accident Facts*, published by the National Safety Council for the year 1952:

Industrial Deaths	15,000
Industrial Injuries	2,100,000
Killed in off-the-job Accidents	34,500
Accidental Deaths in the Home	29,500
Accidental Injuries in the Home	4,400,000
Motor Vehicle Deaths	38,000
Motor Vehicle Injuries	1,350,000

According to the National Safety Council, every 20 minutes four people are killed and 360 injured, with the costs amounting to $300,000 during that time.

Industry is doing something about accident prevention, so is the Department of Public Safety, but the only way to do something about home accidents is by doing such a thorough job of training men on the job that they will carry it with them to their homes and apply the principles of safety off-the-job. The Department of Public Safety is doing an excellent job of accident prevention, but they have an extremely difficult problem.

Select Your Men

The first important prerequisite in accident prevention is to select your men. I mean, really look them over. You want to select a man who is not only physically able but who is mentally capable of comprehending and carrying out instructions. The examining physician in most cases is in no better position to judge his mental condition than you are if you actually sit down and take his application. In a lot of cases however I must admit that our examining physician has been very cooperative in helping us keep from our payroll some fellow who, although physically sound, did not have the mental capacity to work safely around machinery.

When you have taken the man's application, check the references which he has given you. You will find these very helpful. Having passed him yourself, send him to the examining physician for a physical. There are various standards for physicals. Your company doctor will be glad to assist you in working out a standard to fit your needs. Our applicants are rated A, B, C, or D. A, of course, is the best and capable of doing any kind of work. Class B are those who are fit for any job but have temporary, curable or correctable defects, such as bad teeth, bad tonsils, etc. Class

C limits the applicant to certain jobs only, and, of course, class D is usually rejected. In our organization class C or D applicants are to be passed by the Safety Department before being placed on the payroll.

Having passed all preliminary requirements, your applicant reports for duty and is placed on the payroll. We have found that indoctrination pays untold dividends. Take the new employee to the department head and have him, if you do not have time, explain the work that is expected of him with special emphasis on the hazards of the job. One of our superintendents, who has been very successful in reducing accidents in his mill, each week takes all new employees into a room where there will be no interruptions and talks to them in an informal way about the company, some of our projects and accomplishments, not neglecting of course the accident prevention program. We have found it to our advantage in some cases to explain to the new employees the benefits he is entitled to under the State Compensation Insurance laws.

It is not always the new employee that is injured. One analysis we made revealed that 65% of all accidents occurred to employees who had had less than one year of service. Of course, most of our employees had been with us less than one year. About 25% occurred to employees with less than one month of service. The rate kept going down until six-year service was reached, then the rate started rising again. It was most interesting to note that the peak of accidents was around 10:30 a.m. to 11:00 a.m. and 2:30 to 3:00 p.m. We were unable to find out why this was true however so our finding was of no consequence.

Some Employees Are Repeaters

It is a generally known fact that some employees are accident-prone. We made a survey of such men in our organization with a view of helping them and at the same time helping ourselves. A member of the Safety Department with the superintendent would call on the man and discuss each of his accidents with him, stressing the fact that it was in the spirit of helpfulness. Almost invariably the employee did not realize he had had the number of accidents the records showed. With his consent we had an up-to-date physical examination made by our company physician and his eyes examined by a competent eye specialist with the understanding that if he needed glasses he would pay for them. We paid for the examination however. We checked the record of one employee who had been with us for 25 years. In the last 10 years he had had 10 accidents, nine of which were injuries to the hand. The last accident took his hand off when he attempted to brush a piece of lint from the mote board with his hand instead of using the stick which he carried in his hip pocket for that purpose.

Of the 35 accident-prone employees interviewed, only one showed any resentment. He quit his job because of our investigation. All the others seemed to appreciate the interest shown by us. In the two years following our investigation only one of these men had an accident whereas before the investigation they had been having two accidents each per year. We have every reason to believe therefore that in this two-year period we prevented 139 accidents.

The Purpose of This Short Course

As I understand it, the purpose of this short course is to cover oil milling problems from the seed dump to the finished products. I think we have had accidents occur in every department of the mill, as well as on the truck and at the gins, long before reaching the mill. One employee fell off his truck while packing seed down, breaking his arm. Another fell off the seed dump, breaking his arm. More fatal accidents occur in the seed house than any other part of the mill. Seed cave-ins take their share of lives. We have done considerable work on that particular type of hazard and hope we have it corrected. Our method is to cave the seed from the top and equip the employee doing the work with a standard belt and life line. We have had this procedure made compulsory by having top management issue the instructions. We have had several serious injuries and two fatalities on screw conveyors in the seed house. We have eliminated this hazard by replacing the screw conveyors with belt drags.

Last year we had a very serious injury in the cleaning room when a belt on a Reeves variable drive broke, striking an employee in the face. A hazard of this type should always be guarded even though you may feel, as we did in that case, that it was guarded by position.

Time will not permit me to call attention to all the accidents I could name in the various department of an oil mill. I would like to say however that in the linter room you have the linters, which are always dangerous and should be shown a lot of respect. I can think of nothing that can do more damage to fingers and hands in a short time than can oil mill linter saws. The guards should always be kept on the chains and sprockets of the lint beaters. We had a man lose a finger on one of those at one time, and he was the one guilty of leaving off the guard.

We have had several injuries on the separator by men sticking their hands too far into the machine while it was operating. We placed tags on the machine, showing "A man was injured here" and giving a description of the accident, but still they would put their hands into the machine. We now have a sign on the machine, simply stating "do not put hand in this machine while it is running." As it has now been two years since we have had an injury on that machine, maybe the sign has turned the trick.

We have had only one serious injury in the roll room. This employee and a helper were taking down the top roll when he lost his footing, falling to the floor. He broke a leg, a wrist, and a vertebra. He was incapacitated for more than a year, but when he was able, he came back to work and has not had an injury since. That occurred some six years ago.

The hydraulic press room is the scene of various strains and sprains due to shoving pans and pulling cakes. Sometime we had injuries from slipping on the floor. The screw presses have eliminated a number of hazards in the press room but not all of them. One of our employees lost a finger in the chain and sprocket at the back of a certain type expeller. These guards should always be kept on. We have but few accidents in the meal room; however a man lost his life a few years ago when he attempted to hold a belt on the pulley with his foot and his trousers caught on

the shaft. The solution to that is, do not use that method to hold the belt on the pulley.

Most of our accidents in the cake and meal warehouse occur when an employee tries to tear down a stack by pulling one sack out of the corner of the stack and the stack falls on him. We finally broke up this procedure when we had two serious injuries in this way in consecutive years. We had an employee lose his life when he jumped from the top of one oil storage tank to another. The top of the tank gave away, and he fell into the tank of oil. Our superintendent was standing there, telling him not to jump.

It appears from our experience that after you have applied all your knowledge toward accident prevention, you will still have some accidents. Heaven only knows what our record might have been had we not had a safety department. Through the efforts of our department and the cooperation of management, supervisors, and the employees we have had our compensation insurance rate reduced from a debit of 93% of the base rate to a low of 19% credit.

Accidents can be prevented. It behooves us therefore to employ the highest type labor available, indoctrinate them in the job assigned to them, and follow up. The best safety device in the world is between the ears of the individual employee.

Present Practices in Industrial Water Conditioning

BERT I. THORNGREN, Maintenance Engineering Corporation, Houston, Texas

OUR industrial economy demands an abundance and a great variety of raw materials. The one universal and most important of these is water. It is required in larger quantities than any other raw material: for example, to produce one ton of gasoline requires 15 tons of water, one ton of steel requires 100 tons of water, and the production of one ton of rayon utilizes 830 tons of water. Furthermore for almost every other raw material some substitute has been developed, but not for water.

The use of water by industry may be classed in three general categories, as follows: a) as a source of heat and energy through the generation of steam; b) as a cooling medium, and c) as a raw material in the manufacturing process itself.

In each of these applications of the utilization of water serious difficulties and economic losses can develop—and often do. In the generation of steam we must combat such problems as:

1. Scale.
2. Adherent sludge.
3. Corrosion of boiler metal.
4. Priming or "carry-over."
5. Turbine corrosion.
6. Turbine depositions.
7. Corrosion of condensate return systems.

In the cooling systems of industrial plants, where the majority of all the heat generated in the operations must be dissipated, numerous problems present themselves, such as:

1. Scale and/or sludge depositions.
2. Corrosion.
3. Bacteria and algae.
4. Cooling tower deterioration.

Where water is used in the actual manufacturing of a given product, varied difficulties are encountered. These may take the form of one or several of the following:

1. Discoloration due to the presence of iron or manganese.
2. Precipitation of calcium soaps.
3. Undesirable bacterial growth.
4. Corrosion of equipment.
5. High total dissolved solids.
6. High turbidity and suspended matter.

Let us then review briefly what has been accomplished in the way of properly conditioning water to offset these problems. This field of scientific endeavor had its beginning about 100 years ago, when it was first realized that ordinary hardness in water, the cause of scale and sludge deposition, could be decreased by the addition of lime. Shortly after this the discovery was made that, under certain conditions, even further softening could be accomplished by the addition of sodium carbonate, or, soda ash. Thus came into being the cold lime-soda process of hardness removal from water for general uses. From this meager beginning advancement has been made until today most or all of the difficulties can be overcome by proper choice of treating methods, correct design of equipment, and exact control and operation.

THIS discussion will be a review of the methods available for treatment of boiler water and cooling water. For boiler water conditioning let us divide the subject into two parts: a) pre-treatment or external treatment and b) internal treatment.

By external treatment we mean any treating done before the water is fed to the boilers. Here is the field where the greatest advances have been made, and careful judgment must be exercised to select properly the correct method of treatment for the best and most economical results. A review of the various methods available and recent developments are in order.

The old lime-soda process has already been mentioned. This method is still used extensively. Basically, the process consists of adding sufficient lime to react with the bicarbonates present in the water or, in other words, to remove the "so-called" temporary hardness, and then adding eenough sodium carbonate to remove the permanent hardness. Coagulants, such as aluminum sulfate, ferrous or feerric sulfate, and sodium aluminate may or may not be used. The major advancement accomplished in the use of this process is the introduction of the so-called sludge contact or sludge blanket equipment. In these units the raw water and freshly added treating chemicals are passed through a blanket of sludge, or a large volume of sludge is circulated so as to come in contact with the incoming water. The usual recirculation ratio is about 5 to 1. By this method residual hardness values of 2 gpg. readily can be obtained. The advantages of this development are: a) more complete utilization of chemicals added; b) less area required for plant installation; and c) smaller capital investment.