The Technical Application of Fixed Fire-Protection Systems

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For many years previous to World War II the design control of fixed fire-protection systems was by a rigid set of simple rules, based on successful results as far as insurance dollar losses were concerned. However war with its attendant shortages of materials forced a closer look at the efficiency of such systems and brought the profession of fire-protection engineering into a recognized position.

This discussion will attempt to highlight the engineering thinking evolved over the last 15 years, which will bear strongly on future evaluation of fire protection systems which your company may need.

Sprinkler Systems

The sprinkler system is a mass-protection unit which covers every area of any building it protects and is expected to prevent major loss to that building by fire. As a tool it handles a large majority of the fire protection problems. It is designed to control fires that spread at a relatively slow rate to a small area by the use of sealed sprinklers, which open only over the fire area, or to discharge water in advance of a fast-spreading fire by quick detection operation of entire systems of open sprinklers.

Criteria for design of such systems were established minimum distances between sprinkler heads and maximum area protected per sprinkler head. Water supplies were capable of maintaining 15 p.s.i. flowing pressure at the highest point of the sprinkler system when selected flows such as 500, 750, 1,000, 1,500 g.p.m. were flowing through water mains.

These criteria produced a very high degree of successful control operations. However in the early 1940's inadequate water distribution was noted in some cases when they were applied to large open-sprinkler systems installed in airplane hangars. C. M. Wood, a civil engineer from Georgia Tech (for whom I had the good fortune to work), then developed an hydraulic design method which overcame the unequal distribution of water in deluge open-sprinkler systems that could occur when the current standards were used.

Hydraulic design of this type brought into focus the new engineering concept of water density per square foot of floor area, which is now accepted as a design requirement for open-sprinkler systems.

Sealed-sprinkler systems, since total flow tests were not practical, because of their excellent success record did not come under close scrutiny for water density until the early 1950's when the rubber industry desired to pile rubber tires much higher than had been their previous practice. Both the Underwriters Laboratories Inc. and the Factory Mutual Laboratory made extensive studies of rubber tire fires, and the requirements promulgated from these tests are based on density of water discharge per square foot and on an additional engineering factor, the minimum area to be protected by the sprinkler system. Since the fire tests on rubber tires other hazards such as whiskey-rack warehouses and high piled storage have been studied. Sprinkler protection has been stated in the form of g.p.m./sq. ft. density and the minimum area protected.

It is predicted that design criteria for sealed-sprinkler systems will eventually be based on a minimum water density/sq. ft. of floor area to be discharged over a given minimum of the building area for a given minimum length of time. Such requirements will allow for maximum design efficiency of the sprinkler systems you buy. For the oil and fat industries some of the following figures may be reasonable:

Water Density—gallons per minute per square foot	
Vegetable oil	.2 to .4 g.p.m.
Warehouses—8 ft. to 20 ft. piles	.35 to .50
Cooling towers	.35 to .50
Process areas	.2 g.p.m.

These densities may be required for minimum areas between 2,000 and 5,000 sq. ft.

A study of your present sprinkler systems with your insurance engineer may reveal design deficiencies which could be easily overcome.

Special Sprinkler Systems

The most notable recent advance in special sprinkler systems was the adaptation of airfoam to the open-sprinkler system in 1948 and 1949. This system, now recognized by certain top fire-protection engineering groups, such as Factory Insurance Association and National Board of Fire Underwriters, gives a new dimension to the sprinkler system.

The foam-sprinkler system, in addition to the massive over-all protection of the sprinkler system, lays a vapor-sealing blanket over spilled flammable liquids. This will affect such engineering factors as water supply, drainage, etc., favorably to the point that over-all costs may be reduced while a more effective fire-protection system is installed.

Water-Spray Systems

These systems, developed more than 20 years ago, became well recognized when they were adapted to safety in rocket powder-plants. They are adaptable to protection of individual hazards rather than to general building protection. Their basic design uses the same principles of water density, area of protection, and duration of water supplies. In addition to these basic points, the systems are designed to accomplish the following: control of fire, extinguishment of fire, and prevention of damage by fire.

When you are involved in the purchase of such equipment, be sure to require full engineering information on these three points from your fire protection contractor in addition to basic design information.

Foam Systems

With the acceptance of mechanical or air foam materials by the armed services during World War II a new basic engineering concept was developed. For areas of flammable liquid storage where adequate spacing of storage was not practical, an air foam system was devised to create a vapor barrier over spilled flammable liquids. This vapor barrier is controlled by the same Underwriters' approved valves as a sprinkler system and has been accepted in several instances as a substitute for relocating and rebuilding too closely spaced flammable liquid storage. "Equivalent Isolation" by adequately designed foam systems has already substantially reduced fire-protection costs.

Carbon Dioxide

Fire protection by CO_2 for many years was limited in scope by the cost of storage in high pressure CO_2 cylinders; however approved fire-protection systems of low-pressure refrigerated CO_2 have now broken this barrier. Systems holding 12 tons or more of CO_2 are relatively common. Systems of such size using 50-lb. CO_2 bottles would have meant the use of 500 cylinders for each system.

Reasonable-cost mass-storage of CO_2 by the low-pressure method appears to make practical a longer duration of protection not before available on a commercially practical scale. This type of mass-CO_2 protection has now found application in such special risks as coal bunkers, and successful tests have been made on corn cobs and similar materials.

If you are called on to study hazard protection for special conditions, you will do well to consider this new dimension of CO_2 protection.

Dry Chemical

Fixed systems, using a dry chemical, are a comparatively new development in fire protection. The first printed standards were accepted by the National Fire Protection Association in 1957. Applications for its use are being constantly increased. It is especially adaptable where inerting of surface fire is indicated. Grease-covered ducts and linty surfaces indicate possible use of this type of system.

Alarm System

There are many forms of heat, smoke, infrared, and other types of detection available; each has its place in fire-protection design. Caution however must be taken in the selection of detection units since inherent weaknesses are not usually stated, *i.e.,* one type will operate from the reflection of light on ripples of puddles of water, another may be operated by simply waving a broom across its scanning area.

The most effective recent development is a detector which uses two fixed radio-active sources to ionize separate chambers. Products of combustion enter one chamber and upset the electrical balance, thus creating a signal.

The basic engineering of such systems should consider type of fire, size of fire, and desired speed of detection as fundamental.

Specialized Fire Control and Detection

The most noteworthy new development is the suppression of explosions before they can do appreciable damage.

Conclusion

Your insurance fire protection engineer is regularly dealing with all types of fire-protection systems. Give him your full cooperation, and study your fire-protection problems with the same engineering approach that you would give any mechanical or chemical engineering problem.

Integrated Processing of Peanut for the Separation of Major Constituents

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IN THE PRESENT-DAY METHODS of processing oil seeds the oil and cake are obtained by treating the seed in a screw-press and/or a solvent-extraction unit. The cake is generally used for livestock feed and fertilizer. To a limited extent it is also further processed to isolate the protein and obtain a carbohydrate meal as a by-product. Extensive work has been reported on the properties of the protein in the peanut meal as influenced by various processing conditions. It has been shown that high temperature and pressure employed during the mechanical expression of oil adversely affect the quality of the protein (2). Where a protein with minimum denaturation is required the meal is obtained by low-temperature solvent-extraction.

Heat degradation of the protein occurs also in the collagen during the degreasing of bones for the manufacture of glue. To avoid this degradation Chayen and Ashworth have developed an "impulse rendering" process (1). It is reported that this process removes the fat with minimum damage to the structure of the nonfat-matter in the raw material and thus makes possible the manufacture of high-class glue protein. Practical difficulties have been encountered in the application of this technique to vegetable oil seeds.

In view of the growing importance of vegetable proteins for enrichment of food and for industrial uses, attempts have been made to develop new methods for the recovery of oil and protein from the oilseeds, wherein high temperature and pressure are avoided. In some of these, dispersion of the oilseed in water has been used to effect a separation of the oil and protein from each other and from the other constituents. Sugarman has patented a process for the simultaneous extraction of oil and protein from peanuts and other oil-bearing materials, wherein the kernel is ground with water under optimum condi-