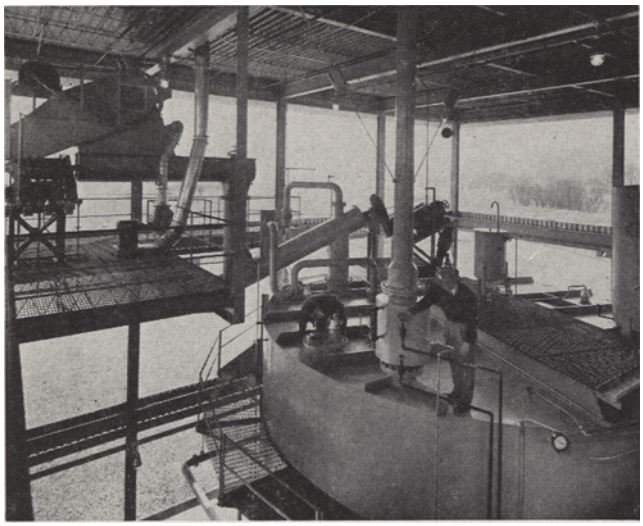

FIG. 3. Inclined wet-loading conveyor preceded by plug seal conveyor—an improved method of sealing the flake inlet to the extractor.

loading conveyor has made possible a major improvement in sealing the extractor at this point. Such an installation is shown in Figure 3. Additional safety features include a dry plug seal conveyor for the flakes ahead of the inclined seal conveyor and adequate aspiration on the head end of the flake elevator coming from the milling building. It is at this point that the previous mentioned sample for the combustible gas analyzer is taken. The safety of the older style, gate-loading device used on many basket extractors can be improved by providing ventilation to the outside for the upper loading device. A vertical stack through the roof will provide a good draft and normally will help to prevent any large amount of hexane vapor from seeping back to the milling building.

Maintenance Procedures. During maintenance shutdowns, safety rules must be enforced with special care. The large number of people in the plant, their relative unfamiliarity with the operation, and the fact that equipment containing solvent vapors may be open increase the chances for an accident and make careful education in, and strict enforcement of safety mandatory.

Purging and ventilating procedures for the extractor were mentioned previously. Building ventilation must be maintained at normal efficiency. It is also advisable to run aspiration fans, the vent fan, and any other similar equipment during the shutdown to provide additional ventilation.

Welding or flame-cutting operations should never be permitted within the extraction building or the surrounding area. Strict enforcement of this rule from top management on down not only eliminates a very potent hazard but also adds important emphasis to the whole safety program.

Processing Equipment Improvement. Mention should also be made of a significant number of process-equipment improvements which have been made during the past 10 years and which have contributed greatly toward safer operations. Among them are the following:

improved evaporators of the vertical rising-film type which have greatly reduced the quantity of miscella in process in the distillation system;
the use of bubble cap or disc and donut oil-stripping columns which are not likely to plug and therefore mean less danger of producing a low flash point oil;
the desolventizer-toaster which has greatly improved the meal-desolventizing operation;
mechanical and process improvements to extractors which have increased the operating reliability; and
simplification of the over-all plant design by improved layout and the use of fewer pieces of equipment to do a given job.

These remarks have been limited to hazards within the extraction building. Of course, safety is not confined to this building alone, but considerations involving the hazards of flammable liquids extend also to the milling building, boiler house, the solvent unloading station, the oil-loading station, and other facilities which may be adjacent to the extraction building. In addition, of course, each of these facilities has its own specific safety problems.

Personnel training for safe and efficient operation is another very important factor. As mentioned previously, there is no plant built which cannot be made unsafe by poor operating procedures. Personnel training, as well as engineering for safety, is a continuous job which deserves attention and supervision from each individual concerned with the operation of an extraction plant. The motto "Safety First" is not good enough in an extraction plant; rather it should be "Safety Must Be First."

REFERENCE

1. Marsh, W. S., "Fire and Explosion Hazards in Soyabean Processing Plants," 1947.

Safety Permeates All Manufacturing Operations

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JUST AS IN THE CASE of the Ten Commandments, plant design and operating procedures that are safe, from both a personnel and property standpoint, are ideals to which practically all can subscribe. Likewise most engineers or others concerned with plant design and operations find that it is much easier to subscribe to an ideal than to follow safe practices in the every-day conduct of the business. This is true for a number of reasons, not the least of which is the fact that safety permeates all manufacturing operations, whether it be the design of a soap kettle, the running of a solvent extractor, the handling of a truck, the layout of a milling room, the generation of hydrogen, the lighting in grain elevators, the removal of fumes from the laboratory, the power plant maintenance schedule, the wiring of office equipment, or the piping of the refrigeration unit. Although the unknown or the unexpected are lurking about all plants to a greater or lesser extent, one cannot gainsay the thesis that accidents don't

TABLE I
Kansas City Fire Losses

Year	Population	Number Killed	No. Killed per 100,000	Number Injured	No. Injured per 100,000	Dollars Lost	Dollars Lost per Capita
1940	399,000	3	0.8	82	23.0	$ 836,000	$2.09
1945	403,000	19	4.7	132	32.7	1,051,000	2.62
1950	456,000	12	2.7	167	36.6	1,746,000	3.84
1955	491,000	12	2.5	275	55.8	2,142,000	4.37

just happen; they usually are caused by somebody's ignorance or carelessness. Knowledge of the equipment employed, the raw and other materials used, the products manufactured, and the nature of the manufacturing processes help to hold accidents to a minimum as well as to reduce their severity.

Considering the foregoing, one might ask "are accidents becoming less frequent or less severe?" and "does the oil and fat industry have a safety record to which one can point with pride?" To be perfectly safe in answering these questions, one would have to resort to the fence-straddling technique of the politician who said, "yes and no, but don't quote me." However, for help in answering these questions, let us "take a look at the record" as another famous politician once said. In this connection it can be seen from Table I that fire losses in Kansas City (1) have increased since 1940 from the viewpoint of not only property loss but also of lives lost and persons injured. As reported in Chemical and Engineering News (2), 1955 was a banner year, safetywise, for the chemical industry as a whole with the frequency rate dropping 22% from 1954 to 3.21 disabling injuries per million man-hours; this enabled the chemical industry to rank sixth, after electrical equipment, aircraft manufacturing, cement, and automobiles, respectively. However, in severity rate, the chemical industry ranked seventeenth. But in spite of this fine showing for the chemical industry as a whole, it can be seen from Table II and Table III that the oil and fat industry left a lot to be desired from a safety-record standpoint; in fact, its frequency rate of 11.25 injuries per million man-hours was the highest in the chemical industry as a whole. On the other hand, the 4.0 million and 1.8 million injury-free man-hours accomplished respectively by Procter and Gamble Manufacturing Company's soap and glycerol plant at Long Beach and Buckeye Cotton Oil Company's oil and fat plant at Memphis gave them a rating of only fifteenth and nineteenth in the chemical industry in which nineteen categories were listed; the first or best was Du Pont's synthetic fiber plant at Old Hickory with 28.7 million injury-free man-hours.

TABLE II
Safety Performance in 1955 of Chemical Industry

18 Categories of which	Injuries per Million Man-Hours	Days Lost per Million Man-Hours
Oils and Fats were	11.25 or highest	570 or seventh
Fertilizer was	11.18 or second	3,447 or highest
Coal Tar Products were	6.74 or fifth	1,261 or second
Soap and Glycerol were	2.55 or eleventh	636 or fifth
Synthetic Fibers were	1.67 or sixteenth	138 or lowest
High Explosives were	1.63 or seventeenth	1,221 or third
Laboratories were	1.59 or fifteenth	231 or sixteenth
Paint and Varnish were	1.14 or lowest	307 or thirteenth

TABLE III
No-Injury Performance in 1955 of Chemical Industry

19 Categories of which	Company Operating	Plant Location	Millions Injury-free Man-hours
Synthetic Fibers were	Du Pont	Old Hickory, Tenn.	28.7 or highest
Paint and Varnish were	Du Pont	Parlin, N.J.	12.0 or second
Plastic Materials were	Visking	Clearing, Ill.	8.6 or sixth
Laboratories were	Du Pont	Wilmington, Del.	7.2 or eighth
Coal Tar Products were	Du Pont	Deepwater Point, N.J.	6.1 or twelfth
Soap and Glycerol were	Procter and Gamble	Long Beach, Calif.	4.0 or fifteenth
Fertilizer was	Monsanto	Anniston, Ala.	2.5 or sixteenth
Oils and Fats were	Buckeye Cotton Oil	Memphis, Tenn.	1.8 or nineteenth

It is realized, of course, that "it takes more than one swallow to make a summer" and that figures or statistics can be misleading unless carefully interpreted. This latter point is well illustrated by a Chicago Crime Commission report (3), which discussed some FBI figures indicating that juveniles under 18 years of age committed 49% of all burglaries in the nation. Although the record showed that 49% of all arrests for burglary involved juveniles, it so happened that only 29.6% of all burglaries were solved by any arrest; in other words, no one knows who committed 70% of the burglaries, but one conclusion could be that it apparently is easier to apprehend youthful amateurs than the older professionals.

After making due allowance in this connection, one cannot escape the conclusion that the above data, in conjunction with several accidents within the industry which have been large enough or sufficiently spectacular to have attracted widespread attention, show the need for revitalized safety programs at most plants of the oil and fat industry as well as the establishment of an industry-wide attack on all plant-safety matters of a chemical or engineering nature. For this work the services of the skilled technician, rather than that of the well-meaning amateur, must be enlisted to a far greater extent than in the past.

The skilled or trained chemical engineer is necessary because there still are so much data within the industry relating to fire and health hazards that need collecting and studying from the viewpoint of scientific analysis. And in the broad field of safety which permeates all manufacturing operations in the oil and fat industry, there are so many opportunities for wandering along blind alleys and spending money on needless frills that it behooves management to encourage their chemists and engineers to take an active part in re-evaluating the old and developing the new in preventing and minimizing accidents. These men are qualified from a technical standpoint both because of their training and their every-day association with the problems at hand, an activity that may bring their health and well-being into jeopardy if an unsafe design or process is used. Therefore it is considered that the time has now come for the industry to make an organized attack on its various fire and health hazards rather than follow the individual plant or guerilla attack that has characterized past efforts along this line.

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2. "Safer Than Ever," Chemical and Engineering News, p. 4,434, September 10, 1956.
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