Technical Safety Symposium

The Solvent-Extraction Process Is Not as Hazardous as It Seems

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IN PONDERING RAMIFICATIONS of the fire hazard in plants of the oil and fat industry, particularly in solvent-extraction plants, there came to mind the story in which the optimist tells the pessimist to cheer up because "things are not as bad as they seem," to which the pessimist replies "no, but they seem so!"

There isn't any question but that the fire hazard in solvent-extraction plants is very real and of the first order of magnitude as the astronomers might say; but, even so, it is not as bad as it seems. This is particularly true on a comparative basis when one considers the other types of plants in the oil and fat industry that ordinarily are looked upon as not being unduly hazardous, if not relatively safe. Because so much has been said, often loosely, about "highly flammable solvent" and "dangerous extraction-process," most of the insurance people and those in the industry of a non-technical nature, as well as many of the engineering fraternity for that matter, will consider the foregoing as a strange thesis. However, if one digs for facts instead of jumping at conclusions, it is seen that the solvent-extraction process, when properly designed and operated, presents a fire hazard from a dollars and cents standpoint that is no greater than a number of other industry operations which are only little feared.

To play that back again more slowly: the solvent extraction-process, when properly designed and operated, presents no greater fire hazard from a cost standpoint than the pressure extraction-process or raw and finished products storage and handling. Aside from theoretical considerations, the general proof of this is seen in the data presented in Table I and Table II, taken chiefly from "Fire Record Bulletin FR 55–6" by the National Fire Protection Association, but some was obtained from personal communications and various newspaper and journal articles.

Data in Tables I and II do not reflect the complete fire record of the solvent and pressure oil-extraction industry; however it is considered sufficiently representative and complete to indicate the general trend as well as to highlight the fallacy of over-emphasizing the fire hazards of the solvent-extraction process while at the same time under-estimating the seriousness of the fire hazard resulting from dust, spontaneous combustion, or other things associated with pressure extraction or storage and handling of raw and finished products.

From Table I it is seen that fires at solvent-extraction plants resulted in an average property damage of about $253,000 per accident as compared to an average property damage of about $317,000 in the case of fires at pressure-extraction plants. From Table II it is seen that fires at plants storing and handling raw products, none of which involved the use of solvent in any way, resulted in an average property damage of about $266,000 per accident as compared to an average property damage of about $206,000 in the case of plants storing and handling finished products, only four of which were related to the use of solvent. But even though the property damage is lower in the case of solvent-extraction fires, it is sad that the loss of life is higher; in fact, if one disregards the accident in 1935 when the large-scale, solvent-extraction industry was relatively new in the United States, each major solvent-extraction plant fire has resulted in about one death as

TABLE I

Fire Record of Vegetable Oil Plants

Location	Date	Product	Damage	Deaths
Solvent Extraction				
Chicago, Ill.	Oct. 7, 1935	Soybeans	$600,000	11
Seattle, Wash.	July 6, 1948	Fish livers	450.000	4
St. Joseph, Mo.	July 13, 1948	Soybeans	5,000	2
Savage, Minn.	April 27, 1949	Soybeans	31,000	1
Richmond, Calif.	June 3, 1949	Tung nuts	43,500	1
Columbus, Ohio	Aug. 23, 1949	Soybeans	250,000	—
Belzoni, Miss.	Nov. 12, 1951	Soybeans	150,000	—
Cedar Rapids, Ia.	April 29, 1951	Soybeans	450,500	—
Minneapolis, Minn.	Feb. 14, 1955	Flaxseed	500,000	4
Chicago, Ill.	Sept. 2, 1955	Peppers	50,000	—
Average per accident			253,000	
Pressure Extraction				
Springfield, Ill.	Feb. 15, 1940	Soybeans	$150,000	—
Des Moines, Ia.	May 29, 1945	Soybeans	240,000	—
Tiptonville, Tenn.	Jan. 5, 1947	Soybeans	720,000	—
Eagle Grove, Ia.	Aug. 23, 1947	Soybeans	168,000	—
Mankato, Minn.	June 10, 1948	Soybeans	553,000	—
Norfolk, Va.	Nov. 1, 1950	Corngerm	178,000	—
Atlanta, Ga.	Nov. 28, 1952	Cottonseed	100,000	—
Sioux Falls, S.D.	June 7, 1953	Soybeans	466,500	—
Huntsville, Ala.	Dec. 27, 1953	Cottonseed	250,000	—
Troy, Ala.	Sept. 4, 1954	Cottonseed	160,000	—
Pine Bluff, Ark.	Sept. 17, 1956	Cottonseed	500,000	—
Average per accident			316,863	

TABLE II

Fire Record of Vegetable Oil Products Storage and Handling

Location	Date	Product	Damage	Deaths
Raw Products				
San Antonio, Tex.	Aug. 15, 1945	Peanuts	$410,500	—
Alexandria, La.	Feb. 10, 1947	Copra	585,000	—
West Memphis, Ark.	May 7, 1948	Soybeans	270,000	—
Tunica, Miss.	Oct. 22, 1948	Cottonseed	400,000	—
Frederick, Okla.	Nov. 5, 1948	Cottonseed	150,000	—
Okla. City, Okla.	Mar. 24, 1950	Cottonseed	32,000	—
Minneapolis, Minn.	Nov. 29, 1950	Flaxseed	375,000	—
Sikeston, Mo.	Dec. 26, 1950	Soybeans	200,000	—
Augusta, Ga.	Oct. 26, 1951	Cottonseed	375,000	—
Dothan, Ala.	Mar. 4, 1952	Cottonseed	3,000	—
Clayton, N. C.	June 25, 1952	Cottonseed	94,000	—
Davidson, N. C.	Oct. 2, 1952	Cottonseed	75,000	—
Sulphur Spgs., Tex.	Oct. 11, 1953	Cottonseed	355,000	—
Yazoo City, Miss.	Nov. 20, 1956	Cottonseed	400,000	—
Average per accident			266,035	
Finished Products				
Galesburg, Ill.	June 26, 1945	Soybeans	$400,000	—
St. Louis, Mo.	Feb. 25, 1945	Soybeans	32,500	—
McAlester, Okla.	Sept. 28, 1948	Cottonseed	75,000	—
Enterprise, Ala.	Sept. 8, 1949	Peanuts	15,000	—
Baden, Ont.	Nov. 19, 1949	Flaxseed	9,500	—
San Francisco, Cal.	April 10, 1951	Copra	785,000	—
Abilene, Tex.	Sept. 19, 1951	Cottonseed	30,000	1
Sherman, Tex.	Nov. 15, 1952	Cottonseed	24,000	1
Brooker, Fla.	May 5, 1954	Tung nuts	250,000	—
Long Beach, Cal.	Dec. 23, 1954	Flaxseed	800	—
Amarillo, Tex.	Nov. 15, 1956	Soybeans	300,000	—
Dallas, Tex.	Nov. 24, 1956	Cottonseed	550,000	3
Average per accident			205,983	

compared to no deaths in the case of pressure-extraction plant fires.

Attention is invited especially to the fact that, of the 47 accidents listed in Tables I and II, only 14 of these plant fires involved solvent whereas 33 did not involve the use of solvent in any way. Thus the handwriting on the wall is sufficiently plain that the management of the plants in the oil and fat industry should bestir themselves to greater awareness of and effort in combatting the fire hazard that permeates the entire industry, including pressure-extraction plants and storage and handling plants for both raw and finished products as well as solvent-extraction plants.

By way of criticizing the foregoing, one could point out that the solvent-extraction plants are newer, better designed, and more carefully protected from a fire-hazard standpoint than the older pressure-extraction plants and the storage and handling plants, thereby enabling them to show a comparatively better safety record even though the fire and explosion hazards are greater. It could be mentioned that there are more fires in these latter plants than in the solvent extraction plants because there are more of them. Likewise it might be explained that the accidents listed in Tables I and II do not cover all of the accidents, especially the numerous small fires, and if they did, solvent-extraction plants might not compare so favorably with the nonsolvent plants. But regardless of what explanations may be made or how detailed the analysis, the fact still remains that the data in Tables I and II are sufficient to show that solvent extraction is not the only culprit from a fire hazard standpoint. Dust has been a contributing if not the causative factor in several extraction-plant fires or explosions that have been attributed to solvent. Insurance firms and fire officials should not exuberantly apply rules and regulations for the construction and operation of solvent-extraction plants which increase costs unless the rules and regulations definitely make a tangible contribution from a safety standpoint.

For example, a number of insurance firms and fire officials make a fetish of requiring underground installation of solvent tanks and piping—a procedure that is more expensive from a first-cost standpoint and decidedly more treacherous and expensive from a trouble-shooting standpoint. It is debatable whether underground installations are safer than those above ground. Many chemical engineers and other technicians skilled in general plant-operations and related safety matters prefer the above-ground type of installation of tanks and piping from a fire-hazard standpoint (Figure 1). But regardless of what theoretical or other arguments might be advanced for requiring underground installation of tanks and piping, one certainly is entitled to question their scientific accuracy or justification when the newspaper (1) reports:

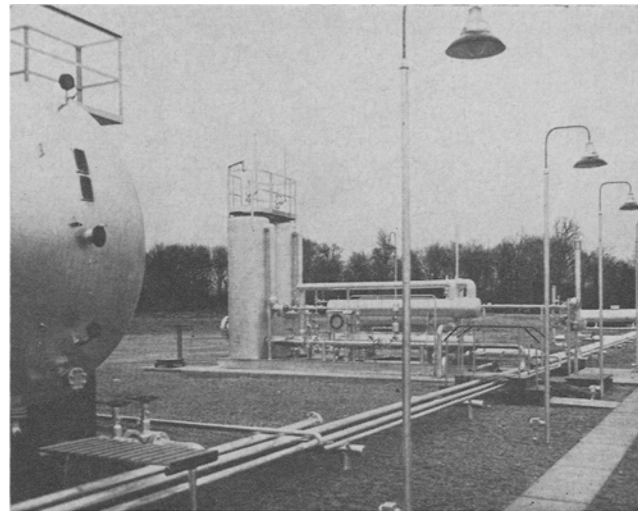

FIG. 1. Typical above-ground installation of tanks and piping.

> after weeks of living with a dangerously combustible situation, employees in a large office building are beginning to breathe normally since the baffling gasoline mystery has been solved after the building owners' expenditure of about $14,000 to eliminate extensive gasoline seepage into the basement. Apparently there is a submerged creek system in parts of downtown Kansas City, and this permitted movement of thousands of gallons of gasoline from defective underground storage tanks several blocks from the office building into which it was seeping.

Numerous other cases could be cited of fires, threats of fires, and other troubles that were traceable to underground storage and piping and largely would have been eliminated if the above-ground type of installation had been made.

In conclusion, everyone should be aware of the fact that safety permeates all manufacturing operations and that management, technical personnel, and operating engineers should recognize that other phases of their operations, as well as the solvent extraction process, deserve more careful consideration from a fire-hazard standpoint.

REFERENCE

1. Clark, Kim, The Kansas City Star, October 7, 1956.

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Foam Protection for Solvent-Extraction Plants

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ANY EXTRACTION PLANT using hexane or some solvent similar in nature lives with the always-present possibility of fire which, in some cases, may be accompanied by more or less severe pressure waves. That the industry has experienced no greater number of fires than it has is a tribute to the care and watchfulness of all who are concerned with the operation of the plants. The lives and well-being of the men employed in the plants depend upon the continued efforts of all. Property can be insured and the plant that has been destroyed can be rebuilt, but there is no way to call back to life the man who has died in the fire that destroyed the plant. We can only bend every effort to keep him alive. The men who work in solvent