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

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 combating 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 techni-
cians 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:

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


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plants have reason to be grateful to top management for willingness to make substantial investments to contribute to safety in the plants and for willingness to close down plants when conditions call for shutdowns to secure safe operating conditions even at sometimes heavy costs.

The fire may originate in either of two general areas. It may start in some piece of processing equipment, or it may begin in some part of the surrounding area. The history of our industry is that most of the fires and by far most of the property losses and injuries to personnel have been the result of fires that took place outside the processing vessels. This discussion will therefore be concerned only with fire in the extraction plant, outside of the processing equipment.

We all know that in order to start a solvent fire we must have two conditions present at one and the same time. We must have a space that contains solvent vapor in concentration that falls within the limits of flammability, and we must have concurrently within the same space a spot at elevated temperature. This spot can be the result of a very large number of things. To name but a few, electrical sparks or arcs caused by static potentials, voltages induced by lightning, arcs caused by the careless or uninformed fellow who grounded his electric welding machine to a pipe perhaps half a mile away, mechanical sparks, smoldering oil-soaked insulation, and so on. It follows that if we can keep the solvent confined to its designated containers, we can have no fire in the space which we mention. Likewise, if we can keep every ignition source out of the space, we can have no fire. Note that this space of which we speak can, under certain conditions, extend for a surprisingly long distance, possibly for as far as half a mile. Our first line of defence is set up by the two required conditions for fire. Keep the solvent where it belongs and keep ignition sources away.

Ideally no more than the above is required for complete safety. Practically the solvent does sometimes get out of bounds, and mishaps do occur that could ignite the solvent vapor if present in the right concentration. Probably some persons have waded in liquid solvent or in visible layers of solvent waste high. They may have been wet to the skin with liquid solvent, and certainly many have breathed in enough solvent vapor to be thoroughly intoxicated. Probably the same ones have been present when something happened that would certainly have ignited vapor had there been any there to ignite. Most of us who have seen the two requisites for fire are most happy to be alive to say that we did not see both of the fire requirements at the same time.

These two essential elements for fire have one thing in common with a plain old crap game. Roll the dice a sufficient number of times, and snake eyes will jump up. You lose. Spill solvent enough times and have ignition spots enough times, and it becomes mathematical certainty that the two will get together, and again you lose. The results will make newspaper headlines.

Accepting the fact that solvent will get loose now and then, it would be desirable to have as little in the extraction area as possible and to get the spilled solvent out of the extraction area to some safe place as speedily as possible. Some plants drain any spilled solvent to a holding pit located out of the extraction area where the chance that it will become ignited is as remote as possible. The quantity of fuel within the extraction area might be minimized by locating certain containers in or above this holding pit. For example, the water-separator tank might be located above the holding pit, and the amount of solvent in it would not provide fuel for a fire in the extraction area.

In most of the fires which the industry has experienced, the fire was extinguished only when there was no available fuel remaining to be burned. Obviously, if it is not possible to extinguish the fire, then the smaller the volume of fuel, the shorter the duration of the fire.

Once solvent has been spilled into the extraction area, it is desirable to keep it in liquid phase as far as possible and to remove and dissipate any vapor as speedily as possible. In some plants natural means have been relied upon for the dissipation and removal of solvent vapors. It is interesting to note that most of the fires in such plants have taken place at times when there was no perceptible wind.

The Minneapolis Fire Prevention Bureau desires to have the extraction building purged continuously at the rate of 20 changes of atmosphere per hour. Our first reaction to this idea was that it represented an unreasonably high rate. The longer we thought about it, the more logical the idea seemed to be. Twenty changes per hour may amount to 50,000 CFM or more, and a huge solvent spill would be required to maintain a vapor concentration equal to the lower limit of flammability for a very long period of time. Depending upon the efficiency of design, the solvent vapor would be very rapidly diluted and the space occupied by vapor of flammable concentration would be very limited. Limited hazardous space and shortened hazardous time both tend to reduce the chance of fire.

The vaporizing of spilled liquid solvent can be reduced or terminated by either of two methods. Previously mentioned has been the idea of draining it out of the extraction area, and the drainage might be hastened by flushing with water. A second method utilizes foam. Foam can be released to cover the solvent that has been spilled and will effectively terminate the vaporizing of any solvent that can be covered. While foam cannot deal with every condition that can arise, it can substantially reduce the quantity of fuel available to support fire; it can effectively reduce the space occupied by vapor, and it can effectively reduce the time interval during which vapor is present. Each of these reductions lessens the chance for fire to break out, and will tend to decrease both the intensity and duration of the fire if it does take place.

To prevent the fire is much to be preferred over extinguishing or, as with most solvent-plant fires, allowing the fire to consume all of the available fuel. While we try in every way we can to prevent the outbreak of fire, we do have to consider that sometime we may actually have an extraction-plant fire. If we have a fire, we would certainly want to extinguish it just as quickly as possible. To put out the fire something more than plain water will be needed.

We have been privileged to see the results of several extraction-plant fires. Some of the completely destroyed plants were supposedly protected by auto-