

Date February 13, 1973

To W. L. Watson, Calvert City Subject VINYL CHLORIDE SAFETY ASSOCIATION

From J. T. Barr, Calvert City MEETING - ATLANTA, JANUARY, 1973
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cc: N. H. Brock, Jr./Trexlerstown
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J. A. Marts/Pensacola/42
E. A. Primeau/Pensacola/42
F. L. Riddle
G. F. Sieckmann
M. H. Stermon

The fifth meeting of the Vinyl Chloride Safety Association was held in Atlanta on January 31-February 1, 1973. Approximately 55 persons representing the 31 member companies from seven countries and the United States attended. Also attending from APCI were Roy McGinnis of Calvert City, who has issued a brief summary report, and John Marts of Pensacola, who has a tape recording of the entire proceedings.

New officers for the forthcoming year were elected as follows:

President - Rdy Asti, Stauffer
Vice Chairman - Joe Mudd, General Tire
Program Chairman - B. Bradford
Secretary - P. Bogard, Tenneco
Treasurer - L. Rogers

Two subjects were brought up for a general discussion. One involved the permanent storage of the official tapes of the proceedings. S. J. Moll of Borden volunteered to act as permanent caretaker for these tapes. There was an extensive discussion regarding making these tapes available for use by members.

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It was decided that the original tapes, themselves would remain in Mr. Moll's custody and that each representative would discuss with his Management the wisdom of preparing duplicates which could be used as a lending library. The second subject involved the preparation of industry-wide standard practices and procedures. This has been an item which a number of members have wished to develop, but have met resistance from some representatives on a basis that these standards could become regulations imposed by federal agencies in the future. Others feel that it is better for the organization to develop these standards than to have it done for them by these agencies. The representatives were asked to discuss this with their Management also. Mr. Carey has authorized me to notify the Association that we are in favor of proceeding with both programs, and a letter so stating has been sent to Mr. Asti. In the meantime, Mr. Bogard will attempt to develop a prototype standard procedure on ventilation of slurry tanks for the consideration of the group. Mr. Ed Biehl of Pantasote is particularly interested in developing these standards, and has offered to act as coordinator for any future program for either all or part of the members of the Association.

Tenneco Explosion

The first formal discussion was a report by Pete Bogard of Tenneco on the recent explosion in their blend tanks. A 25,000-gallon stainless steel cone-bottomed tank which was equipped with a 10 ft. long agitator shaft, bearing two turbine blades and a vortex breaker ring suspended by four legs from the bottom turbine, was involved in an explosion. Most of the tank lid, agitator and walkways were blown about 75 ft. in the air and landed some 54 ft. away in a road. Investigation disclosed that two of the hanger brackets for the vortex agitator had failed sometime in the past, and that the third one failed at the time of the incident causing an imbalance in the agitator which allowed the shaft to rub against the tank cover developing enough energy to ignite the vapor. There were no serious injuries, although three persons were examined at a hospital. There was extensive damage to nearby building walls, pipe and associated equipment. The tank was "operationally empty" at the time of the incident, but the agitator was turning. The material fed to these tanks had been thoroughly stripped to the best of their knowledge. At the time of the explosion the rarefaction wave stripped the bolts on the cover of the adjacent tank, and the flame front ignited the vapors in that tank at the manway. The resulting fire burned for about 20 minutes

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without flashing back into the tank vapor space, and it is apparent that the tank was above the upper explosion limit. He was not certain if the fire went out by itself or was put out by the action of the fire brigade.

In the ensuing discussion, it developed that several persons, including Conoco and BFG, had had minor incidents similar to these in the past. Conoco had a minor "lift" about four years ago, and BFG about ten years ago. At the time of their incident, Conoco installed facilities for purging with inert gas, but these are no longer in use by them, nor by a show of hands by anyone else in the industry. Also by a show of hands, no one uses a suppression system. Several companies indicated they did vent and/or purge to greater or less degree. About one-third of the people indicated they have open hatches, most of them with man savers on them while the remainder seemed to have closed tanks of one sort or another, two or three using bolted lids, as did Tenneco.

The most common procedure in industry is to sweep air through the tank to a discharge system. Borden states that they pull about 3,000 cfm across a 14 ft. diameter tank. They depend on the greater density of the cold air to sink in the tank and get mixing and have no special agitation. BFG stated that they have checked the concentration of vapors in their tanks, and they and many others stated that without some means of purging the concentration consistently runs above the lower explosive limit. One company who does use the purging system stated they had vapor detectors in the exit stack and normally recorded about 10% of the LEL in the exhaust line.

Alternate methods of safeguarding the system were discussed. Calculations by Tenneco consistently showed that if roof venting were used to safeguard from damage, more than one-half of the area of the tank would be needed. The use of steam for sparging the space was not thought to be safe because of the probable static, but almost all use some sort of water spray which could cause the same problem. Only four companies indicated that they had steady bearings in some of their tanks.

Borden has taken the following steps to prevent reoccurrence: they turn off the agitator when the tank is empty; they have replaced the steel near the shaft with a 1/2" lead plate so that stainless steel cannot strike against stainless steel, and removed the cap seal on the shaft; the vortex breaker has been placed on the tank outlet rather than on the agitator; they now

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blanket with nitrogen on a once-through basis and are considering installation of a subsurface nitrogen feed to be recirculated in some form not described. The exit gases pass through a 4" vent 65 ft. in height with a conservation vent and flame arrestor, and they have placed counterbalanced lids rather than bolted lids on the manways. They have removed the sight glasses and lights from their tanks and placed the agitator start-stop station, the rinse water valve and level indicator at ground level to avoid having men on top of the tanks except when necessary for maintenance.

It was pointed out by several persons that care should be taken when using nitrogen purging in the presence of a J&W detector because of the effect of nitrogen on its accuracy and because of the saturation effect which occurs in the detector cell itself when it is exposed to concentrations above the flammable limit.

Goodyear spot checks the monomer content of their stripped slurry on about two batches per shift by extracting the slurry with hexane and analyzing by VPC. Their specification is less than 0.15%. This requires very good stripping and results in an improvement in efficiency because of the improved record of vinyl chloride, but they reported that the blend tank vapor still is found to be within the explosive range most of the time.

All but two companies report that they use Class I, Group D electrical equipment in the slurry areas. Several have stated that centrifuge effluent and tank washings have triggered alarms on J&W systems, and that a hazardous electrical classification should extend at least through the centrifuge area and that the centrifuge effluent should be routed safely. Tenneco asks that anyone who has further information on this subject send it to them for inclusion in the proposed standards which they are to prepare.

Industrial Fire Brigades

Mr. Dan McDonald of Ethyl Corporation described the procedures used in their plant for maintaining a trained fire brigade. They have a two hundred million dollar plant with about 2500 employees, and they are a member of a mutual aid system which involves about 70 nearby industrial and municipal organizations. The mutual aid system is connected by radio and is primarily used to maintain equipment lists for emergency use. Each company has its own brigade and does not generally assist in someone else's plant.

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The most important part of maintaining a good fire brigade was given as a sustained and continuing individualized effort to keep up the interest and confidence of the members. Discussion brought out that membership in the fire brigade was about evenly divided between a volunteer basis and a condition of employment. It was reported to be very important that there be some incentive for the members, but this usually takes the form of annual dinners, uniforms, small token presents such as jackets or caps, and most important of all, the opportunity to actually fight fires on a regular basis.

Ethyl began their training with a basic fire fighting course which lasted one day. It familiarized the men with the equipment they would be using and gave them a chance to use fog nozzles as protection to approach equipment and valves which needed to be operated. This was followed by a one-week school at Texas A&M with an annual one-day refresher course at LSU. The inplant training consists of two hours every two months for each shift group. The men are paid overtime for this two hours and their regular pay for the training session.

A short film was shown of the men participating in the LSU school where they extinguished five types of fires. These included an LPG Christmas tree fire, a standard oil pan fire, a fire in a distillation tower from which kerosene overflowed while burning, a simulated tank truck spill and ignition, and a dummy process unit. The use of air packs is considered normal training for all operators. The fire brigade receives special training in hose handling and self protection while engaging in fighting a fire.

ICI stated that they had found the most efficient material for fighting this type fire was a high-expansion protein based foam used at a dilution of 400-600:1. Dry powder is good for only very small fires and only for temporary control. If a large fire is to be extinguished, this foam is the only one which they have found useful. The brand name in England is Angus HEP, Pyrene has an equivalent.

Tenneco stated that they had found the adjustable non-creeping portable monitors manufactured by Akron or Stank to be very useful. Considerable emphasis was put on the fact that fog was necessary for personnel protection while handling monitors or

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high pressure lines and that, therefore, it was usually necessary to have multiple hose lines, although it is possible to buy a combination fog and stream nozzle so that the men operating this line do have some fog protection.

The above discussion led into some discussion of bomb scares. There has been one bomb scare at Keysor Century since the last meeting. Those commenting on the subject stated that they had been advised by their local police that the wisest thing to do was make as little fuss as possible when a bomb scare does occur because this is what the person is looking for, and if he finds that there is little disruption, he will have no incentive for a repeat call.

FIA - SRI Program

The luncheon speaker was Mr. Bill Doyle, lately of FIA, who reported on the status of the industry-sponsored program at Southern Research Institute. This program originally had three objectives. The first was to measure the dispersion of the vinyl chloride vapors by water spray. It was found quickly that sprays were not effective in reducing vapor concentrations in closed areas. The second question then was why do sprinklers appear to help in normal plant situations to give an apparent reduction of vapor concentration. This was found to be because of dilution by entrained air through the air movement caused by the water from the sprinkler heads.

The third and most extensive part of the program has been the test chamber work to see what effect sprinkler heads have on the flame front propagation after an ignition. This work has been delayed far beyond the initial target date because of weather conditions and the fact that it turned out to be a more difficult problem than was anticipated. In brief summary, it has been found that ordinary sprinkler heads are of very little effect while Rockwell "T" heads are slightly better in the long run. It does not appear that sprinkler or deluge systems will have any significant effect on wave front propagation.

A film was shown of the test chamber and several tests made with ethylene and vinyl chloride vapor. These fell into two classes in which a stoichiometric mixture of the air and gas under test was ignited by an electrical squib in a 10 x 10 x 15 test chamber,

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the walls of which were made of polyethylene film. Tests were performed with and without sprinkler heads being operated and were filmed by high speed movie cameras at approximately 1,000 frames per second from two different directions.

The results show that the sprinkler is completely ineffective in preventing the spread of the wave front, and in fact, increases the rate of the wave propagation. In ethylene the rate of movement was estimated at 50 ft. per second in a quiet chamber and 70-80 ft. with the sprinkler head on. The numbers for vinyl chloride were 30 and 50 ft. per second respectively. This difference is attributed to the fact that turbulent wave fronts move more rapidly than do ones in a quiet condition, and that the sprinkler head caused sufficient air movements to give turbulent conditions. Some results have been reported by the Japanese in which they get a detonation in ethylenes, that is, a supersonic flame front speed with a very high energy source and that the film on similar test chambers shattered. The energy source used in this test was more than adequate to give good ignition, but apparently not sufficient to give the detonation. It was indicated that in an ethylene mixture a spray gives a 10:1 reduction in the probability of detonation occurring. The efficiency in vinyl chloride vapor is not known. One reason for this is the cooling of the surface, but it has also been reported by FM that the LEL is raised by a water cloud. There have been other reports previously that a high humidity condition also provides a safer situation either because of a change in the LEL or by decreasing the energy of ignition sources. Some future work is to be done by FIA on this question of ignition energy levels.

It was brought out in the discussion that in any ordinary plant situation one should expect a turbulent wave front because of the effect of equipment and pipes on the spread of any vapor cloud and that, therefore, the higher propagation speeds mentioned before should be considered normal.

The Texas Eastman polyethylene plant explosion was a detonation which was set off by an exploding muffler when the vapors were sucked into the intake of a compressor. One compressor muffler was shattered outward and was considered the source of the ignition, while the remaining mufflers in the same area were compressed inward by the shock wave. Torches, tool sparks, and electrical sparks may not be adequate to set off a detonation. It is possible to get a self-induced detonation in a vapor cloud from turbulence and/or static in at least ethylene and hydrogen spills if a vapor cloud exists above certain size. Therefore, it is not necessary to have an external source of ignition to get a fire from a massive release.

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The question came up again of possible static ignition from sprinkler heads in an exploded mixture. Mr. Doyle stated that he believed the static danger was less than the benefit gained from having the deluge system working. Some work in Southhampton, England on explosions in large tanks has shown that droplets falling through the vapor cloud were adequate to ignite the mixture, but this is thought to be a special case. In support of Mr. Doyle's belief, it should be pointed out that in every test chamber experiment done by SRI that the sprinklers were turned on for 2-3 minutes after the mixture had been placed in the test chamber to give good mixing, and then were turned off for those in which the tests would be run without the presence of water. In no case was there any ignition from the sprinkler heads.

The work yet to be done at SRI is to go back and repeat some of these test chamber ignitions with a lower energy ignition source, located more nearly in the center of the test chamber rather than to one side as the previous tests were done. This is expected to be complete by July, 1973. Films were shown of several of the tests, and the flame front was clearly visible in the high speed film. In those tests in which water was not used, the polyethylene chamber walls burned vigorously, but in those tests during the time the sprinklers were running, the film did not burn but merely burst and released the pressure with little visible flame.

After the group reconvened, ICI showed slides of damage done to their polyethylene compressor area. They have built this plant as a totally open plant with only a roof, and they estimate that using sprinkler heads with 0.3 gallons per sq. ft. will give them 100 changes per hour in the area effected by the spray. This requires a special building design to allow this much air to move, and they had to eliminate the usual ventilator on the roof ridge. They found this construction much cheaper and safer than the use of auxiliary blowers and suppression devices.

OSHA Inspections

Mr. R. Vath of Pantasote reported the result of a two-day inspection at their injection molding plant which has 60 employees. The inspector arrived at the plant early in the morning, introduced himself, and showed his credentials. He started with a one-hour discussion in the office of the plant manager on the standard requirements, such as records, first aid, fire brigades and similar subjects. He then spent an hour with representatives of the

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bargaining unit. It developed that the union had requested the inspection because of a failure by the company to correct what the employees thought were several unsafe conditions, primarily wet and slippery floors, and that there was a very poor working relationship between the company and employees, especially as regards to safety. The inspector then checked Form 100 and made a random check of Form 101. From this he pointed out that there was a significant trend in the high incidents of foreign bodies in the eyes, and cited the company for a poor eye protection program. He was very careful to repeat the rights and responsibilities of the company, himself, and the employees, and seemed sincere in his intent to insure a good safety program.

After these discussions, he toured the plant with two representatives from management and two from the union, carrying a Polaroid camera, a velometer and audiometer. He checked the velocity in all of the paint booths, the solvent storage facilities and similar points of possible fire danger. This was not a chemical plant, therefore, there were relatively few of these places. He found one place where the bushing on the wiring to a grinder had pulled loose and the wires were being rubbed. When management called an electrician to fix this problem immediately, he did not cite the company for this.

The inspector looked more for unsafe actions than unsafe conditions. This may have been due in part to the discussions that he had had with the employees and a statement he made later to management in which he called the employees attitude toward safety very poor. The company received a citation for a man sitting on the tines of a fork lift truck cleaning equipment with compressed air at greater than 30 lbs., but he also stated to management that he suspected this might be a setup deliberately staged by the employees. He nevertheless did give a citation. There was a citation for exposure to fumes when he found a man cleaning an oil spill with solvent. He also cited them for having oil on the floor. There were a total of 22 citations, five of which called for fines totaling \$270, and they were given various times to make corrections. This occurred several months ago, and he has not returned on a follow-up check, and stated that fewer than 10% of the inspections were followed up. All of the citations issued were for conditions which are on the OSHA list of most commonly cited violations.

The company was told to get started on an ear conservation program, and given a number of other generally helpful suggestions by the inspector.

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In the discussion which followed, it was generally agreed that the OSHA regulations do not speak specifically to the cleaning of employees clothes by air hose whether or not they have the 30 lb. limit surface. It was the general opinion of the group that air cleaning of clothes should be expressly forbidden in all cases, that dusty conditions which require cleaning of clothes should be corrected, that clean uniforms should be supplied when conditions are bad enough to warrant, and if clothes are to be cleaned while worn, it should be done with a vacuum cleaner and not an air hose.

General Tire reported that they had received an inspection by OSHA in their PVC Plant when one of their employees complained to OSHA that a neighboring plant was emitting odors that were annoying in the General Tire area. When the inspector came to visit the offending plant it was closed, so he made a quick walk through of the General Tire Plant and gave them four minor citations. He did follow up with a reinspection which covered only the citations issued in the prior inspection, and when he found that one had not been corrected in the time limit he had established, he raised the fine from \$30 to \$3,000.

B. F. Goodrich has had an inspection at their Calvert Plant, of which we were aware, and have had a NIOSH inspection at their Louisville Compounding Plant. This happened only three weeks before the meeting, and at that time they had had no report back, but the inspector had taken samples for particulates and lead. This points up the fact that not only OSHA but a variety of other governmental agencies have the right to enter and inspect operating plants.

In regard to the Pantasote inspection, it developed during the discussion that OSHA regulations require a visible velometer readout on all spray booths, with explosion proof fittings within 20 ft. We should review our painting practices, especially in the Instrument Shop, with this in mind.

Recent Accident Experiences

1. J. Mudd of General Tire reported on two major spills which have occurred in their plants in the past year. In the first case they were in the middle of major maintenance shutdown with all utilities off, except a portable generator being run to supply the boilers. In preparing to steam clean a vinyl

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chloride line, the line was broken at two points and steamed between these two connections. A branch section of the line was opened at a Victolic coupling which apparently was under tension and sprang open several inches when the coupling was released. Approximately 4,000 lbs. of vinyl chloride escaped. This was due to the fact that there was a blind in the line near where it branched from the main section and that the indicator on a plug valve was installed wrong allowing the monomer to drop from a tank, and because the Victolic coupling had sprung open, it could not be reclosed quickly. The vinyl chloride got into the sewer which sloped toward the boiler area. The deluge system was manually operated. The boiler was shut down and steam purged, and a weir gate in the sewer was closed. This prevented an ignition of the vapor cloud, and a favorable wind prevented it spreading to an ignition source. A 6 ft. high cake of ice developed in the area where the vinyl chloride was concentrated, and it took several hours with a fire hose to thaw this ice and relieve the trapped monomer.

Their second spill occurred in a storage area where a 15,000-gallon carbon steel horizontal tank was used for monomer storage. There was a 4" valve on a bottom nozzle which had a companion flange threaded for 3/4" which bore a valve and a line to the sewer. The operator periodically bled off water from the bottom of this tank to the sewer and had gotten into the practice of leaving the 4" main valve open. In this case, when he opened the 3/4" valve, the line broke off and he could not close the 4" valve because of disuse. The operator left the area to sound an alarm, went back inside the diked area to attempt again to close the valve, was overcome by vinyl chloride fumes, collapsed, and was rescued by people coming to answer the alarm. An estimated 2,000 gallons of vinyl chloride was drained into the dike area, where fortunately the drain valve was closed. The man recovered with only two days absence from work, and the monomer again was dispersed by a favorable wind without further incident. They have revised their operating procedures to keep the 4" valve closed and locked except when in service, and all small lines are now welded rather than threaded. They have also installed a spill procedure. The alarm for it activates an intermittent siren which is different from the fire alarm. When this alarm sounds, a lab technician proceeds to the boiler with an explosion meter, the guard stops all traffic on the nearby streets, and management reports to

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the spill area to make a decision as to its disposal. In the case just discussed, it was decided to activate the deluge system to increase the boil-off rate of the monomer. In this case, it also resulted in considerable freezing, and it required more than two hours to dissipate the vapor cloud.

This prompted considerable discussion from the floor as to what to do with the spill. ICI stated that in their major storage area they have the diked area sloped to a sump pit where it is possible to pump the majority of the spilled material back to a spare storage tank. Deluge systems are useful and speed up the boil-off but result in extensive ice. Foam is useful for slowing down the boil-off, if this is desirable, by insulating it. Flaring was not considered desirable because of the large quantities involved and the formation of hydrogen chloride. Previous reports have discussed the desirability of having a diking condition that allows the spilled liquid to flow to an area away from the storage tank so that should it ignite, the tanks are not enveloped in flame. General Tire expressed the opinion that they favored the use of deluge systems to slow the dispersion (which was contrary to their statement about increasing the boil-off rate given above) in order to reduce the size of the cloud and allow safe dispersion under prevailing conditions. It appears obvious that there is no pat answer for any one given situation.

One person stated that they had bought and used large excess flow valves manufactured by MGM and suggested that these be installed on all bottom nozzles of storage tanks.

2. Mr. Young of ICI reported an incident in which a 50-ton capacity recovery vinyl chloride storage tank had been out of use for about ten weeks, supposedly empty. Upon an attempt to recommission the tank, it was found that a section between block valves was plugged. An operator opened a manometer connection in this section and some green liquid began to flow out. A part of this was caught in a drum and a part spilled on the gravel. The operator first noticed a crackling underfoot, and then a loud bang. The diked area was flooded with water and alkali was added and the solution stirred with a hose. When the hose sprayed against some uncovered gravel, there was a further explosion. It is obvious that this was

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caused by a concentrated peroxide which had been left in the tank upon the venting of the monomer when the tank had been taken out of service sometime before, and that with time the remaining vinyl chloride had formed these polymeric peroxides.

ICI studied this material very thoroughly and described it as a soft white putty-like solid, smelling of formaldehyde, which floated on water because of entrapped gases, and which explodes upon heating to 97°C or upon impact or friction but does not completely destroy itself, and the residues can be hit again and again with an explosion upon each impact. The impact energy required to explode was estimated at 1.34 Joules when wet and 0.64 when dry. This compares with 10 Joules for benzoyl peroxide which is considered to be very impact sensitive. The material is soluble in ordinary organic solvents and is decomposed in 4% sodium hydroxide at 43°C. It was shown by spectograph to be a peroxide of vinyl chloride and not vinyl acetate, which could also have been present in this particular situation.

They filled the empty storage tanks slowly with water, injected sodium hydroxide solution, and then heated the tank slowly to 80°C, drained, opened, and entered, and found it to be safe after this treatment. They now analyze their recovered monomer for oxygen and try to hold the oxygen level below 2-300 ppm in the vapor space. They are using Nash pumps for monomer recovery and add an inhibitor Topanol at 5 parts per million, but without pH control. The general conclusions which were reached were that recovered monomer should not be stored any appreciable length of time. Two days was suggested as the extreme maximum, and most persons stated that they held theirs only a few hours. Tanks should not be vented without draining the liquid contents in order to avoid concentration of any peroxides that may be dissolved in the monomer. The drain water should be tested regularly for peroxide content. One company stated that they had put a riser pipe in the bottom of their storage spheres with an auxiliary nozzle so that they could add 20% sodium hydroxide in the volume below the outlet of the riser and that this solution was checked regularly and replaced when its concentration was depleted.

3. Pimsa reported that they found a man lying dead at the foot of a blend tank. Cause of death was a fractured skull. On the top of the tank they found some spilled resin and skid

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marks. They believe the man slipped and fell under the lower portion of the guard rail where there was 16" clearance. Alternatively, he may have been sitting on the railing and inhaled enough vinyl chloride vapor to become dizzy. There was a record that the man had taken drugs at a celebration some two weeks previously, but had appeared normal on the day of the accident. A detailed autopsy was not permitted by the family. As a result, they have raised the height of the rail around the blend tank top so that it is too high to sit on, and attached a cyclone fence so that a man cannot fall through. They have installed better lighting in the area and initiated a buddy system. They have also installed external level indicators so that it is not necessary for a man to peer into a tank to determine its level.

4. IRSA reported that a worker was found dead on top of a blend tank. He had been seen less than ten minutes earlier walking in another area of the plant. Autopsy showed a trace of barbituate in his blood, but the cause of death was given as heart failure due to lack of oxygen. The operators in this plant were thoroughly trained in first aid and applied mouth to mouth resuscitation without success. They have changed their operating procedure and now keep the lids closed on blend tanks. This man had apparently been attempting to hose out the tank because the tank was empty and a hose was found hanging in the manway. Shortly after the incident, they tested the vapor content of the tank and found 8,000 ppm vinyl chloride. This company had had a similar incident which did not result in a death three years ago in a polykettle, but this man was a sniffer and apparently deliberately got himself into this difficulty.
5. Dow reported that a man had finished cleaning one polykettle and was getting another ready. He proceeded to enter this second kettle without going through the normal vessel check procedures and was overcome. He was revived and survived, and stated that he had a loss of memory and has no recollection of entering the kettle or of any subsequent actions. The man had always had a good record as a safe worker, and it was concluded that he had been partially anesthetized by an excess of vinyl chloride.
6. Mr. Harold Beer of Diamond Shamrock reported that they use Lenape Forge manways at their Delaware City Plant. Over the years these gradually wore and required more force to close

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or open the handles. It had become a practice for the men there to use some mechanical assistance in placing the handles in the desired position. In this case, a reactor cleaner proceeded to the wrong reactor and was able to force the handle on a charged reactor so that the manway was able to rise against the stop and blew out the "O" ring gasket. The reactor was about three hours into the polymerization cycle, or an estimated 30% conversion. When the other men in the room heard the noise and looked toward the reactor, the cleaner was seen to be staggering down the aisle dazed and covered from head to foot with slurry. He remembers nothing of the incident. This appears to be a traumatic amnesia rather than anesthetization. The man had a record of good attendance and safety; however, since he had been promoted some three months earlier, there had been a series of operational mistakes which had resulted in BB's, over charges and dumps to the floor. The man was discharged after counseling him that it did not appear he was fitted for work in this type industry.

The vapor detector system returned to normal readings in about 20 minutes in the reactor area, which had ventilation equivalent to 12 changes per hour.

As has been reported earlier, several companies have interlocked their manway handles and bottom valve handles with the pressure instrument on the vessel so that an air cylinder operates a pin that prevents movement of either of these handles so long as the pressure indicator shows any positive pressure on the system.

BFG reported that a similar incident in which a man had partially closed the vessel but had not pulled the handle down into the final locking position. He was able to pull a vacuum on the vessel without detecting a leak under vacuum conditions, but when the vessel was charged with monomer, the lid raised partially and the charge was lost to the atmosphere.

BFG has promised to send us further information on the material of construction of their "O" rings. Whatever type they use they are able to reuse seemingly without any swelling problems, but they do recommend thorough cleaning of "O" rings and grooves and a light coating of Dow Silicone grease.

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7. Ed Biehl of Pantasote reported on two occurrences. In the first case the plant had experienced several power surges due to a bad voltage regulator in a local substation. When they finally lost power completely they had massive releases of vapor from the polykettles, but in two cases their Fike one-piece rupture discs did not fail. Mr. Fike himself investigated and tested the remaining discs from that lot, and felt that the discs had been installed wrong so that they were rocked in the holder and, therefore, did not fail. Mr. Fike emphasized to Pantasote that he had experienced several cases in which people did not maintain the vents between the rupture discs and relief valves, and that he was making it plain to all of his customers that he accepted no responsibility for failure for performance of rupture discs unless the vents were maintained adequately. Later in the day, further discussion on this point brought out the fact that there still is considerable difference between the way various companies handle this problem, and several companies still allow the gasses to vent directly into the reactor building, or use manual valves and pressure gauge and depend on operators checking to see if a pressure buildup has occurred. Neither of these is considered proper or safe.

In another incident at Pantasote, an operator tried to push recovered vinyl chloride out of a tank with DM water pressure. A check valve failed to shut, and vinyl chloride got back into the DM water tank and bulged the bottom seam. An identical occurrence happened a month later at their other plant.

They also reported that they had had a bomb scare and that they used a 1/2 pint of alpha-methyl styrene for each 2,200-gallon reactor to get a complete kill on the polymerization. This, of course, was with good agitation.

At this point, BFG admitted that they had once had a "pop" in a DM storage tank when vinyl chloride vapor had entered. In addition to preventing the entrance of vapor, they have now gone to bottom feed for their DM water to avoid the possibility of a static discharge.

8. Mr. Per Ranges of Norsk Hydro reported that when their plant reopened after the past Christmas holidays, an operator made a mistake and blew the water seal in their sewer system by

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releasing excessive amounts of vinyl chloride. This pressure then went to a concrete sewer pipe under the dryer building, and the pressure broke the pipe and lifted a section of the floor. This is a special situation because of the extreme cold weather in their area, and they would recommend that people use open trenches, as do we.

9. Mr. Dixon of Goodyear reported that in their bulk process reactor they have a 20" quick opening manway in which the hatch is of a rotating or submarine hatch type. This cover carries a 4" valved pipe. Shortly after charging the reactor, this cover in some manner rotated and broke off releasing the monomer into the building. Ignition apparently resulted from metal striking against metal. Four persons were injured, three from burns and one from jumping off a 20 ft. platform. They do not know the cause of failure, nor have they been able to determine the reason from discussion with their licensor or other licensees; however, they have drilled the flange and installed a safety pin which will prevent rotation of the head until the pin is removed.

He also reported that twice in a two-month period they lost their initiator freezer. These are large walkin freezers where they store ACSP and IPP and similar active initiators. Their practice was to have a lab man reuse old shipping containers to weigh out the individual reactor charges which were later carried to the reactor floor. Theirs is a mixed initiator system. They have changed their procedure now so that only clean fresh containers are used and housekeeping has been improved as have the instructions for the technicians. Both ICI and Conoco reported similar problems. When asked for a show of hands, eight companies stated that they had had a catalyst failure or loss in the past 12 months. There were several other persons who had their hands up until the man who asked the question added the time limit of 12 months, when they then put down their hands. It does appear that this is a continuing problem in the industry.

10. PPG reported that they had a monomer spill when a tank was overfilled. It is their practice to fill their storage tanks until the high level alarms come on, then by means of a charge pump to circulate the tank for mixing to take a sample for analysis. The operator misvalved the units and pumped from

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one full tank to another. This caused the relief valve to lift, and monomer was discharged into a common feed header which led to a vent stack that is purged with nitrogen gas. Sufficient liquid monomer was delivered to the bottom of the stack so that it vaporized and pumped liquid out of the top of the stack which was 110 ft. tall. The stack was only 100 ft. from their cracking furnaces. They have vapor detectors and HAP's and manual operators on their deluge systems. They got an alarm and a trip of the deluge which is made up of the Rockwell heads at 0.25 gals./sq. ft. The vapor cloud did reach their furnaces, and five burners were snuffed out, presumably from being fed an overly rich air mixture, but there was no indication of explosion or back propagation of the flame front. This may indicate that the deluge system was adequate to prevent flame propagation.

It was recommended by several persons that where possible all handling systems, monomer and otherwise, should be an intrinsic fail safe system in which the tank design is above the operating pump head. This is not possible, of course, in many cases.

11. Dow reported another case of misassembly of a Jamesbury valve being used as the bottom valve on a reactor. This was found before the reactor was charged when an adjacent reactor was dumped and slurry entered the vessel. Jamesbury has recognized this problem and has modified their valves up through 4" size, but not the larger sizes. Dow has field-modified the stems of all of their larger valves with a fillet and socket so that the stem cannot be inserted in the wrong position.

They also reported a case where a 3" Keystone butterfly valve was overtightened by using a cheater on the handle, and the stem bent 90° resulting in incorrect indication of the valve position. This incident resulted in only a slurry spill.

Sampling for Chlorinated Hydrocarbons

Mr. A. A. Allemang of Dow Chemical presented a paper describing the development of a portable instrument for sampling chlorinated hydrocarbon vapors. This was done so that they could attach one to a worker and get a history of his exposure throughout the normal working day. In brief, it consists of a Unico C-110 sampler fitted with a cartridge of activated carbon on the inlet. Air is pumped into this carbon bed throughout the day. The carbon is then

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extracted with carbon disulfide and analyzed by VPC. They have developed calibration curves for efficiency of absorption and desorption for about 20 materials, and use these to calculate the total exposure. This same instrument could, of course, be used in a stationary position to measure concentrations, and should be very easily adaptable to other materials.

A complete copy of the text of this paper, along with details on the instrument and its calibration, will be sent to each member of the Association. I strongly recommend that when we receive this, we proceed to purchase one unit at least and use it in our plants for exposure testing. The instrument is not expensive and is intrinsically safe and weighs only a few pounds. The new limit of 200 ppm of vinyl chloride for eight hours exposure requires us to maintain better records than we have up to this time.

Safety Problems in Monomer Plants

Mr. Sid Pitts of Conoco described some of the general safety precautions which are taken at their six hundred million pound polymer plant which was started up in 1968. In the storage area all the spheres are diked and deluged. They use vapor detectors to control the deluge systems, and in addition have HAD's and remote manual operation. They have a remote interlocked bottom valve and pump for the spheres, and they fill either from the bottom or through a top leg. They prefer the bottom filling and discharge.

All tank cars and trucks are checked before loading. They use a solid line for a top filling, with Chicsan joints and Hamer couplings. They have a vent recovery system for air pollution abatement and safety. If cars are to be entered, they are purged with nitrogen and entered under nitrogen atmosphere using proper safety precautions. They have learned from experience that it is necessary to check the excess flow valve on the bottom of a tank regularly every time a car is entered, and more times than not they find that these valves are inoperative, being frozen in an open position. Therefore, they are not to be depended upon. They have also had some trouble with dome bolts working loose and leaks developing in this area.

Their barge loading facilities also have a recovery system at the dock and have remote shutoff on all lines at three different locations near the dock.

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All workers in their plant have regular blood and urine analyses done. Thus far, in no case have they ever found any unusual results.

Their vapor detector alarms are set to give the first signal at 20% of LEL and the second signal at 40%. Their control room air intake is shut off if vapors are detected in the neighborhood. This is because they do not have available to them a safe place for an air intake to maintain pressurization. They, therefore, prefer to stop air flow rather than risk drawing in vinyl chloride.

In the discussion that followed, it developed that most companies who unload use flexible lines rather than solid, and they confirm that either the excess flow valves don't work, or that they work at a value considerably below their supposed design of 250 gpm. The most common method of grounding is with a set screw clamp rather than a spring load clamp, with the cable leading to the central plant grid system and not simply to a pipe or nearby structure.

In a discussion which developed after the final meeting, the question was asked how many persons check the gasket on the agitator nozzle on a regular basis. One person stated that they did so on a regular basis once a year. Two companies said they were studying the problem. One company said they checked only on startup of a new reactor when they normally experienced about a 25% failure, and two companies said that the agitator gaskets were checked whenever maintenance work was done on the agitator or shaft. The rest of the companies apparently have no preventive maintenance program in this area.

J. T. Barr
J. T. BARR

JTB:sl

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AIR PRODUCTS & CHEMICALS, INC.

CHEMICALS GROUP

CALVERT CITY, KENTUCKY

TECHNICAL DEPARTMENT

TRIP REPORT

VINYL CHLORIDE SAFETY ASSOCIATION

JOHN T. BARR

NOVEMBER 19, 1971

Place: Rochester, New York

Date: November 10-12, 1971

Personnel: John T. Barr

Report By: John T. Barr

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The third formal meeting of the Vinyl Chloride Safety Association was held at Rochester, New York on November 10-12, 1971. Formal minutes of the meeting will be issued by the secretary and will be circulated when received. This report contains notes taken on items of special interest to us.

The first day's session was devoted to a business session and a discussion of peroxide handling, with a trip to the Lucidol plant. The writer was not present.

1. The agenda was continued on the second day with a discussion of welding practices by the writer. Comments from the floor indicated general concurrence with the policies and procedures used at Calvert. A few persons reported emergency work was done in operating plants using fire blankets and wetted work areas. Most problems occur when contractors or other persons unfamiliar with the process are involved.
2. W. J. Bradford of Olin outlined the emergency procedures used at the Thompson plant. He emphasized the following points for assuring a satisfactory procedure.
 - a. Have specific job assignments, with overlapping duties, to assure complete coverage.
 - b. Review and drill frequently. Fire and reactor rescue drills are given each shift monthly.
 - c. Keep simple, short, and have the outline posted at work areas.
 - d. Revise and update frequently, using feedback from drills and safety meetings.

Discussion from the floor revealed that FIA requires a similar system at the plants it covers. Many plants have cooperative programs with nearby installations similar to our CIMAP. Some of these have installed leased telephone lines in lieu of radio systems.

About eight plants have emergency power generators. Two or three reported successful use of venting to mix isoprene in cases of power failure, one reported an unsuccessful attempt. One quart of isoprene per thousand gallons of vessel was adequate, and slow venting through a 3-inch valve gave sufficient mixing without foam carryover.

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3. W. J. Boyle, Jr. of Monsanto described a job safety analysis program very similar to our safe work practice system. An outline of his program is attached. It is derived from a longer paper by F. R. Barnako of Bethlehem Steel, a copy of which I have. It was emphasized that a poorly done job was worse than none. One participant reported that their plant was in serious trouble with safety, production, and quality. They shut the plant down, analyzed every job from the standpoint of safety, and rewrote their procedures. The result was a great improvement in production rates and quality. Other persons reported similar results when safety procedures were incorporated into the body of the operating instructions.

Strong supervision, and frequently strong disciplinary action, is needed to enforce a safety program. Spot checks and reprimands were mentioned by many. Union understanding and cooperation is a basic requirement.

4. W. Miringoff of Hooker led the discussion on bulk monomer handling. Reference is made to the Houston Loss Prevention Symposium of 1969, AIChE Loss Prevention Vol. 3, in our library. A major problem is oxygen and resultant peroxides and corrosion. A maximum level of 500 ppm in the vapor phase was recommended. Hays and Teledyne oxygen meters were reported as satisfactory for this purpose. The problem is most acute with those who receive monomer by rail, and in recovery systems. Bulk storage and rundown tanks may be vented to recovery systems to hold down the vapor phase oxygen level.

Emphasis was placed on vacuum-tight recovery systems. Persons using Nash compressors again reported fewer problems than those using reciprocating compressors. One person described a peroxide-initiated explosion in a knock out pot very similar to the one we experienced two years ago. Tenneco uses a 5 psig inert gas line on the stuffing boxes of their compressors so that if a leak develops no air can enter.

The question of dikes was discussed again. Most governmental and voluntary standards require dikes, but many feel that this traps any resulting fire under the tank. Some use runoff areas, with dike drains locked open, or tanks on the upper side of a sloped area.

Copper and brass now appear to be accepted materials of construction. Aluminum is not, particularly in the presence of moisture. Teflon is in disrepute because of porosity and its tendency to act as a growth site for polymer.

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Several expressed concern at the poor maintenance given road beds by rail companies, and the increasing frequency of accidents related to this cause. Barge shipments offer increasing hazards. A barge loaded with tanks recently broached off Holland and several tanks were broken loose. These were recovered without incident even though a 2-inch header was opened. A number of cities now limit severely the number of cars that may be in storage at any one time. There will be a DOT hearing in Houston in the near future on this general subject.

5. It was voted that the Association should proceed as rapidly as possible to prepare a set of industry-wide minimum safety standards. The new officers were instructed to organize committees to accomplish this.
6. W. M. Iliff of Uniroyal described their pressure vessel inspection programs. Several states, including Pennsylvania, Ohio, and New Jersey, require annual inspection of unfired vessels, as does a rising number of insurance carriers. Uniroyal has a file for each vessel, with a peel-out view on a grid for recording data. A plot of findings is kept and used to determine corrective action. Inspection includes internal and external visual checks, Branson Sonoray or equivalent on spot checks, hydrostat at 1.5 times rating (except glass lined) plus a hammer test, and drilling and miking on suspect areas. About half the producers have a similar program. Almost no problems have been found with fresh monomer tanks, but much more frequent difficulty is experienced in recovery systems. Some inspect vulnerable areas such as KO pots and rundown tanks every three months. Reactor jackets are included in the program. Duplicates of the test results are filed with the insurance carrier, and the state in some cases.
7. C. E. Bowman of Union Carbide described their program. It is computer based, which prints out a list of scheduled vessels every six months. Their unfired vessels rated over 50 lbs. are tested every five years. Every reactor is tested with inert gas at 160 psig after every opening (1-10 batches). The openings are soaped, and the pressure is allowed no more than a 1 psi drop in 15 minutes. They have double bottom valves on Lenape Manways. They then cover the bottom valve with water, pull a full vacuum and look for bubbles.

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There was much diversity of testing procedures and frequencies. Some companies had instituted a program of gasket replacement, to find that many failed very quickly, especially on unsound flange faces. The recommended procedure seems to be to run to failure, but with a regular program of retorquing, especially around the agitator mounting.

Industry practice is to test glassed vessels at rated pressure only, and to set relief valves and rupture disks very close to that pressure, and not as low as FIA had requested of us. Reverse buckling disks are growing in popularity, and teflon-lined or protected disks are waning.

8. C. G. Thompson of Tenneco discussed the required level of supervision. Old congested plants require a higher level of supervision than do newer plants to give the same degree of safety and proficiency. Sensor systems, better instrumentation and interlock and alarm systems, greater physical separations, and better layout make new plants inherently safer. Larger computer controlled plants are the coming thing. The total number of people will not decrease, but productivity does increase. Two persons have visited the 80-reactor computer controlled plant of Huls (Chemical Engineering, March 9, 1970) and gave very favorable reports. The computer cost is given as \$750 M-\$1,250 M per 100 MM lbs., with the lower figure for larger reactors. Tenneco describes their new plant as semi-automated and programmed for charging and dumping, with many interlocks and alarms, and manual override if needed. Conoco says about the same thing of their new plant. It is reputed to have stainless reactors. Those working in this area are generally developing their own systems, and feel that the development fee requested by Foxboro is excessive.

As the result of their Flemington fire Tenneco issued completely new operating and emergency procedures, installed a training and safety foreman, added one operating foreman per shift to make a total of two, and requires that the polymer area foreman remains in the polymer area. He must file daily a check sheet to show that he has followed at least one batch completely through all steps, and checked both men and equipment. They estimate that these added safety steps cost about 1% of sales, and payout on safety equipment another 1%, or a total of about 0.2¢/lb. Total cost at Burlington last year was about \$500 M. The older plants must play catch-up.

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New hires are on 30-day probation. After their first check-in day they spend one or more days with the general foreman, then a similar time with the area shift foreman, for training in operating and emergency procedures. He then spends a week with a buddy, observing only. A test is then given by the training foreman. If he passes, he is rerated every ten days by the general foreman and reviewed after three ratings to determine if he will be made permanent. About 75-85% are kept.

They are installing a video tape system to prepare training films on the job. They spend at least 2 hrs./mo./man in formal safety training and 2 hrs. more informally.

An area foreman has about 8 people to supervise, a maintenance foreman 12-15. Every supervisor in the plant, including the plant manager, must turn in two cards every day giving the name of a person he has talked to about safety, and the topic.

This plan was decided on after 6 months planning after it became obvious that an improvement was needed. It has been in operation about 6 weeks. Others present who have used similar intensive programs say that they need revision at intervals to maintain interest.

About half the plants have full-time safety men at the site, and about half of these are technically trained.

9. As of the first week of November, FIA had \$35,000 pledged to the vapor cloud dispersion test program, and thus it is assured of proceeding.
10. Peter Bogart of Tenneco discussed their corporate experience with OSHA. None of their PVC plants had been inspected, but some other operations had. The quality of the Federal inspectors was high, but they gave only superficial inspections, not going into details of the processes. This is expected to change as they gain more experience. About 3,000 citations are recorded to date, most being on fairly simple type violations. A summary of the most frequent type of violation is attached.

The inspector first meets with supervision, and goes over the required records, and asks about safety programs, meetings and inspections, operating and emergency manuals, and similar indications of management attitude. Next comes

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the walk-through, with a check for required postings, house-keeping, and "nitty-gritty" type violations. The union is entitled to be present only at this time. Afterwards, the inspector meets again with supervision. At this time some negotiation is possible, and violations that are fixed on the spot may be forgiven. Attitude and cooperation are given high consideration, but some said that each inspector felt that he must find something wrong, and in every case they could.

Employees are required to be notified of any hazardous condition, noise, dust, vapors, etc. and of allowable exposures. Records must be kept of exposure and hazard levels. Citations must be posted at the site of violation. Personal protection is to be used only on an interim basis, or after all engineering efforts have been made, and not on a permanent basis or as a substitute for permanent correction of an unsafe condition.

It was recommended strongly that plants make their own practice inspections with an eye to the listed types of violations. Foremen, safety men, technical people and supervision should be trained in certain segments of the requirements of the law and then used as inspection teams.

Lead dust in compounding plants was mentioned as a particularly difficult problem to control and one that is usually on the inspection check list.

The most damaging thing that can happen is to have an employee state, after a violation is found, "I've been telling them about that for six months at safety meetings." One possible defense is to ask the inspector to talk to other employees.

11. S. A. Lemaster reported on the monomer sniffing problem. There have been six fatalities in recent years because of vinyl chloride inhalation. These were considered accidental, and occurred not because of monomer toxicity, but because of its efficiency as an anesthetic and depressant effect on the central nervous system at relatively low levels. A potentially more serious and growing problem is addiction to sniffing vinyl chloride. This has no long-term organic effect, as does carbon tetrachloride, trichloroethylene, vinylidene chloride, or other solvents, but may lead to accidental overdose and thus death. In addition the combination of low blood oxygen and high adrenalin level can lead to fibrillation and almost certain

death. There have been 110 cases of this type of deaths reported in the general public in the last ten years, most due to glue or Freon inhalation.

The usual sniffer is an emotionally upset and immature person, similar to those susceptible to alcoholism. Annual physicals have shown no particular sensitivity or susceptibility to monomer in any of those found to practice the habit.

Several companies reported finding employees in positions pointing to deliberate self exposure. Some resulted in near-fatal incidents. Most companies discharge those proven to be deliberately practicing sniffing.

12. H. E. Kling of American Chemical noted that there is pressure to reduce the present allowable 8-hour noise exposure from 90 to 85 db. The General Radio meter meets the calibration and accuracy standards, while the Scott meter does not. It is reported that duPont has an accumulative exposure meter.

The most effective methods of abating noise were given as design and specification of equipment; vibration dampeners; soundproofing by enclosure in boxes, rooms, or enclosures using a lead-vinyl curtain (Acustofab); or division of work areas by partitions. Curtains and reflective baffles were not particularly effective, nor were troweled-on mastics.

Many companies now post signs in high noise areas stating exposure limits. About two-thirds give hearing tests as part of the preemployment physical, and a number include the test in their annual reexam.

13. Recent accidents and near misses were reviewed.

Conoco now has one unit of their vapor detector on the air inlet to the control room to shut down the fan in case of a nearby spill. This is the result of the accident reported last meeting when a plug valve with an incorrect position indicator allowed a release of cracked DCE. Other companies reported that they had received incorrectly assembled valves from the factory, including a three-way valve intended for installation under twin reliefs that was closed in all positions.

Diamond reported workers hearing a crackling noise as they walked near the recovered monomer tanks, and inside pumps on startup. It was found to be peroxide, and a great

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quantity was found inside the tank. This caused difficulty in cleanout, since it is shock sensitive. They were also experiencing milky monomer, tank and header fouling, and high gels. They now inject ammonia to a pH of 7-9, vent the tanks to hold the vapor O_2 level below 1000 ppm (others recommend 500), take especial care to prevent leaks in the recovery section, and keep residence time below 1 day. This has eliminated the peroxides and improved product quality. Other members report that strong (<20%) sodium hydroxide or steaming to above 160°F also destroys peroxides safely.

Norsk Hydro reported five incidents, two of which resulted in fires. The first was similar to the Conoco problem, except that the plug was ice which melted and released material that ignited in a furnace. Three weeks' production was lost. A less serious fire resulted from a blown gasket in a quencher. Acid damage was almost as severe as fire damage in all cases. Their third incident was a leak in a steel and concrete underground tank when a plate buckled. This did not cause a fire. They also had an operator open a bottom valve on a freshly charged reactor. The water froze the valve open because of the expansion of the monomer and the entire 10-ton charge was dumped. It did not cause a fire, but was dissipated by a good cross draft in the building. To avoid this, some companies have gone to elaborate precautions - red and green lights at the valve activated by the pressure transmitter, double key locks on charging and dump valves, mechanical rod interlocks, air-operated valve actuators with internal pressure signal override, etc. ←

Their fifth incident was a runaway reactor. The operator saw the overpressure, opened the manual vent, heard the relief open, then saw several head gaskets blow. Glass damage inside the reactor was severe, and a PI Burdon tube was straightened. It was estimated that internal pressure reached 45 atmospheres. Rechecking the relief (4 x 6, with 2-inch orifice) showed it to open at 15 atm. as rated. The reactor was reglassed after annealing.

Conoco reported two similar incidents within a week when they experienced a sharp pressure rise with an apparent normal temperature. Shortstop was added and safe conditions restored. Most people felt that this was an overcharge of initiator or undercharge of suspending agent.

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Several persons warned against starting agitators in batches that had been charged accidentally with stopped reactors until after the batch was cooled by partial recovery or jacket water. This usually results in a sudden pressure surge and blown reliefs.

Ethyl reported a fire in a potassium persulfate run caused by contamination with potassium hydroxide. They also had a gasket blow under a relief valve when it reseated. Investigation showed that an undersize gasket had been used which resulted in a very small mating area.

Tenneco found a man overcome at a blend tank hatch. He had leaned over to hose it out because the spray rinse system was ineffective, and did not have a buddy with him as required. Conoco reported a similar experience, and American Chemical had a death earlier from the same cause. Practice varies widely in the industry, ranging from bolted and locked hatches to open tanks with forced ventilation, but most recognize the hazard from the vapor present. Many use "man-catchers" on all tank and silo manways. Some have remote call devices at out of the way positions to summon help. These range from radios and telephones to Freon-powered boat horns and home-made signalers made from garage door openers.

Pantasote furnished uniforms with no shirt pockets. They had found several cases of aluminum particles in the product which was finally traced to Magic-Markers falling out of pockets.

The Tenneco incident was the result of men not complying with known procedures because it was inconvenient, not enforced, and not supported by supervision. Two supervisors were fired and one demoted as the result, and it was one cause for the institution of the extensive safety training program described earlier.

Great American reported a case in which a cleaner and his buddy put the Copus blower in a reactor opened for cleaning and went for a smoke break. On returning about seven minutes later, one man went to check his reactors. When he arrived at the open reactor about five minutes later the other man was passed out at the bottom. He took the lanyard in but found he had no wristlets, and his belt broke. It took about 3 minutes to attach wristlets and haul him out, artificial respiration was applied, but he was dead on arrival. This is a

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case of an experienced man not performing any of the required safety checks on the entry permit.

Hooker asked New York State to allow substitution of a safety call device for the standby man, and got instead a requirement to use both. They expect OSHA to adopt this attitude. It is felt by many that it is only a matter of time until it will be forbidden for men to enter a reactor for routine cleaning.

Conoco uses a reactor stripper solution sold by Welco (Glenn Wellman, Cleveland, Ohio). Their cleaning equipment is not particularly satisfactory (it incorporates a Gamma jet). The solution recommended for stainless steel is particularly effective for glass-lined vessels. They like it better than high pressure water. A thousand gallons of solution lasts about one week. It is caustic, but not toxic.

Monsanto had an operator who dropped a wrench in an open, unpurged reactor and thought he could hold his breath long enough to retrieve it. He passed out, but a man nearby threw the Copus blower in and summoned help and he was removed with no permanent damage, although he suffered temporary renal impairment. They made a training film of a reenactment which has been very effective. Another company reported that a welder realized that he had not heard sounds from a man in a tank car, found him unconscious, and put his torch, with oxygen flowing, near him while he summoned help. The man recovered. Both these rescues were the result of intensive safety instruction and drill.

Goodrich uses 3000 lb. water lances with 36 in. minimum length. They had suffered two minor injuries in past years, one from a leak in a braided hose and the other a burst from a dropped gun. One reactor (not PVC) had internal coils, so they shortened the gun length to 20 inches. An operator stepped back off the agitator work platform and forgot to let go of the trigger, and injected enough water into his leg to swell it very badly. It was their first lost time accident in 12 years use of water blasters.

The writer asked about safety precautions used at car loading stations as the result of the recent fall at Calvert. Five companies use life lines, and reported several problems in enforcing their use. Spot checks after hours and disciplinary action was necessary to assure use. One problem that many worry about is the operator climbing up and down the car ladder with one hand full of samples, particularly on trucks where the ladder is mashed in to inadequate toe clearance. One company has a deak end track and has a walk platform to

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the car top from the building. Another tried a retractable side platform, but it was soon knocked down. Two had retractable ladders from above down to the car. Most have not faced up to the problem, but agree that it is a prime candidate for OSHA citations.

Allied reported a problem with a mechanical vacuum pump located in a non-explosion proof area used to evacuate reactors. Two instances occurred where the monomer charge line was opened before the vacuum line was closed. They moved the pump. The general consensus of feeling was that either the recovery vacuum system or a separate steam jet with vertical discharge was a better arrangement.

14. An effort was made to discuss the AOL problem. There is still a strong reluctance to discuss this subject except on the part of a very few companies. Pantasote has an active program with three consultants, two foreign. They began by x-raying hands every year, then suspect cases more often, up to 3 months. They have a workman's compensation case pending. It is their feeling that inhalation of VCl is the primary cause. Hooker has paid two lump sum awards in New York on arrested cases for \$9 M and \$4 M. Their doctor was trained at the University of Michigan. Conoco is starting a program, but has not decided who is to read the plates.

About 10 companies indicated that they had some sort of program. They were asked to send any information that they could share to the secretary, who will circulate it. Conoco and Pantasote promised to send me their program directly.

15. The very aptly named Mr. Courtney B. Justice, who is a lawyer acting as Special Assistant to the Administrator of EPA, was the luncheon speaker on the 11th. He gave a brief outline of the purpose and extent of OSHA. It was not unlike that which we have received from the various seminars given around here. He did say that he had been specifically authorized to state that the PVC industry was not considered a critical industry, and, therefore, would be subject only to routine checks in the absence of an accident or complaint. He emphasized that attitude and cooperation with the spirit of the law would be important. He suggested that if we had any questions or wished to make comments or protests, we could do so either through our regional office or directly to Mr. G. Guenther in Washington who is a special coordinator for such activities.

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16. The dinner speaker was Mr. Charles F. Kroshel of Bacharach Instruments. He discussed vapor detection systems and demonstrated the new intrinsically safe diffusion head which they are marketing at this time. They have also made some improvements in their electronics, such as installing a non-suppressible zero so that the operators cannot turn down the readings at points which give a constant low signal without setting off the alarm. He brought along no descriptive literature or price list, but I asked him to send me a complete set of all information on their most current models. They have been asked by EPA to develop a cheap portable instrument for use by field inspectors. To date they have not succeeded in designing one with the desired ruggedness and accuracy at the price EPA requested, which was somewhere under \$200.

Their present line of instruments feature a diffusion head rather than a conveyed sample, but an air aspirator can be placed in front of the head to generate air currents in a dead spot. They work on the heat of combustion principle rather than thermal conductivity, and their new model uses a platinum oxide coating on a ceramic bead rather than a hot platinum filament. This is supposed to make the instrument intrinsically safe even in the absence of a guard screen and also more rugged.

Lay out of the sensing heads is the key to success of the system and proper attention must, of course, be placed on the likely points of emission and the air currents in the area. The instrument is useful as a preventive maintenance tool, as well as a safety alarm, in that heads mounted near pumps and relief valves can give warning of small leaks so that the repairs can be made in a routine manner rather than on an emergency basis.

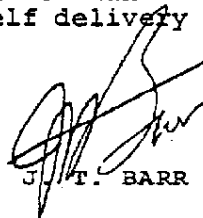
Bacharach is trying to improve its service capabilities, and presently has a repair shop in operation in Pittsburg in addition to the home office in California, and plans to have one in Texas within the next few months plus others which are under consideration.

There are at least four systems of the new type in operation, and those persons who admitted to having them were all extremely well pleased with their performance. One major point made was that they must not be hooked up to the deluge systems for some time after installation because it takes extensive retraining of the operators to avoid the supposedly minor spills and leaks which will set off the system. Great American claims that their monomer efficiency has increased

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by a minimum of 1.2% since the system has been installed, and Conoco and Tenneco confirmed that this was a very realistic figure. Operators are forced to adhere to proper practices, and many heretofore unrecognized leaks were discovered. Pantasote says that they still get at least one reading of 20% LEL every 36 hours on the average. Most companies have set their alarms to turn on the emergency fans at 20-30% of LEL and activate the deluge system at 50-60%. All report that there is nothing like getting the operators wet a few times to instill improved work practices.

As the result of the fatalities above under accidents, Great American had designed for them a remote head for their portable unit which has not only the sensing head, but a call button, and this is left in the reactor while men inside are doing any type of work. This portable instrument can be obtained with either 0-100% LEL or 0-1000 ppm for any specified common gas, and calibration charts can be furnished for any additional gas. It also can be equipped with a 0-25% oxygen scale. This instrument has been so successful that delivery is now quoted at greater than three months compared to essentially off the shelf delivery for the remainder of their equipment line.



J. T. BARR

JTB:sl

AP00050745

Most Common Citations by OSHA

CITATIONS

1. General Environmental Conditions.
2. Personal protective equipment, proper type, properly used, and properly maintained.
3. Safety Programs
4. Noise
5. Records
6. Fire Protection. Availability, Suitability, Sufficiency for Hazard, Training in Use.
7. Machine Guarding.
8. Bolting Down of Equipment used in a Fixed Location.
9. Misuse of Compressed Air.
10. Grounding.
11. Secure all Compressed Gas Cylinders.
12. Unguarded ventilating fans.
13. Unguarded forklift trucks.
14. Unguarded table saw.
15. Unguarded splitter.
16. Open electrical junction box.

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17. Unguarded "V" belt on air compressor.
18. High piled material.
19. Truck wheels not chocked.
20. Drill press not bolted down.
21. Exit sign light burned out.
22. Fire extinguishers not hung.
23. Beakers down knobs or loose,
24. Rough floor in kitchen, dirty floors,

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JOB SAFETY ANALYSIS

Vinyl Chloride Safety Association
November 10-12, 1971
Rochester, New York

William J. Boyle, Jr.
Monsanto Company
Springfield, Massachusetts

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SAFETY ANALYSIS

1. THROUGH THE EXPERIENCE AND KNOWLEDGE OF THOSE WHO PERFORM THE WORK, TO METHODICALLY IDENTIFY HAZARDS ASSOCIATED WITH THE WORK AND TO DEVELOP STEP BY STEP SAFE PROCEDURES WHICH ELIMINATE OR MINIMIZE THESE HAZARDS.
2. TO INCREASE EMPLOYE SAFETY AWARENESS AND IMPROVE SAFETY ATTITUDE BY EMPLOYE PARTICIPATION IN THE FORMULATION OF SAFE WORK PRACTICES.

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SEQUENCE OF ACTIONS

1. LIST ALL TASKS WITHIN THE DEPARTMENT:

- EXAMPLES:
- a. CHARGING A KETTLE
 - b. PREPARING PREMIX
 - c. BREAKING INTO A LINE

2. RANK THE LIST OF TASKS FOR ANALYSIS PRIORITY.

FIRST: THOSE TASKS HAVING THE HIGHEST FREQUENCY OF INJURIES.

SECOND: THOSE TASKS PRODUCING THE GREATEST NUMBER OF VIOLATIONS OR UNSAFE ACTS.

THIRD: THOSE TASKS THOUGHT TO BE PARTICULARLY HAZARDOUS EVEN THOUGH NO INJURIES MAY HAVE OCCURRED.

FOURTH: THOSE TASKS HAVING HIGH SEVERITY POTENTIAL.

3. BREAK THE TASK DOWN INTO STEPS:

*CAUTION -- NOT TOO DETAILED

NOT TOO GENERAL

- a. EACH STEP WILL GIVE "WHAT IS DONE - NOT HOW."
- b. MAKE A PRELIMINARY BREAKDOWN TO ENSURE ALL STEPS ARE LISTED.

4. DETERMINE HAZARD AND ACCIDENT POTENTIALS.

- a. EXAMINE MATERIALS AND TOOLS USED IN EACH STEP.
- b. LIST CONTACT POSSIBILITIES.

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SEQUENCE OF ACTIONS

Continued

5. ELIMINATE HAZARD AND ACCIDENT POTENTIALS.
 - a. DESCRIBE THE SAFE PRACTICE TO BE FOLLOWED.
 - b. LIST PROTECTIVE CLOTHING AND/OR EQUIPMENT NEEDED.
FOR SAFE TASK PERFORMANCE.
 - c. LIST CHARACTERISTICS OF MATERIAL USED.

AP00050751

METHOD QUESTIONS

WHO WILL ACTUALLY DO THE J.S.A.?

FOREMAN - OPERATING SUPERVISOR - ENGINEER.

WHO WILL PARTICIPATE IN THE J.S.A. FOR A PARTICULAR JOB?

A CROSS SECTION AS A MINIMUM. ALL WHO DO THE
JOB, IF POSSIBLE.

WHEN WILL THE J.S.A. BE CONDUCTED?

DAY OR NIGHT - AVOID "BUSY" TIMES.

HOW LONG SHOULD THE SESSION LAST?

DEPENDS ON THE AVAILABILITY OF THE PERSONNEL.
15 MINUTES - 45 MINUTES.

WHERE SHOULD THE J.S.A. BE CONDUCTED?

A QUIET, RELAXED ATMOSPHERE OUT OF THE PRIME
WORK AREA.

WORK AREA MAY BE USED FOR DEMONSTRATIONS.

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SAFETY ANALYSIS

ADVANTAGES OF THIS APPROACH.

1. MEN FAMILIAR WITH THE OPERATION CONTRIBUTE FROM A LARGE POOL OF EXPERIENCE.
2. TRAINING ADVANTAGE - LEARN FROM EACH OTHER.
3. A PARTICIPATING ROLE FOR EMPLOYEE.

AP00050753

POINTS TO PONDER

1. THE PERSON CONDUCTING THE ANALYSIS MUST APPROACH THE WORKERS WITH ENTHUSIASM AND SINCERITY.
(AS YE SOW - SO SHALL YE REAP!)
2. THE WORKER MUST BE TOLD:
 - A. THIS IS NOT A TEST OR TIME STUDY.
 - B. HE IS THE AUTHORITY - HE KNOWS THE BEST WAYS AND THE SAFEST WAYS TO DO THE JOB.
 - C. THE END PRODUCT WILL BE THE PUTTING TOGETHER ALL OF THE "BEST" FROM EACH WORKER.
3. SITUATIONS THAT MAY OCCUR.
 - A. WORKERS WILL ADMIT MISTAKES AND ERRORS THAT THEY HAVE MADE. (ESPECIALLY IF THEY WERE MADE A LONG WHILE AGO.)
 - B. NEW WORKERS TALK MORE - THEY MAY WANT TO PROVE THEMSELVES.
 - C. ANALYZE ONE JOB AT A TIME. DON'T LET THE ANALYSIS TURN INTO A GENERAL GRIPE SESSION.

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