UC 149-2

UNION CARBIDE **INTERNAL CORRESPONDENCE**

TECHNICAL CENTER

V C

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Location

Date April 2, 1981

Originating Dept. Coatings Materials

Subject Vinyl Chloride Storage Facilities to Implement the VAGH One-Step Process; EON 23013

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Gentlemen:

In defining the potential methods for satisfying corporate needs for storage of vinyl chloride (VCM) and propylene oxide (PO), there have been several options identified as outlined in a report by J. R. Teague dated March 23, 1981. It appears that Case 1 is the lowest cost option if:

- No serious environmental problems arise because of resuming vinyl chloride handling at North Charleston.
- The rail fleet has sufficient VCM cars that can be turned around rapidly enough to keep the sphere full. With this system, at least a two-car inventory in storage on the rail siding would be desirable.

We propose that the efforts in the immediate future be directed towards a fairly detailed development of Case 1 so that a cost estimate of ±25% quality can be developed. We would hope to define all of the significant scope items for this system and receive enough information to resolve the two concerns outlined above. We need a ±25% estimate for the storage facilities by April 24.

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Part of the scope for this project will be the refrigeration requirements for the sphere and unloading system. The size of this system will depend upon:

- The venting requirements for the total storage and unloading system.
- The operating pressure of the sphere.

The previous VCM storage sphere was stored at a pressure below its ambient vapor pressure by means of a monomer condenser that was cooled by a large refrigeration system. This system has been removed and is not available on site. This means that it will be necessary to provide a refrigeration system if we want to store the VCM at cooler than ambient conditions.

Examination of VCM storage practices at other locations at UCC and at other companies indicate that refrigerated storage is not the normal mode of operation. Refrigeration is needed when:

- Oxygen is present in the tank vapor space.
- Polymer product quality is effected by the small amounts of PVC that may form in VCM stored for long periods at ambient conditions.

The VAGH One-Step Process Technology Team feels that VCM stored at its vapor pressure will be of acceptable quality for the process. Therefore, we recommend providing only enough refrigeration to maintain proper venting control during unloading and loading operations.

After the cost of Option 1 has been developed, we need to give the remaining options enough development to be sure our present judgement of the relative costs of the other cases when compared to Case 1 is correct. This will not be as detailed as the data in Case 1 unless we see the cost differential is not as large as presently thought.

Very truly yours,

R.L Criser

R. L. Criser

RLC/lrv

Attachment

8.1 Storage

8.1.1 General

Vinyl chloride storage areas should always be selected to comply with all applicable local codes and regulations, especially those involving occupational health, environmental control, hazardous materials and fire prevention. Organizations such as The National Fire Protection Association, The National Board of Fire Underwriters and the Factory Insurance Association can be consulted about proper site selection.

8.1.2 Conditions of Storage

(A) Vinyl chloride is a very volatile, toxic and flammable gas at normal atmospheric conditions. Vinyl chloride may be stored for reasonable periods of time (one year) without danger from the hazardous decomposition or polymerization of vinyl chloride when kept in contact with ferrous materials and in the absence of air, oxygen, water, light or excessive heat.

Containers and vessels used for handling vinyl chloride at ambient temperatures are usually under pressure. Nitrogen blanketing may be employed to increase the storage pressure in order to facilitate tank pumping operations. Refrigeration can be used to maintain the storage temperature within an acceptable range - below 50° and preferably between 0°C and 20°C.

Vinyl chloride, properly stored, uninhibited either under refrigeration or at normal atmospheric temperature, should be checked regularly for the presence of polymers.

(B) All piping, instrument leads, storage tanks, relief devices and other equipment employed to handle vinyl chloride should be constructed of recommended materials. (See Section 7.2) This equipment should be designed to withstand a full vacuum, if practical, or a working pressure of at least 100-150 psi conforming to the ASME code for unfired pressure vessels or any code applying to the locale of planned storage. Vapor recompression or refrigerated storage tanks can be designed, however, for lower operating pressures.

Shut-off valves and control valves should be of steel or a suitable alloy not containing copper, and these valves should be designed for working pressures of at least 150 psi. All welded construction is recommended to insure a

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8.1 Storage (continued)

8.1.2 Conditions of Storage (continued)

leakproof integrity. Wherever possible, all liquid inlet lines should enter the bottom or extend to the bottom of the storage vessels. This contributes to the guarding against the accumulation of static electricity. All equipment should be properly grounded and bonded with resistance to ground never exceeding 25 ohms. The stand leg should have an opening in it near the top of the tank to act as a vacuum breaker and to help prevent blowback. All electrical wiring, lighting and equipment should comply with NEC requirements. Vinyl chloride tanks should be painted with white or other heat reflective paint.

(C) All storage areas should have installed an appropriate water spray system or automatic sprinkling system or other special fire extinguishing systems which are suitable for use with Class B fires. Portabl fire extinguishers of the carbon dioxide or dry chemical type should be readily accessible to personnel in these areas. (See Section 5)

Diking and/or draining to a safe location should be provided in all storage areas to completely confine and dispose of the liquid in the event of a major spill or vessel rupture.

8.1.3 Isolation

Vinyl chloride storage areas should be selected and constructed in accordance with local codes or authorities having jurisdiction. Such highly volatile and flammable materials should be stored outside of buildings. Preferably, vinyl chloride storage tanks should be segregated away from major process units. Process units such as furnaces or reactors, which have a higher than average fire or explosion risk potential, should be situated as far from such storage tanks as practical. All potential ignition sources should be eliminated from such storage areas. Cylinders containing vinyl chloride should be stored in a vertical position, outside of buildings and in an isolated and well ventilated area. It is best to store cylinders in the open, but provision should be made to shield them from the sun's direct rays and to prevent the accumulation of dirt, snow, water or ice on their valves or safety devices. Vinyl chloride storage areas should be restricted to authorized personnel only and are often classified as "regulated areas" per OSHA.

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8.1 Storage (continued)

8.1.4 Regulatory Aspects

(A) 20 CFR 1910.1017 outlines the scope, application and specific requirements of the Occupational Safety and Health Standard for Vinyl Chloride.

Specific sections of this standard provide for personnel exposure limits, regulating areas to authorized individuals, environmental monitoring, respiratory protection, labeling, etc. A vinyl chloride program must be established and comply with all the requirements of 29 CFR 1919.1017.

(B) 40 CFR Part 61 "The National Emission Standards for Hazardous Air Pollutants" outlines the rules and regulations governing vinyl chloride emissions that have been established by the Environmental Protection Agency. The provisions of this standard should be complied with by the owner or operator of a vinyl chloride plant.

8.1.5 Compatible and Dangerously Reactive Materials

Vessels used for vinyl chloride should be only used for vinyl chloride. They must be purged with a dry inert gas until free of oxygen (<1,000 ppm) prior to filling. VCM is generally non-corrosive at normal atmospheric temperatures when dry (moisture free). However, mild to appreciable corrosion has been reported when vinyl chloride is wet even at ordinary temperatures. This may be due to the presence of impurities. In contact with water at elevated temperatures vinyl chloride accelerates corrosion of iron and steel. Acetylene as an impurity in vinyl chloride may form an explosive compound (acetylide) when exposed to copper or copper alloys.

8.2 Labeling and Identification

The statements and items listed below summarize the major labeling requirements; however, they are not necessarily complete or comprehensive. It is recommended that the Federal Code of Regulations be consulted for the specific details and labeling requirements of the Department of Transportation, OSHA and the Coast Guard.

8.2.1 Department of Transportation Requirements - Coast Guard.

8.2.1.1 Cylinder by Water, Land or Air

49 CFR 172.101 - Each container and overpacked cylinder containing vinyl chloride (including tank cars) shall carry a label "Flammable Gas" and a name "Vinyl Chloride" as shown on the outside of any shipping container and on any shipping papers.

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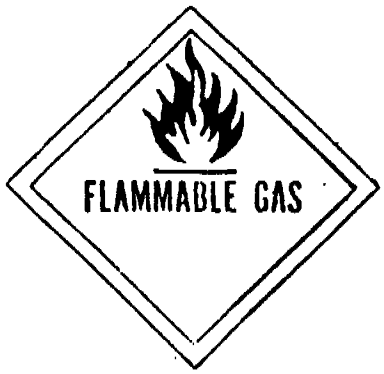
8.2 Labeling and Identification (continued)

49 CFR 172-417 - Small cylinders should have a four-inch "Flammable Gas" label which is red in color and has black printing and cylinder marked with "Vinyl Chloride".

§172.417 FLAMMABLE GAS label.

(a) Except for size and color, the FLAMMABLE GAS label must be as follows:



(b) In addition to complying with §172.407, the FLAMMABLE GAS label must be red. The printing and symbol must be black.

49 CFR 173-306 - Exceptions from Department of Labor labeling requirements.

49 CFR 172.400 - General labeling requirements, placement of labels.

49 CFR 172.326 - Any portable tank (cylinder) containing more than 1,000 pounds of vinyl chloride must be marked in letters two inches or more in size with the shipping name "Vinyl Chloride" and have the Flammable Gas label affixed.

Any truck moving the portable vinyl chloride containing tank must be placarded on the two sides as well as front and rear with "Flammable Gas" placard. (Paragraph 172.515 and Appendix B)

The square on the point placard should be made from tagboard and have a size 10 3/4" by 10 3/4". It should withstand thirty days open weather exposure. The letters on this placard should be red in color with white lettering.

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Unloading barges and ships

Procedures for unloading vinyl chloride monomer from barge and ship cargo tanks are essentially the same as for unloading tank cars. There is, however, more variation in facilities and conditions at customers' plants that may require modifications of unloading methods and equipment. PPG technical service engineers are available for consultation on particular barge- or ship-unloading problems.

Facilities for unloading barges and ships should have self-contained breathing apparatus available for personnel and instruments for monitoring vinyl chloride vapor concentrations.

Construction materials

Aluminum and its alloys must not be used in equipment to store or handle vinyl chloride because explosive aluminum chloroalkyls can be formed. PPG's vinyl chloride is made from ethylene and contains no detectable amount of acetylene. However, vinyl chloride made from acetylene by an older process contains traces of acetylene that could react with copper or its alloys to form explosive copper acetylides. It is not safe to use such vinyl chloride in processing equipment containing copper or brass.

Carbon steel is the recommended construction material for storage tanks, pumps, valves, fittings and pipe to handle vinyl chloride. Although stainless steel is quite satisfactory, it is not necessary. Cast iron should not be used because equipment fracture or breakage could possibly permit a major spill. Equipment and piping should be able to withstand working pressures of 150 psig. If a system containing vinyl chloride monomer may be closed at any time, it should have duplicate relief valves.

Valves and fittings should be of a type that does not require lubrication. Many lubricants are attacked by vinyl chloride and should not be used. Eccentric-type plug valves are available that tighten further as the seats wear out.

Storage tanks

Vinyl chloride has indefinite storage life and does not polymerize when kept in contact with ferrous materials in the absence of air or oxygen, water, light and excessive heat.

Storage areas should be selected to comply with local codes or authorities. Such organizations as the National Board of Fire Underwriters, the Factory Insurance Association and the National Fire Protection Association provide information about site selection on request.

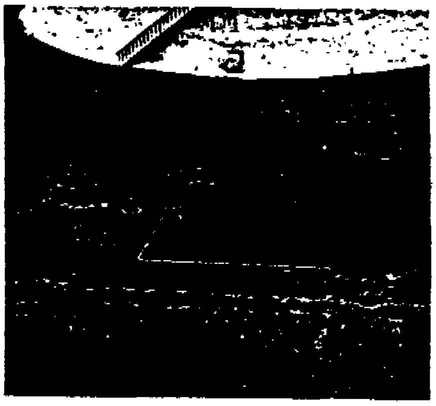
Locate a vinyl chloride storage tank in a segregated area away from major process units. It should be engineered as a Class I, Group D, Division I area and treated as such. Process units such as furnaces or reactors, which have higher than average fire or explosion hazards, should be situated as far from a vinyl chloride storage tank as practical.

To take care of spilled liquid in the event of a tank rupture, adequate dikes and drainage should be constructed (see photo).

Storage tanks should be constructed of materials recommended above, in accordance with the ASME code for unfired pressure vessels. They should be designed to withstand full vacuum or a working pressure of 100 to 150 psig. However, vapor-recompression or refrigerated storage tanks can be designed for lower pressures. All-welded construction is recommended. Tanks should be painted with white or other heat-reflective paint. The installation should include a water-spray system in case of fire.

To prevent a buildup of static electricity while a tank is being filled, the liquid inlet line should extend to the tank bottom. The stand leg should have a hole in it near the top of the tank as a vacuum breaker that prevents blowback. The tank and filling equipment should be grounded against static electricity and lightning. Resistance to ground should not exceed 25 ohms.

Spray nozzle for cooling outside of storage tank in case of fire.



A dike is needed to contain spilled liquid in case a tank should rupture.

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Liquid outlet lines to process should be equipped with check valves to prevent contamination by backflow.

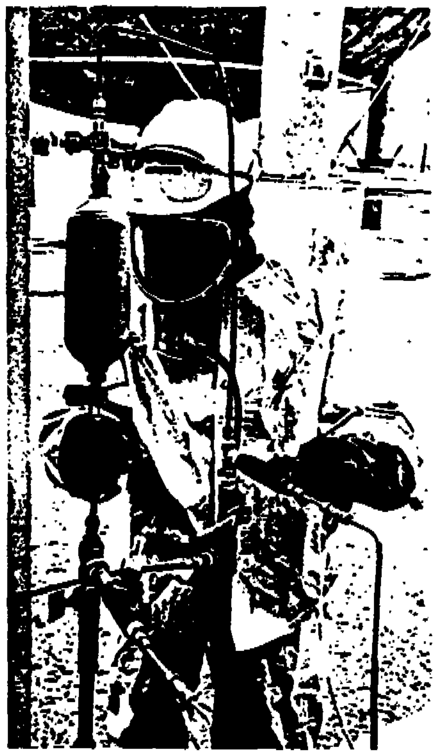
Adequately sized pressure-relief valves should be installed on top of a storage tank. To allow for periodic removal and inspection of the valves, they should be installed preferably with a 3-way plug cock in the line that can block off first one, then another valve from the tank. The EPA vinyl chloride regulation Part 40CFR61.65(b)(4) requires that a rupture disk be installed between the tank and relief valve. The disk must be properly installed to avoid a possible buildup of pressure between the relief valve and the rupture disk.

Indicators of liquid monomer temperature should be installed near the tank bottom to permit observation from the ground. Vapor pressure gages should be connected to the top of the tank but the indicator should be located near the ground. Tanks should also have a liquid level gage with ground-level readout. The level should not exceed 90% of the tank's capacity.

Before a tank receives vinyl chloride monomer, the tank should be cleaned and purged so that final oxygen content in the vapor phase does not exceed 1,000 ppm by volume after filling. Check tanks regularly for the presence of polymer. Tanks in vinyl chloride service should not be used to store other materials.

After a storage tank has been placed in operation, follow standard procedures to prevent oxygen from entering. For example, when tank cars or other shipping containers are unloaded, they could vent oxygen back to the storage tank, if their vapor space was of poor quality. The tanks must be inerted to remove oxygen, preferably by alternately pressurizing and depressurizing with nitrogen. Purge gas must vent to an emission control device.

Horizontal cylindrical tanks are used at ambient temperatures to hold up to 50,000 gallons of vinyl chloride; for higher capacities, spheres are preferable.



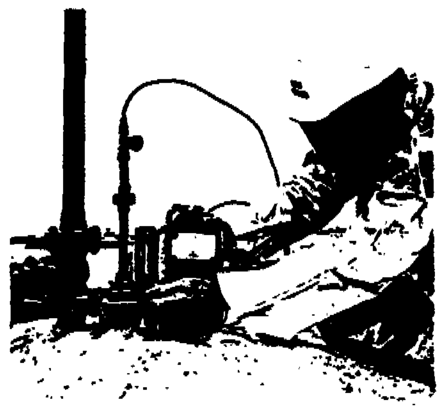
Sampling storage sphere with continuous loop system.

Although vinyl chloride monomer is sometimes stored as a liquid at atmospheric pressure by means of refrigeration, it is usually stored under pressure. The actual pressure inside a storage tank depends on the ambient temperature (see graph on page 10). For example, between the freezing point of water and 25°C (77°F) the internal vapor pressure varies from 1293 to 2943 millimeters of mercury or from 25 to 57 psig. Therefore, every potential leak site should be checked periodically.

All vessels in the vinyl chloride monomer system should be interconnected by pressure equalization lines, which are connected to a refrigerated vapor-recovery system. The term, "vessels," includes storage tanks, shipping containers and processing equipment.

Since it is impossible to condense 100% of the vinyl chloride monomer vapor, the inert gas stream from the refrigeration unit will contain some vinyl chloride monomer and must be vented to an emission control device such as an incinerator.

Reading tank temperature indicator.



Testing storage tank for oxygen with a portable meter.

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Transfer lines

To empty a line of vinyl chloride monomer, take care to bleed it off safely either to a condensing system or to an emission control device. Then blow out the line with nitrogen. Procedures for opening equipment that has contained vinyl chloride are found in Part 40CFR61.65(b)(6) of the EPA vinyl chloride standard.

Before any maintenance such as welding is performed on a long transfer line, steaming should be continued for several hours. The line will have to be reamed if polymer has formed.

Lines that are liquid-full of vinyl chloride should not be closed at both ends without providing means of pressure relief such as a safety relief valve.

Relief valves on transfer lines should be vented to the top of a vinyl chloride monomer storage tank.

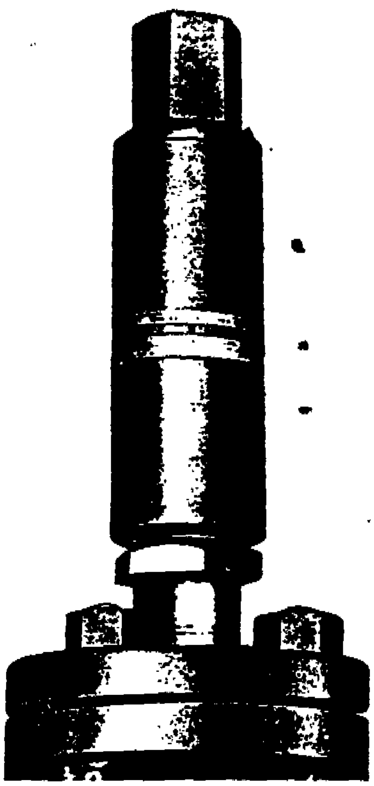
To prevent the buildup of static electricity, pipe connections should preferably be welded. If flanged connections are used, they should be bonded with jumper cables.

Waste disposal

Waste contaminated with vinyl chloride monomer is toxic and a potential fire hazard. The handling of vinyl chloride monomer waste must be done with strict adherence to the OSHA standard, "Exposure to Vinyl Chloride."

Vinyl chloride monomer waste should not be permitted to enter sewers or drains because potentially explosive vapor concentrations can collect.

Waste disposal depends largely on the surroundings, weather and the type of emergency that requires the disposal. Observe all federal, state and local regulations regarding health and pollution.



Relief valve on transfer line is vented to top of storage tank.

Monitoring exposures

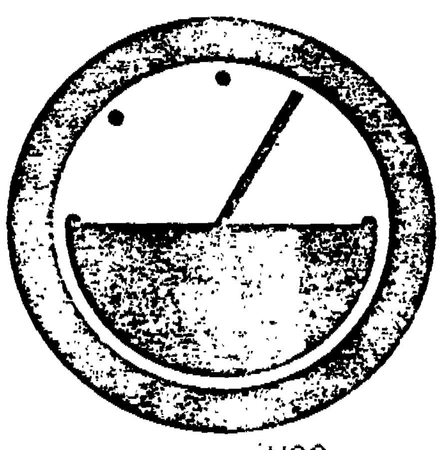
Equipment for determining concentrations of vinyl chloride monomer vapor in workplace air can be divided into three classes: (1) personal, (2) fixed area and (3) portable area monitoring.

1. In personal monitoring, air from the worker's breathing zone is drawn through a tube that can be clipped to his shirt collar. Suction comes from a battery-operated pump that can fit into his shirt pocket or over his belt. Activated charcoal in the tube traps the vinyl chloride while the pump runs for 15 minutes. For analysis, the vinyl chloride is removed from the charcoal with carbon disulfide and is subsequently determined on a laboratory gas chromatograph having a flame ionization detector.

An alternative method gaining popularity because of its speed is an air bag strapped to a worker's back. A battery-operated pump attached to his person draws vapor into the bag. Injecting a needle into the bag obtains a sample for gas chromatographic analysis.

2. Fixed area monitoring uses either a gas chromatograph or infrared spectrophotometer. A suction pump near the instrument draws samples through long tubes ending at remote, fixed-site pickup points, commonly ten or twelve points. An automatic programmer provides sequential analyses of the multiple sampling points for cycles such as several minutes each. The instrument can be equipped to sound an alarm when a preset exposure limit is exceeded.

3. Portable instruments are used where fixed area monitoring is impractical. They can also serve for detecting leaks and for making rapid surveys of areas. The various types f portable instruments used include the infrared spectrophotometer, flame ionizati n instruments, and instruments that measure total hydrocarbons.



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dependable and ineffective against vinyl chloride vapors. Self-contained breathing apparatus supplied with air or oxygen with full face piece and approved by the U. S. Bureau of Mines for this purpose should be used for protection against vinyl chloride.

Liquid VCM spilled on the skin can cause frostbite due to rapid evaporation. Moderate chemical burns can occur to the skin due to liquid exposure, particularly with inhibited VCM, since the most commonly used inhibitor is phenol.

Skin areas splashed with VCM should be immediately washed with soap and water; eye exposures must be immediately washed with water for 15 min. minimum, and medical attention obtained immediately.

Contaminated clothing, gloves, boots, etc. should be removed immediately to avoid prolonged skin contact.

Trained operating personnel must be fully aware of the flammable and explosive characteristics of VCM to preclude the possibility of human error causing a major spill, or providing an ignition source for minor leaks or spills.

Safety considerations

Summing up VCM storage systems should be designed to minimize leaks and spills; have adequate ventilation and drainage to conduct any leaks or spills away from critical operating areas; and the storage and process areas treated strictly as hazardous, both from an engineering and operating procedural standpoint.

All personnel involved should be: well trained in the nature and hazards of the monomer and in the proper handling procedures; equipped with suitable eye protection such as safety glasses with side shields or their equivalent; have adequate respiratory equipment for emergency use; and provided with ready access to an eye wash and safety shower.

Vinyl chloride is marketed under the specification shown in Table 5. For comparison, a typical analysis as manufactured is included.

Until 1956, essentially all VCM was inhibited as produced with 50-100 ppm of phenol to preclude the possibility of spontaneous polymerization during handling and storage.

During the late 1950's it became apparent to most producers that unihibited VCM could be stored and handled safely under the proper conditions.

Since deleting the inhibitor makes the inhibitor removal system at the users plant site unncessary, a considerable capital and operating expense incentive exists to do so. Thus, a major proportion of VCM is now manufactured, stored and shipped in the uninhibited state, although some users still specify phenol inhibted monomer.

Since large volumes of VCM are now stored and handled in the uninhibited state, the proper design, maintenance and operating procedures for storage systems to protect the quality and monomer status of the stored VCM are absolutely essential to safety and loss prevention.

Coincidentally these same steps also optimize the conversion to and quality of the end use product. Like styrene, the only significant end use for VCM is as a polymer (PVC) or co-polymer with other monomers.

The impurities or monomer characteristics which affect the polymer quality adversely are mainly color, oxygen, honopolymer in the monomer iron content, and unsaturated hydrocarbon impurities which produce

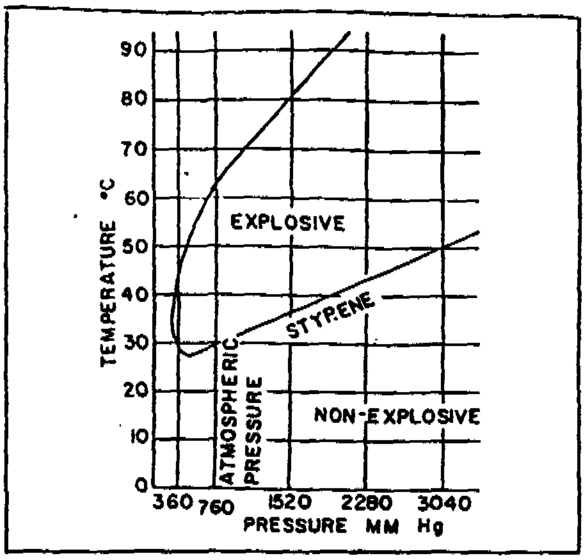

Figure 6. Conditions for explosive mixture with styrene under air.

variable polymerization rates and polymer quality. High water content is also undesirable.

These characteristics can all be controlled within specification limits by the proper engineering and operating control of the final stages of the VCM finishing train and storage facilities.

Construction materials of the system can all be carbon steel, indeed all equipment, instruments, guages etc. must be scrutinized to exclude the use of copper and copper bearing alloys due to the possibility of trace acetylene reacting with copper to form copper acetylides. Aluminum and aluminum alloys must also be excluded due to its reactivity with VCM.

All valves, direct connecting instrument cases, pumps, casings, etc. must be carbon steel or equivalent, and not cast iron or ductile iron, to preclude the possibility of major spills from equipment fracture or breakage.

Stainless steels are acceptable but unncessarily costly for this service due to the size of most systems and in view of the suitability of carbon steels. It is mentioned only because some minor specialty items such as instruments may be more available in stainless steel.

Storage tank pressure

For ambient condition storage systems, design pressure of the storage tanks should be 100 psig, with 150 psig flanges, fittings, etc. used throughout the system. Horizontal cylindrical tanks are generally used for relatively small installations, 50,000 gal. or less. For larger installations, up to multimillion lbs., spheres are preferred.

In the case of vapor recompression and refrigerated systems, lower design pressures can be used for the storage tanks, but pumping and piping systems should still adhere to the 150 lb. design.

For safety reasons as well as monomer quality preservation, the oxygen content of stored vinyl chloride vapor phase must be maintained below 1000 ppm by volume. Thus storage tanks must be cleaned, dried and inerted to remove oxygen prior to introducing VCM into the system. Experience has indicated that the best way to remove atmospheric oxygen from a system is

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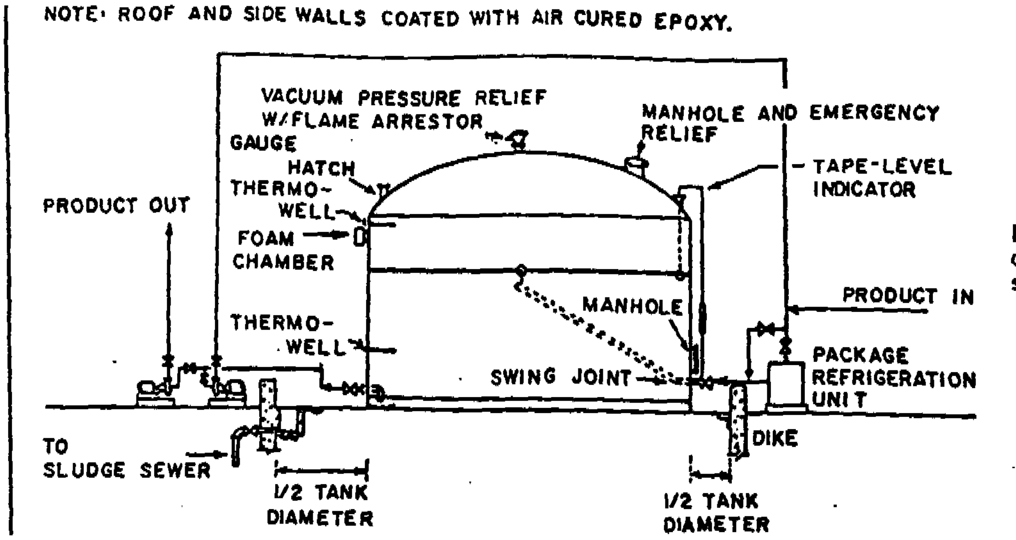

Figure 7. Recommended design for styrene storage tanks.

to pad and depad the system, (including tanks, lines, pumps, etc. as a unit) with nitrogen until the oxygen content reaches the desired level. For example, padding a system originally containing one atmosphere of air to 30 psig with nitrogen, depadding to atmosphere and repeating until the pad-depad procedure has been done five times will reduce the oxygen content of the system to 0.082 volume %.

Experience has indicated strongly that vinyl chloride which is produced on the alkaline side, 0.2-0.5 ppm alkalinity as NaOH, has a more stable storage life. It is recommended that VCM which is to be stored or handled for any period more than a few hrs. be processed on the alkaline side. This can be achieved by pumping to storage via flake NaOH traps.

It is also recommended that flake NaOH traps be installed in the tank farm with the necessary piping systems to load bulk VCM shipments via these NaOH beds. It is essential to protect VCM against contamination by air, water, or any oxidizing chemicals, (peroxides or peroxide precursors in particular), to preclude degrading the monomer quality. Steps to achieve this are obvious, i.e., do not permit tie-ins of any of these deleterious compounds to VCM systems.

VCM should not be exposed to sunlight, and storage temperatures should be maintained as low as possible. Sight glasses if used, should be the suitably rated reflex type with actinic proof shields. However, Dow recommends the use of non-glass devices for level indication. A DP cell located at the bottom of the tank with steam traced vapor leg connected to the tank top is quite satisfactory. Tanks should be painted white or any other heat reflective paint system used to protect the monomer quality. In tropical and subtropical locations it is recommended that vapor recompression systems be used to maintain storage tank temperatures low enough to protect the monomer quality.

Fire protection

Vinyl chloride storage systems should be located in a segregated area well separated from the major process unit and engineered as a Class I Group D Division I area and treated procedurally as such.

Any sections of the process, or any adjacent process which has a higher than average fire or explosion hazard, such as reactors or furnaces should be located as far away from a VCM storage facility as practical.

The VCM storage system should be designed to eliminate and/or minimize the possibility of leaks and spills by paying close attention to design pressures, safety valve settings, selection of valves, instruments and design temperatures.

VCM should not be allowed to "free fall" from top entries into tanks. Inlets should be into the bottom of tanks or, if top inlets are used, grounded dip pipes provided. In addition, all tanks, pipelines and auxiliary equipment such as pumps and compressors must be grounded to preclude ignition of leaks due to static electricity. A major VCM storage facility should be equipped with its own lightning rod.

All operating equipment in a process unit and/or storage system must be inerted to preclude oxygen contamination prior to commissioning, and the obvious steps taken to preclude the introduction of oxygen slugs during service must be routinely followed.

Examples are in loading tank cars, tank trucks, barges, etc., the receiving container vents back to the storage tank. Therefore, these receiving vessels must be inerted to remove oxygen, preferably by padding up and down as already outlined.

It is also important that loading containers be electrically grounded during the loading operation.

It is desirable where feasible to have shipping containers returned from customers with a "heel" of about 5 psig vinyl chloride vapor to preclude the possibility of atmospheric air leaking into the container in transit.

It is a good precaution to analyze the heel of VCM vapor in returned shipping containers for oxygen content prior to reloading. Storage tanks of greater than 10,000 USG capacity should be diked inside a concrete dike with a capacity to contain the entire contents of the storage tank, or tanks, if more than one tank is involved. Also, the diked area must have an underground drain equipped with block valves. This drain should not lead into the main plant sewer system as the danger exists of flooding the entire plant, including ignition source areas with flammable VCM-air mixtures. Since vinyl chloride is lighter than, and essentially immiscible in water, it will float on top of a flowing sewer.

The VCM storage dike drain should discharge to a

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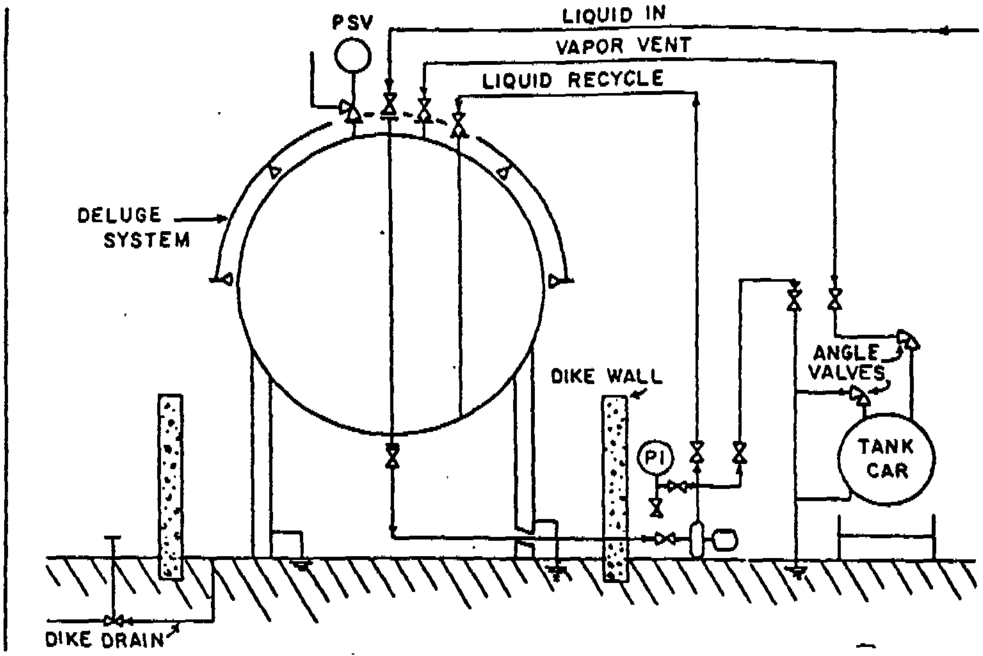

Figure 8. Schematic diagram of a typical vinyl chloride storage system.

separate underground sewer preferably leading to a remote disposal or recovery sump. The drain block valve should be accessible from outside the dike wall, and left normally in the closed position; checked each day and opened when necessary to drain casual water from the diked area.

Pumps and other auxiliary equipment, level gauges, etc. associated with the storage tanks should be located outside the dike wall.

Major storage installations, say greater than 50,000 USG, should be equipped with an open head water deluge invoked by heat actuated devices and/or manually invoked remotely to provide emergency flushing in the event of major spills or fires.

Water alone will not effectively extinguish or control large VCM fires due to its lighter than water character. Water may even spread the fire by floatation, but will serve to protect the tanks and contents from overheating while the fire is being brought under control by chemical means. In the event of a VCM fire, a point to remember is that one of the products of combustion is HC1 gas. It is recommended that in areas where mobile fire fighting rigs equipped with foam or powder capabilities are not readily accessible, fixed foam facilities be installed adjacent to the storage system and piped permanently inside the dike at required points to control and extinguish fires at any point within the dike area. Figure 8 is a schematic of a VCM storage facility.

Summing up

The best way to provide safety in VCM storage and handling facilities is to engineer the installation to minimize spills and leaks; preclude any ignition source for minor leaks and spills that might occur; provide a drained, deluged, dike area; guard against contaminating the system with air or oxidizing chemicals and train people thoroughly in the proper safe procedures for handling the product. #

Literature Cited

1. Diss, E., H. Karam, and C. Jones, "Practical Way to Size Safety Disks." *Chem. Eng.* (September 18, 1961).

Table 5. Specification for vinyl chloride monomer.

Property	Sales Specification	Typical Anal.
Acetylene, ppm	2 maximum	< 1
Acidity as HC1, ppm	5 maximum	< 0.5
Aldehyde, ppm	5 maximum	nil
Iron, ppm	0.5 maximum	< 0.5
Non Volatile Matter (% by weight)	0.05 maximum	< 75 ppm
Phenol, ppm	25 minimum	25-75
Inhibited	100 maximum	
Uninhibited	2 maximum	nil
Sulfur (as S), ppm	5 maximum	< 5
Water (% by weight)	0.03 maximum	< 100

P. G. Shelley graduated from the University of Oklahoma in petroleum engineering and received an M.S. degree from the same institution. Following two years as an instructor at Pennsylvania State University he spent five years in research with Phillips Petroleum before joining Dow. He has been associated with styrene manufacturing and technology for more than 25 years and is presently production manager for styrene at Dow's Texas Div.

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