



DOW CHEMICAL U.S.A.

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Attached are some notes I made at the Vinyl Safety Association meeting in New Orleans in October. Please route the report to folks in your plants.

Also attached is a survey on valve position switches, types, dependability, reason for failure, etc. Your Instrument and Electrical Supervisor might find this interesting.

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NOTES FROM VINYL CHLORIDE SAFETY ASSOCIATION MEETING IN
NEW ORLEANS ON OCTOBER 20 and 21, 1983

1. Old Case Histories

- a. John Barr related the Thompson Chemical explosion of 1964 in which there were 7 fatalities and 22 injured. A PVC kettle was taken out of service to repair a sight glass that was leaking. The glass put in was not designed for the service. It began leaking after start-up and when the operator tried to tighten the flange, the glass chipped and began leaking worse. The reactor building soon filled with vapor and an explosion occurred. Piping on other reactors broke and fed 150,000 lbs. VCM to the fireball. Nearby school buildings suffered extensive damage in addition to total destruction of the reactor building and contents.

Errors made and lessons learned:

- 1) The old type sight glass was replaced with new high pressure type.
 - 2) No hydro test was made after repair.
 - 3) Operator attempted to tighten sight glass with vessel under full pressure.
 - 4) Area was congested overall with a school building within 2000 feet of reactor building.
 - 5) There was inadequate crowd control -- one person was found standing on a vinyl bullet watching the fire and smoking.
 - 6) Building construction was inadequate -- concrete slab floors (multistory) which collapsed.
- b. Joe King reviewed the 1968 Hooker Burlington PVC reactor fire. The incident occurred during the start-up of a new French process. The process was a bulk process (no water) and the first of its type in the U.S. The process involves a two-step reaction in which there is a prepolymerization and a post-polymerization reactor. The material was being transferred from pre-poly to post-poly and a leak occurred at transfer valve. The material caught fire and could not be extinguished with deluge system and local fire department. The firewater capacity was being depleted after

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two hours so additional fire groups were called. Nine fire trucks fought the fire by hooking up hoses to the Delaware River a mile away. The next day, after the reactor vessels were emptied, the fire was extinguished.

Errors made and lessons learned:

- 1) The water capacity at site was insufficient.
 - 2) After the first batch the transfer valve had been removed, worked on and reassembled. The seats were installed wrong and somehow (?) this contributed to the leak.
 - 3) The reactor system was hydroed but the transfer valve was closed during test and only prepoly reactor and one side of transfer valve were checked. The leak occurred on downstream side.
 - 4) Procedures were lacking.
- c. Dan Langlois described the Goodyear PVC reactor fire of 1972. The incident involved a 30-inch diameter nozzle which apparently was an entry manhole. Instead of a bolted flange cover the nozzle was fitted with a locking ring cover, the rotation of which wedged it shut. Somehow after startup the flange rotated to the open position and the cover blew off and caught, and the escaping VCM caught fire. Three people were burned seriously.

Prevention -- A locking bolt was devised with a proximity probe to prevent the ring from moving while in operation.

- d. Ben Reynolds of PPG described an upset and fire in their Oxy-EDC in Lake Charles in 1977. A feed imbalance of the O₂ to ethylene rate allowed O₂ to rise to 30%. The first explosion occurred in the vent scrubber from possibly static ignition. The ensuing fire destroyed one reactor train and damaged the other two.

Prevention - Redundant instruments and analyzers were installed.

- e. Herm Waltmate of BFG reviewed the VCM sphere spill in Altona, Australia. The design was very poor with nine

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separate nozzles entering the bottom of the sphere. Maintenance workers were in the process of changing out a section of pipe on one of the 4" sphere nozzles. The nozzle had an air operated ball valve. The air actuator was supported by U-bolt on the section of pipe which was to be replaced. The workers disconnected the U-bolt and left the air actuator hanging loose on the valve handle. During the work activity the weight of the actuator finally opened the valve, causing a large spill. All the contents of the sphere, 1.5 MM lbs., was lost but luckily no fire occurred.

Lessons learned:

- 1) A new strict maintenance work order procedure was established.
- 2) A new standard was established for liquid VCM valves.

2. Current Case Histories

- a. Jim Fields of Formosa Plastics described the tank car fire incident of July 30, 1983 in Baton Rouge. Five cars had been loaded before the fire. Two more were in the process of being loaded. The operator had disconnected one T/C and partially disconnected the second. After the fire all three angle valves on the second car were found open. Excess flow check valves did not seat and after the fire they were found to be improperly installed and could not seat off. The loading operator was burned seriously and has not been able to recall what happened.

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Errors and lessons:

- 1) Loader apparently disconnected the load hose with T/C valve still open.
or
- 2) In attempting to adjust hose fitting, it blew off.
- 3) The clamp lock fittings were replaced with hammer unions.
- 4) EBV's were installed on all lines between T/C and load rack.
- 5) Instituted a check list to be filled out and signed for any leak situation.

- 6) The Railroad has suggested that T/C's being loaded have the placard display as loaded, to help fire fighters.
- b. Joe King of Occidental related an accident which resulted in a fatality in one of their plants. A high pressure water cleaning room is used to unplug heat exchangers. The room consists of two areas -- one where the water tanks and high pressure pumps are located, and the second where the exchangers are cleaned. The water is piped to the cleaning area and into a "foot" valve on the floor. A 1/4" stainless flexible hose 18 feet long with a nozzle is attached to the "foot" valve. The nozzle is a "mole" design, that is, it has one hole pointing forward, and six back, the thrust of those six causing it to self-propel through the tubes. There is no lance.

The procedure is as follows: The cleaning operator inserts the nozzle into a tube, presses the foot valve, then signals a second operator to turn the pump switch on. Since the second operator is behind the cleaner, it is impossible to watch the nozzle insertion. After the accident the second operator mentioned that the stainless hose had been bucking unusually hard. The cleaner had cleaned seven tubes and when the pump was turned on for the eighth tube, the cleaner jumped back and grabbed at his throat and fell forward. The second operator turned him over and blood was gushing out at the neck. Help was summoned and they found the nozzle had entered at the base of the neck and shoulder and had traveled 18" into his chest. He died in the hospital 40 minutes later.

Corrective actions:

- 1) Occidental personnel will no longer do this. The work will be done by contractors who do this type work.
- 2) The most significant cause was the use of a high pressure nozzle without a stiff lance for control.
- 3) The job will require that a pre-determined depth be drilled so that safe insertion of the nozzle with lance can be accomplished.

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- c. Jim Wallace of Esso Canada told of a PVC resin hopper car which split open. The aluminum car had been in a previous wreck and required some rewelding of seams. The work had not been properly done (no weld penetration) and as the car was being unloaded an air pad was used to facilitate the job. About 50 psig had been applied and the shell split open. No one was injured.
- d. Wallace also reported on a VCM line failure caused by galvanic corrosion. A monel weld neck had been welded to a 304 stainless line and the stainless line corroded and failed.
- e. Lamar White of PPG, Lake Charles, reported on a loading pump incident.

A large spill occurred from a pump after which it was determined that some force had cracked the pump pedestal and sheared all the pump and motor base bolts. The cracked pedestal had allowed the seal plate to move backward, causing the spill. The pump was steel construction on wetted parts and cast iron for the pedestal or support head. It was theorized that either 1) the pump had been blocked in liquid full, or 2) a water hammer had occurred when a long line was closed. The plant intends to replace the cast iron parts with steel or wrought iron.

- f. Solvay reported on a VCM T/C rupture in Austria. Their plant was contacted by a VCM producer and asked to unload a certain VCM T/C which had some type problem.

When the car arrived it did not have the proper papers and was left in the track yard. A few days later, the T/C ruptured and spilled all of its contents. At one time liquid was seen blowing out of the car to a height of thirty feet. A large vapor cloud enveloped the area 5 feet deep. The plant facilities were shut down quickly and no fire occurred. Within an hour, most of the cloud had dissipated. The tank car inspection revealed a crack of 5 feet long by 8 inches wide. The T/C was not equipped with a relief valve.

Errors uncovered:

- 1) Tank car had been overfilled originally because of math error.

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- 2) Person who reviewed weight sheets did not detect problem.
- 3) Procedure called for second weighing before shipment but second scale had been out of order for six years.
- 4) Custom inspector did not find error.
- 5) When tank car reached Italian border, error was discovered but not communicated.
- 6) Solvay was not advised what problem was but was asked to unload.

3. Health - PVC Dust

John Vaughan of ICI reviewed the work going on in his company with regard to eliminating PVC dust inhalation. Although not considered toxic, the dust does coat the lungs and cause respiratory problems.

In order to pinpoint sources and concentrations of dust, they have developed a high intensity light method which clearly shows the dust in the atmosphere and source.

NOTE: Maybe the high intensity light method would be useful within Dow, for example in detection and measurement of asbestos fibers.

The rest of the meeting was PVC related or had no message that needed to be communicated.

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1983 VSCA MEETING

VALVE POSITION SWITCH SURVEY SUMMARY

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A. Survey Participation

Total Number of Companies Responding	7
Total Number of Plants Responding	10+
Total Number of Forms Returned	26

B. Types of Switches Used

Electromechanical - 15/26	58%
Inductive Proximity - 6/26	23%
Hall Effect Proximity - 5/26	19%

C. Mean Time Between Failures (Months)

Type Switch	Min	Avg	Max
Electromechanical	1	16	60
Inductive Proximity	1	9	24
Hall Effect Proximity	2	7	10

D. Cause of Failure

	<u>Electro- mechanical</u>	<u>Inductive Proximity</u>	<u>Hall Effect Proximity</u>
Shifting	4	1	3
Mechanical Failure	2	-	-
Water	8	-	2
Damage by Personnel	5	5	3
Vibration	2	1	1
Bent Indicator Arm	2	1	1
Electrical Failure	-	-	2
Total	22	8	12

E. Maintenance Performed

Realign or Replace

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VALVE POSITION SWITCH SURVEYELECTROMECHANICAL LIMIT SWITCHES

<u>Manufacturer</u>	<u>Model Number</u>	<u>No. of Switches</u>	<u>Cycles per Day</u>	<u>Mean Time Between Failures</u>	<u>Cause of Failure</u>	<u>Maintenance Performed</u>	<u>Unusual Ambient Conditions</u>	<u>Comments on Performance</u>
Proximity	-	21+	10	3 Years	Shifting of switch	Alignment	Vibration	Excellent
	V3L-3-D8	21+	20	X Years	Shifting of switch	Alignment	Vibration	Very Good
	V3L-139-08	21+	2	2 Years	Mechanical failure	Replacement	No	Fair
Microswitch	RX21 and 3R021	21+	4	-	Cam indicator shifting and armature failure	Cam alignment and replacement Armature repair occasionally	No	Fair
Bettis	3R	21+	6	3 Years	Broken spring (rare)	Alignment	No	Good
Fisher	304	21+	8	10 Months	Water in switch	Alignment	No	Good
Controls					Shifting of switch			
Jamesburg	069-0072-00	21+	4	1 Year	Water in switch	Replace switch	No	Good
Microswitch	EXAR and EXAR30	21+	4	6 Months	Mechanical damage by personnel	Alignment Replacement of switch	No	Good
					Water in switch			
Microswitch	51ML1-7646	21+	8	3 Months	Bent indicator arm	Alignment	No	Good
Microswitch	1CX42-7714	21+	8	10 Months	Water in switch	Replacement	No	Good
	2CX3-7904				Mechanical damage by personnel	Replacement of feedback arm		
Bettis Switch	3R321AFC	21+	8	6 Months	Bent indicator arm	Alignment of cam and indicator arm	No	Good, most problems caused by water and personnel
	3R021AFC				Water in switch			
					Mechanical damage by personnel	Replacement of switches		
Yamatake-Honeywell	1LX5001	21+	<20	5 Years	Water in switch (2 or 3/Year)	Alignment or replacement	No	Good
	VCK5001				Mechanical damage (2 or 3/Year) by personnel			
Microswitch	LSXA	21+	2	1 Month	Water in switch	Replacement	Deluge	Fair
Bettis	-	6-20	5	2 Months	--	--	Vibration	Installed for only two months
				(w/o failure)				
Microswitch	-	21+	3-30	6 to 8 Months	Water in switch	Repair (replace internals)	Vibration	Good. Some in service for eight years with no failure
					Shifting due to vibration	Realign	High Humidity	

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1983 VCSA MEETING

VALVE POSITION SWITCH SURVEYHALL EFFECT PROXIMITY SWITCH (MAGNETIC SENSING)

<u>Manufacturer</u>	<u>Model Number</u>	<u>No. of Switches</u>	<u>Cycles per Day</u>	<u>Mean Time Between Failures</u>	<u>Cause of Failure</u>	<u>Maintenance Performed</u>	<u>Unusual Ambient Conditions</u>	<u>Comments on Performance</u>
In house		21+	2	--	Slipped magnet	Alignment or replacement	No	Good on automatic valves
Wesco	MS2A, MS2B	21+	16	8 Months	Mechanical damage Water in switch Slipped magnet or loss of magnet	Replacement of switch Alignment of magnet	No	Fair on manual valves Good
Wesco	MS2AA00	21+	5, max 15/day	2 to 3 Months	Slipped magnet Water in switch Vibration	Alignment or replacement	Vibration and deluge water	Fair. Performance improved with new magnet bracket design.
Wesco	MS2-BB-00	21+	12	10 Months	Mechanical damage 30% Electrical failure 70%	Replacement	--	Average
In house	-	21+	12	8 Months	Bent indicator arm 10% Mechanical damage 60% Electrical failure 30%	Alignment of magnet arms and magnets	--	Fair performance, requires excessive maintenance

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1983 VCSA MEETING

VALVE POSITION SWITCH SURVEYINDUCTIVE PROXIMITY SWITCH (METAL SENSING)

<u>Manufacturer</u>	<u>Model Number</u>	<u>No. of Switches</u>	<u>Cycles per Day</u>	<u>Mean Time Between Failures</u>	<u>Cause of Failure</u>	<u>Maintenance Performed</u>	<u>Unusual Ambient Conditions</u>	<u>Comments on Performance</u>
Pepperl and Fuchs (Germany)	N7-2-12-GK-N	21+	2	X Years	Bent indicator arm (2/Year) Mechanical damage by personnel (1/Year)	Alignment	None	Satisfied
General Equipment and Manufacturing Co. Inc. (COM)	211117	21+	2	+6 Months	None yet, installed 6 months ago	--	None	Good
Microswitch	6FRI-6	21+	16	3 Months	Mechanical damage by personnel	Alignment or replacement	None	Good
General Equipment and Manufacturing Co. Inc.	Series 20 and 40	21+	5, max of 15/day	1 Month	Vibration Mechanical damage	Alignment or replacement	Vibration and deluge water	Fair
General Equipment and Manufacturing Co. Inc.	257126 and 13929	"	8/year	Only in service a few months	Mechanical damage by personnel	Alignment Replace due to excessive dead band	--	Dead band has been a problem. Difficult to adjust position of the switches.
General Equipment and Manufacturing Co. Inc.	211536	21+	12	2 Years	Physical damage 95% Shifting of switch 5%	Replacement	--	Works well and is the most reliable position switch used in the plant.

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