

POLYVINYL CHLORIDE INDUSTRY SAFETY MEETING

Sponsored By The Pfaudler Company
Rochester, New York
Date: April 26 and 27, 1966
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SUMMARY

As a sequel to the meeting of polyvinyl chloride producers following the Thompson explosion, a second meeting of these producers was called and hosted by the Pfaudler Company. All but three of the domestic PVC producers were represented; some had several representatives.

The formal meetings consisted mainly of lectures on the design of Pfaudler equipment; only two speakers discussed safety primarily (a copy of the formal program is appended). The PVC manufacturers exchanged experiences related to safety at the dinner tables and an informal session of the group.

Several recommendations on layout, equipment, and operating personnel protection were endorsed by the producers as safety improvements. A list of these recommendations is appended.

Fatalities have occurred at three producers' facilities in the past year. Tennaco (Cary) and Borden have each found a man on top of their blending tanks, apparently asphyxiated by fumes. UCC lost three people due to the fire and explosion which occurred when the lower manhole on a reacting autoclave was erroneously opened. Several other incidents have occurred which, although fatalities or major fires did not result, are considered serious: several detonations have occurred in tanks or compressors which handle vinyl chloride monomer and operate under vacuum conditions at some time in the cycle. - H₂O VAPOR IN VCL VAPOR TO COMPRESSORS PREVENTS THE
THUS NASH BYTES WOULD PERMIT RECOVERY OF VCL. STEEL RECOVERER

*This we do not
do. Any monomer
from side str.
tanks go to the
air. NAF*

Mr. Bill Doyle of Factory Insurance Association presented a comparison of PVC plants which were built before the Thompson explosion and those built after the explosion. The increased concern with safety was obvious, but several of the more expensive recommendations of the insurance companies have not been adopted across the board. The "new" plants tend to either eliminate sight glasses or provide the safer, more expensive models. They also provide larger relief capacities on the polymerizers (autoclaves) and higher ventilation rates in the control rooms. Monomer recovery areas have

*We still have
sight glasses &
believe they
serve a purpose.
NAF*

*We have
put in "SAFER"
DE GLASSES IN
ALL AUTOCLAVES
TOTALY
ENCLOSURE
WITH O-RING
SEAL.*

UCC 093002

been located some distance from the reaction areas in the "new" plants.
Deluge water spray systems, rather than closed-head sprinkler systems, and concrete autoclave structures, rather than steel-only structures, although recommended by the insurance companies, were installed in only about half of the "new" plants.

We have steel!
NAG

A list of recommendations by Pfaudler on the normal handling and operation of glass-lined autoclaves is attached.

DELUGE SYSTEM
KFFR - WINE
MAYDAY OR
AUTOMATIC ACT.
SPRINKLERS
WE USE LARGE SPILLS
WHENEVER HAVE LARGE SPILLS
BE VCO TO SATURATE ARE
WITH 400 PPS
STATIC CHARGE

DISCUSSION

Safety Recommendations (From the Meetings)

The following list of items was generally agreed upon by the PVC producers as design and operation concepts which would improve the operating safety of PVC manufacturing facilities:

1. Use Nash compressors in monomer recovery area. These compressors use liquid in the casing to seal between the impeller and the casing. The liquid has a cooling effect on the compressed gas and also will tend to saturate the gas which minimizes the static electricity hazard.
2. Locate monomer recovery area some distance from the reaction (polymerization) area. The reaction area is considered the most hazardous, and removing the potential fire-feeding monomer from the adjacent area is desirable.
3. Design control room ventilation system for 15 turn-overs per hour and take suction in a monomer-free area. This should prevent build-up of sufficient monomer vapors in the control room to exceed the lower explosion limit.
4. Use deluge-type fire protection systems rather than closed-head sprinklers. The deluge systems have extremely high water flow rates which means more cooling.
5. Use Pressure Products sight glasses if sight glasses cannot be eliminated. The Pressure Product device seals the two tempered glasses around the O.D., thereby putting the glass in compression rather than using gaskets to seal the glass on the upper and lower flat surfaces which puts the upper glass in tension. The compressive strength of glass is several times its tensile strength.

DIFFERENT
PROCESSES
FOR RECOVERY
We
plan to
use a
Nash Hyton
on our tank
NAG
We are jam-
up to the
recovery area.
NAG

NOT PPS,
BUT NEW VCO
TANKS ARE
IN WEST FIELD
WILL BE
DIKED.
WILL HAVE TO
REPAIR
SOME REPAIRS
TO OUR RECOVERY
SYSTEM TO BE
OUR TANKS

GLASCOTE
6" 300 PPS
Paynight
W/ SPRAY
RING.
DWG 8309-C
2-64
TOTALLY
ENCLOSED +
ROUTED TO AUTOCLAVE
FLANGE.

What do we use?

VPS.

Do we have this? (15' 40")

UCC 093003

This is a "brute force"
real design and not at
all equal to O-RING seal of
the Glascote assembly.

6. Provide short-stop bombs. These bombs contain a reaction inhibitor which, if drained into an autoclave, will stop the reaction.

We don't do this.
WE HAVE ALWAYS
DEPENDANT ON
COLD BRINE
VENTING - WHICH
IS SATURATED
MOST OTHER
PEOPLE DON'T
HAVE THE
COLD BRINE

7. Provide multiple safety devices to protect personnel inside autoclaves. When inside autoclave, the man should wear wrist straps, rather than ankle straps (ropes not connected). A boat trailer winch with which one man could lift an injured worker out of the autoclave is provided by one producer. Also, some means, either an outside observer or an alarm which must be signaled every few minutes, should be employed to spot an injured worker quickly.

present system

We're working on this idea!

Informal Discussion of Incidents by PVC Producers

Mr. Jim Hahn, the plant manager of Tenneco's Burlington, New Jersey plant, called the meeting. The following incidents were related:

1. (Tenneco) detonations in "stripper" (blow-down tank) when dry air (-40°F dew pt.) was used to pressure the slurry to "screener" (skin-trap). Now use nitrogen. Other manufacturers use plant air (0°F dew pt.); none have had similar problems. The strippers are pulled down to below 20" hg. vac. The autoclaves are also evacuated.

2. (Tenneco) detonations in discharge of both stages of reciprocating compressors in monomer recovery service. Other manufacturers have also had detonations. It was postulated that air slugs are pulled into the vacuum systems and, when compressed, explode. The possibility that vinyl peroxides are the culprits was also suggested.

Note: Several manufacturers are now using the liquid-sealed Nash centrifugal compressors to minimize danger due to vacuum operation; none of them has had any detonations.

3. Protection of laborer cleaning reactor internally. One manufacturer has outside man check visually every ten minutes or so (no buddy system).

Goodrich has portable alarm which inside man must pull every three to five minutes to prevent sounding. If line kept taut more than 30 seconds by tying it to agitator, etc., the alarm goes off. The alarm costs approximately \$500.

Several manufacturers use wrist straps on inside man (ropes not connected); one has portable winch so that only one man outside autoclave can extract inside man.

UCC 093004

4. (UCC) - Opening of lower shell manhole in live reactor -
incident was related by Hal Savage.

5. Dump line breakage - Several manufacturers have lost monomer charges through slurry dump lines which broke. Some had used Victaullic joints to make cleaning easy, but most have now gone to welded lines.

6. Fatalities by asphyxiation - Tenneco and Borden have had recent fatalities by suffocation in slurry blending tanks. In each case, the man was apparently looking into top openings of tanks, fainted and was later found draped over edge of tank, head one to two feet below top of tank.

7. Phenol hazards were stressed by several men present. Phenol is used as a polymerization inhibitor (see Item 6 under Safety Recommendations).

8. High pressure water cleaning of autoclaves is being used successfully by U. S. Rubber. Under evaluation by Pantasote.

"Safety in PVC Plants" (After-dinner speech by Mr. Bill Doyle, Factory Insurance Association)

Mr. Doyle's talk centered around a comparison of the PVC plants which were built before the Thompson explosion and those built after the explosion, both groups being insured by members of his association. The plants were mainly located in the northern half of the U. S. There are ten "old" (before Thompson explosion) plants and six "new" plants. Data were not available for all comparison items from all the plants.

Sight Glasses

Factory Insurance Association recommends only the Pressure Products
sight glasses.

Old Plants (10)

- 7 - ordinary type
- 2 - Pressure Products type
- 1 - no sight glasses

New Plants (6)

- 3 - Pressure Products type
- 3 - no sight glasses

They have not paid much attention to the design - Over 1000 of the old ones I believe are properly designed and constructed.

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Pressure Relief Devices

Factory Insurance Association has developed curves for run-away reactions by relating rate of heat release (low, medium, high, very high) versus safety valve size recommended. Liability ruling by the courts prevent their publishing the curves, but the safety valve sizes for the new plants are indicative:

Old Plants (10)

<u>S. V. inlet Size, in.</u>	<u>Vessel Sizes, gal</u>
3"	1600, 2200, 2250, 3750
4"	1100, 2000, 2250, 3700
4" + 8" Rupture Disc	3000
6"	3750

New Plants (6) - 3 of new plants' safety valves were sized off curves developed by Factory Insurance Association.

3" 2000, 2200

Indicated relief capacity for 3750-gallon autoclave is 3" safety valve plus 3" rupture disc from curves.

Monomer Recovery Area Location

Factory Insurance Association recommends that the monomer recovery area be detached from the reaction area, and monomer storage in accordance with the code for LPG storage, - 400 ft. separation for 500-M gal, 100 ft. for 30-M gal, with the use of dikes, and spray systems.

Old Plants - monomer recovery area and reaction area combined.

New Plants - monomer recovery area detached from reaction area.

Ventilation of enclosed reaction buildings - we're in open air - & this is good particularly since humidity is usually high & static sparks are not a problem or contained.

Old Plants

8 - for comfort only
2 - 2 to 15 turnovers per hour

New Plants

6 - have at least 14 turnovers per hour

Fire protection - Factory Insurance Association recommends deluge systems.

Old Plants

7 - closed-head sprinklers
2 - deluge
1 - closed-head sprinklers + deluge

New Plants

2 - closed-head sprinklers
4 - deluge - this we have

We have eliminated safety valves because they coat over inside & don't open at right pressure - or get plugged up resin + won't seat again. Now have reverse curve. P100 P505 and 100. Rupt disc right on top of P100 P505. As discs can be solvent cleaned this!

Several plants have vapor detectors which can speed up ventilation systems and/or actuate sprinkling system.

Autoclave Supports - Factory Mutual recommends concrete supports.

Old Plants and New Plants - half of both types are steel, the other half are concrete.

Short Stop (Reaction inhibitors)

Mr. Doyle asked if they were used. -- A few companies use them. Styrene bombs on portable carriers with high pressure nitrogen to blow the styrene into the autoclaves are used by one company. Other companies use styrene or phenol on occasion.

This should definitely be considered for autoclave use.

Catalyst Storage

No problems likely if stored in accordance with duPont literature.

IPP has own problems which are familiar with - but need to be reminded of periodically.

Handling and Operation of Glass-Lined Autoclaves

Pfaudler recommends the following:

1. Autoclave Installation - use bail bars and all hoist loops provided when lifting vessels. Do not lift a vessel by one lifting loop.

Very little need to lift.

2. Operating Pressure - do not exceed design pressure for fear of spalling glass at high stress points. The pressures which the steel vessels could withstand before the stress limits are exceeded are many times the pressure at which spalling of the glass will occur.

use. 100% below ratings.

3. Flange protective rings - use stainless steel spool pieces to prevent loss of glass on those flanges which must be broken frequently.

MANUFACTURE OF the rings seem to be better as well.

4. Use Torque wrenches to tighten flange nuts to prevent glass breakage due to overtightening of nuts. Torque wrenches will give leak tight seal with minimum bolt tension.

Need more attention to use of TORQUE WRENCHES

5. Regular cleaning of jacket (O.D. of autoclave which is covered by the jacket) is considered essential if heat transfer capacity is to be maintained.

probably should be checked.

NEVER USE HCl or DuSman - use an ALKALINE CLEANER

6. Relief valve settings should be 90 percent of design pressure; normal operating pressures should not exceed 80 percent of design pressure. (Note - since UCC autoclaves are designed for a test pressure of 150 percent of MAWP before glassing, the second 10 percent below design pressure could probably be eliminated but Pfaudler will not guarantee integrity of the glass if pressure exceeds design.)

*Generally
work in
this
manner.*

W. S. Lanier
M. Johnson
June 30, 1966

UCC 093008