Unsuspected Events Lead to Hydrogen Sulfide Fatality

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On February 15 2006, the Cincinnati Area OSHA Office was notified by the media of a chemical release at a local chemical manufacturer. Several people were sent to the local hospitals as a result of their exposure.

The OSHA Area Director sent two of his senior Industrial Hygienists to the site
The Operation

A medium size chemical manufacturing plant in Cincinnati of a very large multi-national corporation

- The plant site contained a number of processes throughout a number of buildings some of which involved quantities of highly hazardous chemicals that were covered by OSHA’s Process Safety Management Standard.

- This particular operation was *not a PSM-covered* process although the Company did conduct a PHA on it

- This operation and its sister operation both manufactured chemical intermediates
1. Two maintenance workers were assigned to troubleshoot a chemical process system that could not pull sufficient vacuum. This was a routine job that they had done before.

2. The crew was the most experienced and knowledgeable on the maintenance staff.
A process operator had narrowed the process problem down to the vacuum system.

The vacuum systems used for this and an adjacent system required the flow of process air through narrow nozzles and these nozzles became clogged periodically.

Troubleshooting identified a clogged nozzle as the problem. The fix required disassembling the system for access.

When maintenance opened the system the worker who actually removed the part, passed out.

Believing that he had suffered a heart attack, his partner radioed for the plant’s Emergency Response Team to respond to a heart attack.
Process Area

Steam Injection vacuum system

Approx. 40'

Interior Stairs

Approx. 25'

Ceiling Vent

Heat Exchanger

Approx. 40'

Exterior Door

Not to Scale
Employer’s Emergency Response

• Within minutes, > 10 members of the plant’s (ERT) Emergency Response Team responded to the scene:
  – carrying AED’s and cardiac resuscitation equipment
  – none had a gas monitor
  – none wore respiratory protection

• When a 2nd maintenance worker collapsed & then a member of the response team said that he was woozy, a manager retrieved an air monitoring device.

• No one ever smelled hydrogen sulfide.

• When an air monitor was brought in, it instantly pegged at 52ppm for Hydrogen Sulfide at the doorway.

• The room was then evacuated
OSHA’s Focus

- Process & Equipment Evaluation
- Maintenance Operation
- Emergency Response
Two Chemical Processes shared a common vent/drain line for the vacuum systems

- Vent Line not inspected nor regularly cleaned

- Both processes had the same type of vacuum system using steam at 160 degrees C

- Only one of the processes used, 2-Mercaptoethanol (2-ME) which decomposed at 150-160 degrees C into Hydrogen Sulfide and Carbon Monoxide
Process Hazard Analyses, though not required by 29CFR1910.119, had been completed on each of the two processes, but several issues not considered:
- The interconnection of the processes (or the potential hazard thereof)
- The potential of the vacuum system to breakdown 2-ME
- Inconsistency of MSDS information eg., identifying a boiling vs. decomposition temperature
- History of apparent hydrogen sulfide exposures in that and the adjacent building
Problems with MSDS's

Process & Equipment Evaluation
MSDS for 2-Methcaptoethanol, aka 2-ME,

- **MSDS Supplier A** listed a Boiling Point = 149-161°C & thermal decomposition to hydrogen sulfide @ undefined temperature

- **MSDS Supplier B** listed a Boiling Point = 155.8°C & decomposition @ 157-158°C, but no decomposition product

- **Company’s MSDS** listed a Boiling Point = 157.7°C & decomposition product as hydrogen sulfide @ undefined temperature

- **MSDS D (from Internet)** listed a decomposition point not a Boiling Point of 157°C & decomposition formation of hydrogen sulfide
Maintenance Operations

The Employer had Lockout and Line Break Programs but they were not always implemented.

- Steam and process lines were isolated by double valving and bleeding **but valves were not locked out**
- Vent line to the vacuum system was never recognized as a hazard source and so, not isolated.
- When the ejector system was opened in preparation to rod out the nozzle, no **air testing for any gases was done** as none were expected.
Emergency Response

- In-plant emergency responders responded only to a heart attack
- No air testing equipment was brought to the response scene
- No responder reported smelling anything
- No responder wore any respiratory protection
- The emergency response plan did not require air testing for medical emergency responses
Violations

29CFR1910.147(d)(3) for not isolating drain/vent line nor following safe line breaking procedures
29CFR1910.147(d)(4)(i) for not locking out process and steam lines,

29CFR1910.1200(d)(2) for an inadequate MSDS – did not state that 2-ME decomposed to H2S at a set temperature or range nor identified the polymerization capability of 2-ME
29CFR1910.147(d)(6) for not assuring isolation or safety of the common vent line, and,

29CFR 1910.120(q)(2)(iii) : not wearing respiratory protection before an air assessment


The Company’s response

* Settled the OSHA case informally
  • Separated the vent systems
  • Revised their lockout and line breaking procedures and retrained their workforce on both
  • Revised their MSDS for 2-ME
  • Revised their PM procedures for vents
  • Revised their Emergency Response Procedures
  • Greatly improved their H2S monitoring program:
    – purchased >100 H2S personal monitors
    – Installed additional area monitors for H2S
Lessons Learned

- Assess all lines in a process
- Check chemicals reactivity and decomposition potential thoroughly for the chemicals in process
- 100% Lockout and Line Break procedure use
- Respond to emergencies in a chemical facility as if it is a chemical-related emergency, make no assumptions
- Protect the responders first
- Watch out for chemicals that can produce Hydrogen Sulfide
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Questions?