Understanding and Applying the Science: A Case Study in Eliminating Process Fires

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Why Bother?

• **Fire**: A process of combustion characterized by heat, smoke or flame, or any combination of these, or where there is evidence that this has occurred.

• **Uncontrolled Process Fire**: Unanticipated fires in the process area that were not specifically expected and planned for.

• Every process fire has the potential to be a major fire. The only difference between a minor fire and a major fire is time.
Characteristics of Flammable Liquids

Partial Pressure (Conc)

Mists

Flammable Mixtures

Upper Limit

Lower Limit

Flame Temperature

Temperature

Auto-Ignition

AIT
Characteristics of a Nitrogen-Rich Atmosphere

![Graph showing the relationship between oxygen concentration and ethylene concentration.]

- **Oxygen Concentration, v/v**
  - 25
  - 20
  - 15
  - 10
  - 5
  - 0

- **Ethylene Concentration, v/v**
  - 0
  - 2
  - 4
  - 6
  - 8
  - 10
  - 12
  - 14
  - 16
  - 18
  - 20
  - 22
  - 24
  - 26
  - 28
  - 30
  - 32
  - 34
  - 36
  - 38
  - 40

- **Areas of Interest**
  - **Impossible Mixtures**
  - **Flammable Envelope**
  - **Capable of Forming Flammable Mixtures with Air**
  - **Non-Flammable**
Case 1 – Hot Oil System
Recommendation 1

• Remove the wooden pallet and hoses from the dike. If it is necessary to keep the barrels inside the dike, place them on the concrete floor or on a metal pallet.
Case 2 – Hot Oil System
Recommendation 2

• Cover the ends of the heaters with an expanded metal shield. This will allow inspection of the heaters while preventing flammable material from coming in contact with the heaters. (It will also protect employees from burns).
Case 3 – Portable Fan
Case 3a – Permanently-Installed Fan
Recommendation 3

- This installation is a temporary fix that has become a permanent installation. The fan should be mounted in a position to provide proper ventilation and permanently wired into the building electrical system. (A further benefit will be elimination of an obstacle in the normal work area.)
Case 4 – Polystyrene Regrind Blower
Recommendation 4

- Repair the leak properly (duct tape is not a permanent solution). There was also a problem with a smaller leak on the grinder itself. The leak was due to a poor gasket in the grinder. This was being addressed by maintenance with the aim of eliminating the leak.
Case 5 – Flammable Storage Cabinets
Recommendation 5

- As a minimum, the bottom vent needs to be removed to allow vapors to escape. A better solution is to use a fan connected to the bottom vent to exhaust the vapor outside the building, thereby providing a continuous purge of the cabinet.
Case 6 – Rubber Dissolver Area
Recommendation 6

• Discontinue use of the plastic bucket by replacing it with a grounded metal tray or pail. Bond the tray with the filter to assure the electrical potential is the same. Remove the adsorbent pads from the area. They should be used to clean a spill and then removed for disposal in an area outside the operating unit. Disposal in a closed, airtight container is the best solution.
Case 7 – Rubber Conveying
Recommendation 7

• The best rubber installation is to grind the rubber at grade and convey it pneumatically to a cyclone separator above the dissolver tank. The rubber is then fed to the dissolver through a rotary feeder, which provides a sufficient barrier between the styrene vapors and the rubber chips. This would require a significant redesign, but is probably the correct solution to this rubber-grinding operation.
Recommendation 7 (cont’d)

- An alternate solution might be to chill the rubber prior to grinding. This improves the operation of the grinder and reduces the activity of the rubber chips. Operations noted that in the past the operation has seemed to work better in cold weather. This solution is not without capital cost implications.
Case 8 – Waste Disposal
Recommendation 8

• Oily rags should be placed in an airtight container outside the work area. Protectoseal provides a very satisfactory fresh/used rag arrangement. Oil soaked materials of any kind, like the cardboard, should be removed from the operating area for proper disposal.

• The leaks of hydraulic oil must be reduced as much as possible.
Case 9 – Hydraulic Oil to Die Screen
Recommendation 9

• Inspect the hydraulic oil line to determine the extent of embrittlement. If deterioration has occurred, replace the piping with a suitable material.

• The site personnel also suggested that a better solution might be to replace the hydraulic screen-pack changer with an electric unit. This would provide a design that would increase the inherent safety aspects of the system.
Case 10 – Polystyrene Compounding Area
Case 10a – Polystyrene Storage Silo
**Recommendation 10**

- The Operations Leader discussed the concern with the Area Engineer and found they could install a vacuum breaker on the bin. These are readily available and proven to operate effectively.

- When we left the site, plans were underway to modify the bins. This should make a significant difference in maintaining the dust-free operation.
Final Thoughts

• The examples above provide insight into the type of situations that exist.
• The tour of the site lasted less than 3 hours.
• The fires that would occur are mostly minor, but they are uncontrolled process fires.
• The cost to prevent them is also minor in most cases; but fires can only be eliminated if those who are involved in the day-to-day operation, maintenance, and engineering are aware of the risks.
Final Thoughts

• Many sites use adsorbent pads and leave them in place for days, weeks, or months without recognizing the fire risk.
• Employees need to understand associated fire technology; not all staff have the basic background to pick out these hazards.
• Employees must be able to recognize the hazard to eliminate process fires.
• The training being conducted is aimed at providing these skills.