NO$_{X}$ RELATED COLD BOX INCIDENT

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Introduction

• Cold Box Overview
• What Happened?
• How did it Happen?
• Why did it Happen?
• Recommendations
• Questions?
BASF FINA Petrochemicals Overview

• JV between BASF Corporation and TOTAL PETROCHEM.

• Operational 2001 – Lummus Design

• Nameplate – 950 KTA Ethylene

• Naphtha based Cracker

• Located in Port Arthur, Texas

• Adjacent to TOTAL Port Arthur Refinery
Cold Box Layout
What Happened?

• Cold Section in Standby due to Hot Section Upset

• Cold Box Bottled-Up

• Liquid was Maintained in Cold Box Drums

• Shortly before 8:00 on Mar. 13, 2008 a loud “bang” with white powder on the ground was reported

• Later determined a detonation occurred in the coldest section of the Cold Box

• The detonation destroyed 4 ft of 6” process piping and 2 ft of a 1” drain line
Vapor outlet from Separator

Vapor inlet to Cross exchanger, E-3009X, from separator.

Liquid inlet to Cross exchanger, E-3009X, from separator.
Fragments of the 1-inch SS drain line

Note the long narrow ‘banana peel’ pattern of the fragments, characteristic of a detonation.
How did it Happen?

- Likely caused by butadiene reacting with NO$_x$ liquids in drain line on low pressure methane pass

- Butadiene migrated from front of Cold Box to back end due to leaking JT Valve.
The leaking Joule-Thompson valve had two effects:

1. Lower pressure caused butadiene to carry over from the 2nd stage drum.
2. Leakage drew heavier material from front of the chilling train to coldest section where NOx liquids can accumulate.
How did it Happen?

- Failure to drain cold box drums during standby operation
- Operations not aware of drain line – not indicated correctly on P&IDs
Why did it Happen?

• HAZOP did not identify hazard of leaking Joule-Thompson valves

• Procedures focused on Temperature only, not Pressure / Temperature Equilibrium

• No reliable means of preventing butadiene carryover during startup and shutdown
Recommendations for Cold Box Operators

- Consider draining drums containing butadiene when forward flow is lost
- Identify critical pressure / temperature relationships
  - Industry literature had focused on temperature
- Develop procedures assuming NO\(_x\) will always be present
- Review your HAZOPs based on any new information provided by this incident
Recommendations for the Rest of Us

✓ Packaged Systems
  • Know what you are getting
  • Verify you get what you wanted

✓ Process Safety Information
  • Verify PSI prior to Start-Up (especially for Pkg Sys)

✓ Full understanding of reaction hazards

✓ Operating Procedures
  • Ensure Key parameters are properly specified
Questions?