

Effective learning from incidents

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After Bhopal
“Protecting Society
Together”



EPSC

THE PROCESS SAFETY NETWORK

Legitimate
Network

Industrial Best
Practices

**Active
Topics**

Pharma:
Dust &
Statics

CHEF /
RAST

SQRA

Leadership &
Organization

EPSC



Digitalization

PS
Fundamentals

Human
Performance

Incidents Repeat – Can we learn more effective?

Oil transfer to a tank



Ammonium Nitrate storage



Effective & Practical Learning

EPSC Learning Sheets

- ▶ Raise awareness on a typical case
- ▶ Anonymous (no shame no blame)
- ▶ A photo with two sentences
- ▶ Relevant aspects
- ▶ The discussion creates the effect
- ▶ Easy accessible in local languages

www.EPSC.be



Learning Sheets



Imploded Storage Tank

EPSC Learning Sheet, June 2019



What Happened:

After cleaning with steam a tank was quenched with cold water to shorten the cooling time (not normal practice). The tank vent was not calculated for the vacuum resulting from this rapid quenching operation, resulting in a collapsed tank (without liquid release).



Imploded storage tank

A larger vent size was installed after the incident



Aspects:

- Atmospheric storage tanks are not designed to withstand external pressure on the tank wall. A pressure as low as 20 mbar below atmospheric pressure can cause tank damage
- The force on the wall can be high even at low pressure as the tank wall surface area is very large: $\text{Force} = \text{Area} \times \Delta P$
- Consider all scenarios resulting in pressures below atmospheric and make sure vent sizes are adequately designed for these, including abnormal operations
- Make sure vents and safety devices remain operable: fouling bird nests, plastic bags, have all caused tank implosions

Atmospheric tanks are usually not designed for under pressures and can be damaged easily

Learning Sheets



SM cloud from a storage tank

EPSC Learning Sheet September 2020

EPSC

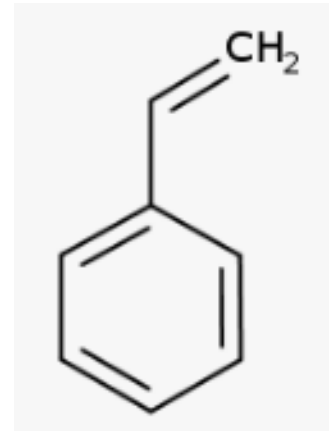


What Happened:

Styrene Monomer (SM) polymerised exothermally in two storage tanks, evaporating SM that was released from the tank. The toxic gas cloud killed 12 and injured ca 1000 in the area.

Aspects:

- SM evaporation created a lethal concentration of 5000 ppm at 200 m distance, killing and injuring nearby civilians.
- SM polymerisation must be avoided by keeping the temperature below 20°C and adding an inhibitor (TBC).
- Control tank temperature with a SIL rated cooling system.
- Understand inhibitor (TBC) depletion characteristics, measure it and add it in time to stop a runaway reaction.
- Keep O₂ concentration 15-20 ppm in the liquid (that equals about 5% in the gas phase) to help inhibiting polymerisation.
- Keep circulation over the tank to avoid stratification.
- Storage siting: take off-site exposure into account.



Styrene

Styrene Monomer storage needs attention

Learning Sheets



Work at Wrong Location

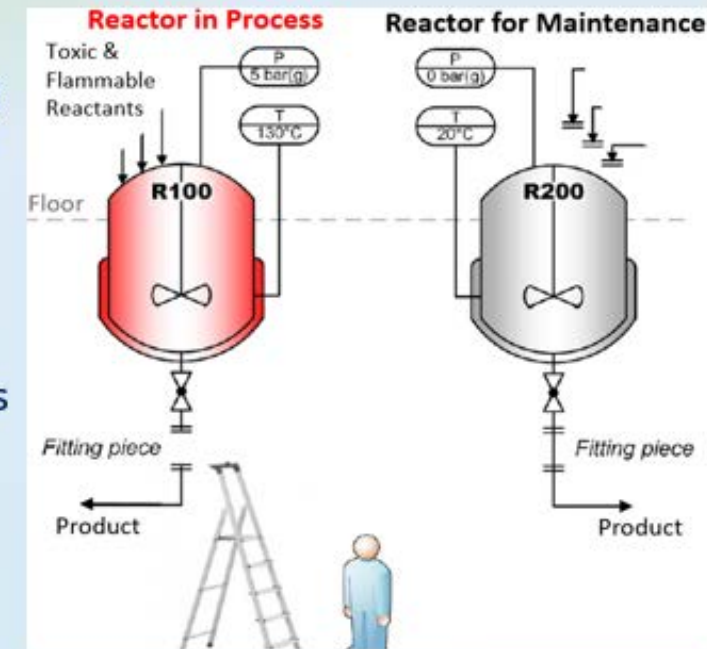
EPSC Learning Sheet , April 2020

EPSC



What Happened:

A mechanic was requested to remove the spool piece below a reactor that was well isolated for maintenance work. Unfortunately he went to the wrong reactor that was in use with hazardous chemicals.



Aspects:

- Mechanics & contractors are not as familiar with the plant as operators and can easily end-up at a wrong location
- It is the responsibility from operations that maintenance people and contractors work at the right equipment
- It is essential to instruct the mechanic at the work location in the field and assure the task is fully understood
- Make sure that critical flanges to be opened in the field are well indicated, e.g. by a label. In this case the reactors were not identified at the lower floor where the work was done
- Just a permit to work, without instruction at the work site, is not a good barrier for this typical mistake

Validate the right location in the field

Learning Sheets



Unplugging

EPSC Learning Sheet Sept 2021



What Happened:

In 1989 the Philips Pasadena disaster started after an ethylene release that ignited.



High pressure ethylene might have been used to blow out residual PE polymer from a reactor settling leg. A LOTO locked ball valve was opened to do so.

Process Safety Fundamental:
Unplugging of Equipment

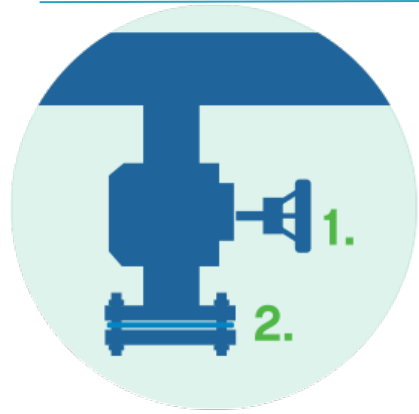


Aspects:

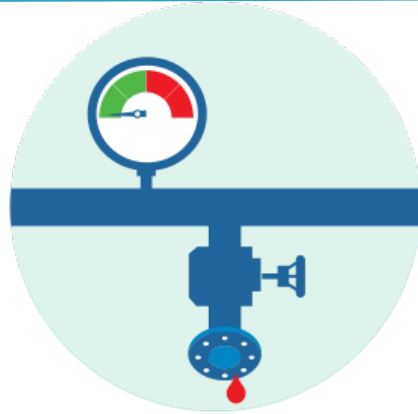
- Polymers have the tendency to plug lines that can restrict flows or block instrument lines.
- Plants generally have no good procedures to remove plugs and operators tend to become creative to avoid shut down.
- The hazards of removing plugs need to be well understood and opening of equipment to reach the plug need to be avoided or controlled by senior management.
- Do not use pressure of hazardous chemicals to de-plug pipe lines or process equipment.
- Before opening an installation to remove polymer or plugs, remove hazardous chemicals, pressure and energy.

Unplugging of equipment needs an approved plan!

EPSC Process Safety Fundamentals



Double Isolation



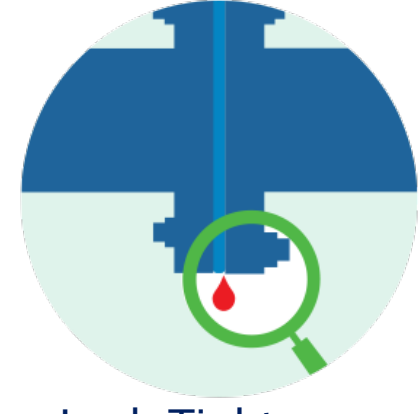
First Line Break



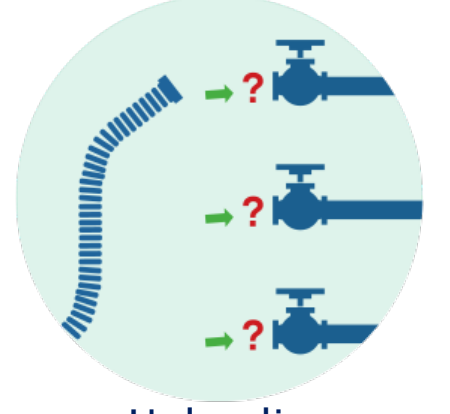
Flexible Hoses



Furnace Burners



Leak Tightness



Unloading



Open Drain



Operating Limits



Overrides



Plugged Equipment



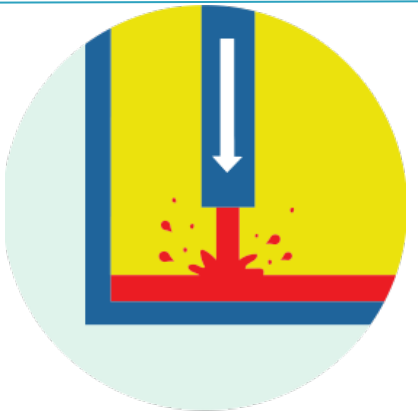
Critical Equipment



Reporting



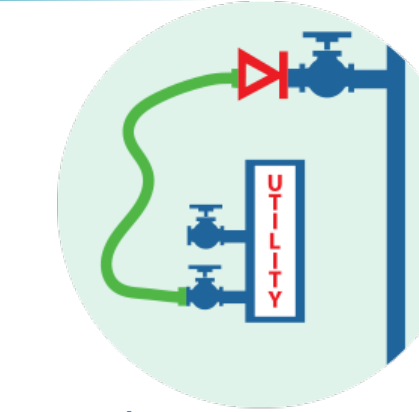
Run Away Reaction



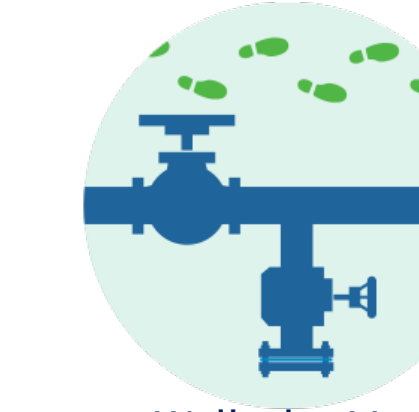
Splash Loading



Line of Fire



Utility Connections



Walk the Line



Single valve

EPSC Members



TOTAL

Nouryon

EASTMAN

lyondellbasell



Linde



Linde

Avebe



EVONIK

sasol



HUNTSMAN



Boehringer Ingelheim



DU PONT



GlaxoSmithKline



MERCK



BOREALIS



NESTE



ExxonMobil

Cargill



worldsteel ASSOCIATION



SITECH

Johnson & Johnson



our shared responsibility to protect society

