

A photograph of an industrial facility, likely a chemical or petrochemical plant. The main focus is on two large, cylindrical green storage tanks. To the left of the tanks is a complex, multi-level orange metal scaffolding structure with numerous ladders and walkways. The tanks are situated on a concrete base. In the background, there are several tall, dark industrial chimneys or smokestacks against a blue sky with scattered white clouds. The overall scene is industrial and somewhat desaturated.

# SDA Dust Explosion

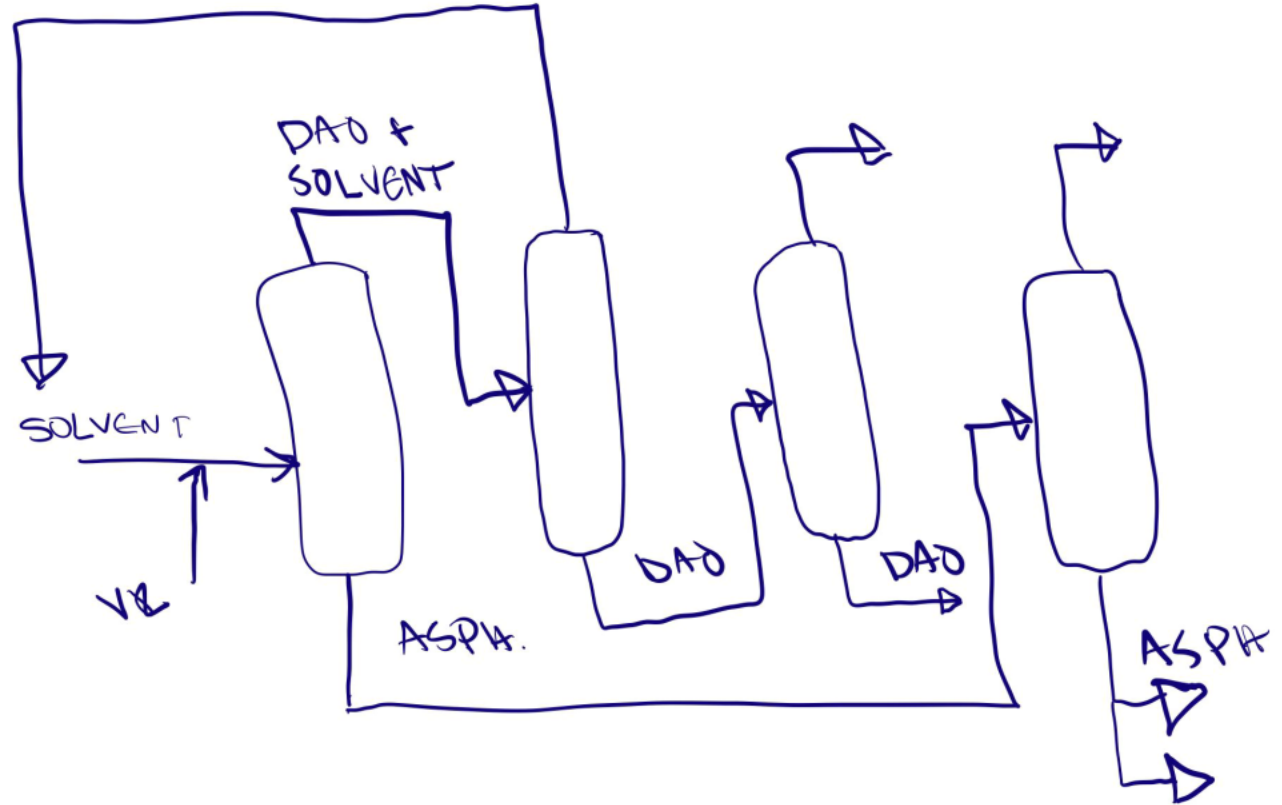
EPSC Antwerp Sept 14th  
Teemu Suursalmi

# SDA Solvent DeAsphaltene Unit

- Started 2017
- Feed Vacuum residue
- Asphaltenes are removed via supercritical extraction
- Solid materials handling



## Process flow diagram SDA



# SDA Dust Explosion

**Porvoo Refinery PL4 | 2.12.2019**

Dust Explosion and Personal Injury



## What happened?

Asphaltene was loaded into a bulk truck trailer. At the final stage of the loading, during the emptying of the loading arm bellow, a flash fire occurred, which was followed by a secondary dust explosion. Truck driver was having full PPE and suffered only minor injury.

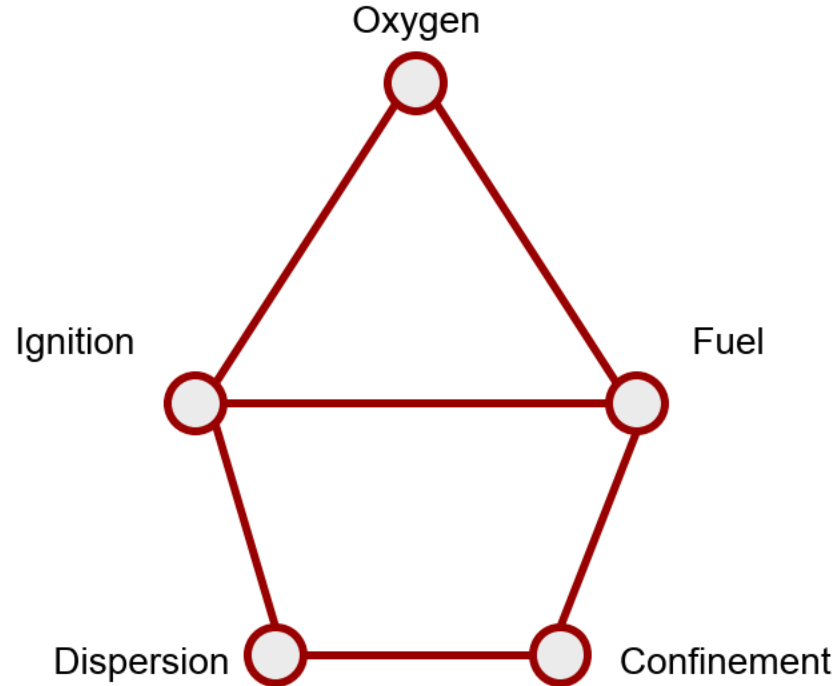
## Why it happened?

During the loading of asphaltene, the loading bellow was charged electrically due to asphaltene flow. The charged bellow created an electrostatic discharge that ignited the fine asphaltene dust inside the bellow. Actions related to prevent and mitigate dust explosion risks were inadequate.

## Key lessons learned

- Inherently Safer Design options are required in asphaltene loading systems to eliminate the risk of dust explosions.
- Competencies need to be assured to sufficiently identify unfamiliar hazards of new technologies.
- Dust Hazard Analysis (DHA) needs to be systematically carried out if combustible dust is involved in the operation. → Analysis of dust properties in designed process conditions sets the basis for sufficient hazard identification and risk analysis.

# Dust pentagon

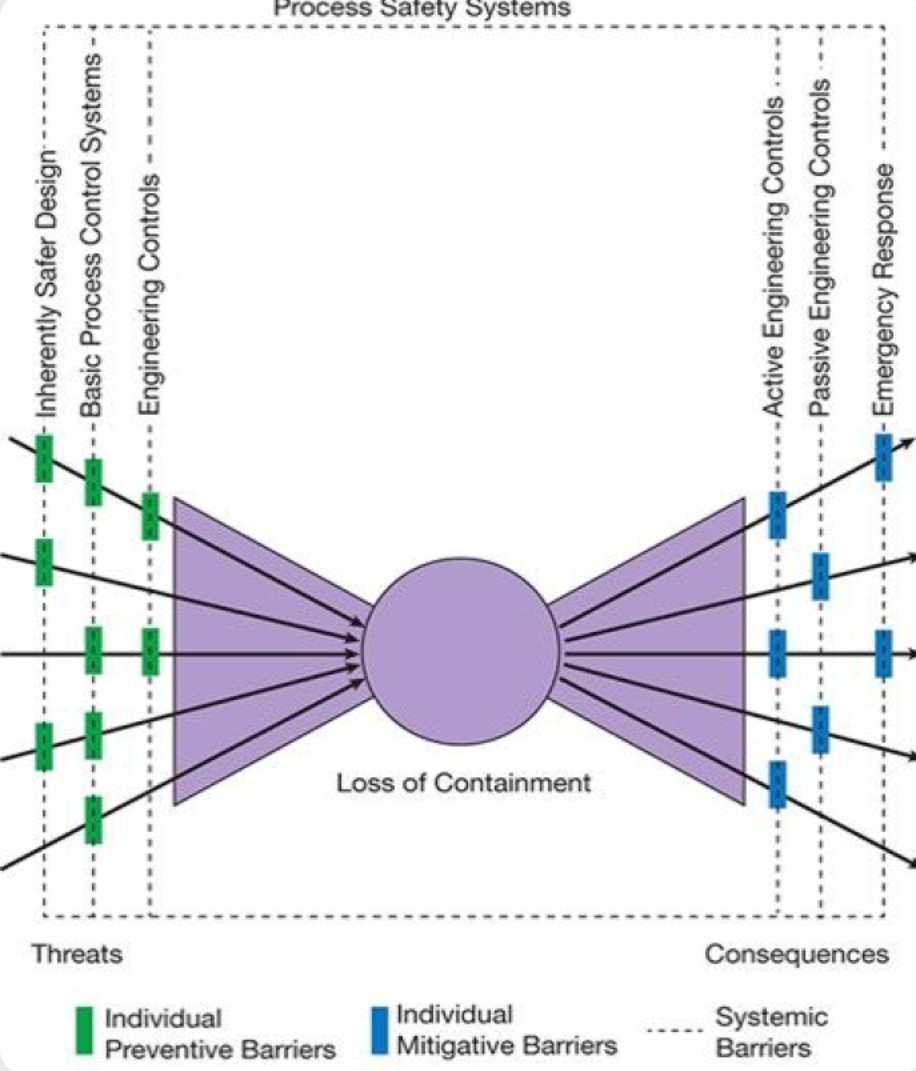






## Corrective actions

- Asphaltene loading system safety modifications (SDA Retrofit project)
- Update of HSE Design Guidelines to include dust hazards
- Update of SDA asphaltene loading system PHA (Process Hazard Analysis) and DHA (Dust Hazard Analysis)
- Arrangement of proper training to ensure competence when handling dust material

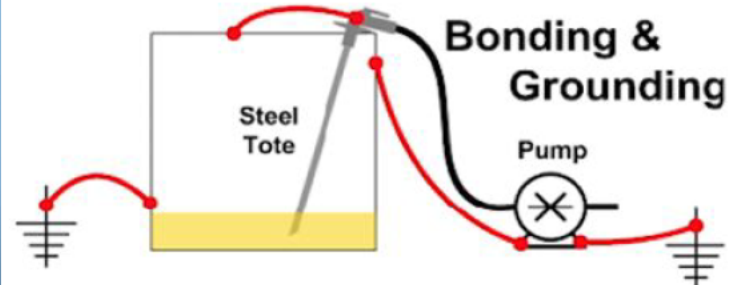
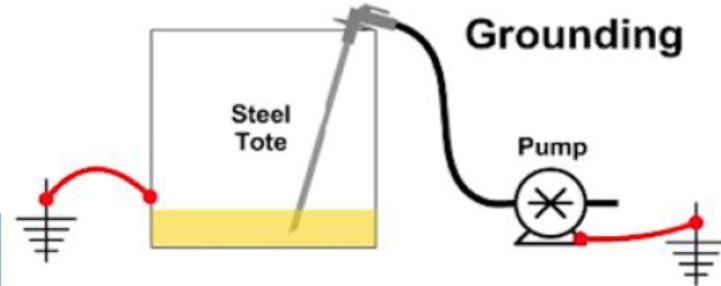
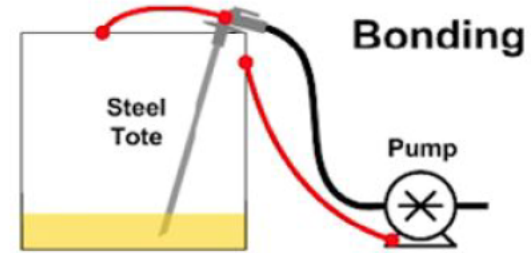
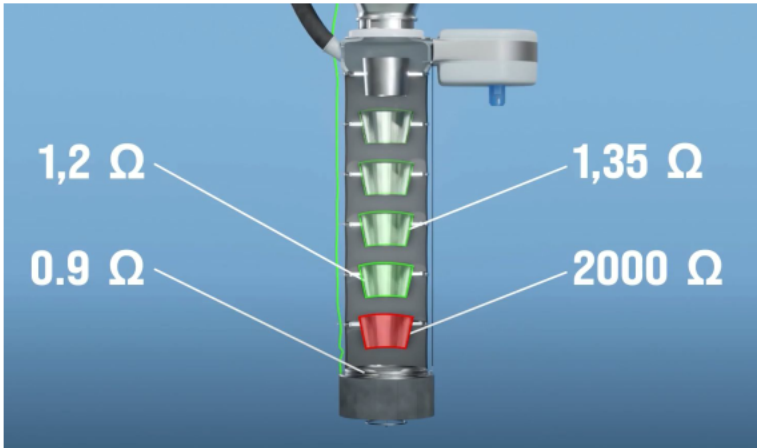


## What is missing?

- Design changes
- MOC
- ...

# Bonding vs Grounding

- What is the difference?
- 5 year check cycle for cabling
- Understanding of safety critical equipment in this area





# SDA Retrofit project

- Dust handling system upgrade (4 blowers and 4 filters)
- New type of loading bellows (6 pcs)
- Explosion protection system (detection, protection)
- Modification of current system equipment to meet ATEX rating with lower MIE 3-10mJ
- Improved cleaning (vacuum) system for asphaltene
- Steels structure modifications to enable area cleaning and preventative maintenance
- Secure bonding and grounding of equipment
- Add camera/dust monitors to loading area
- Re-locate/modify loading panel for truck driver





## Universal organizational lessons of the incident

- Understand the hazards
- React to warning signs
- Inherent safety and risk management
- Identify unfamiliar hazards and ensure safety of new technologies
- Dust Hazard Analysis based on correct properties of dust

# No Harm. Together.

