SCIC
SINGAPORE CHEMICAL INDUSTRY COUNCIL

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PreDigest

Tank hazards and incidents

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Lesson learnt from JAC Storage Tank Fire

Incident summary:

On 20th April 2016, a major fire broke out at former Jurong Aromatics Complex (JAC) facility in Jurong Island, Singapore. The fire started at a condensate storage tank which developed very rapidly, and ensued into a full surface tank fire within minutes of initial roof collapse. The tank involved was a 46.6 metre diameter, internal floating roof type storage tank, and the fire took about 5 hours to extinguish.

The primary cause of fire was suspected to be due to lightning strike. The extended roof collapsed and subsequently, fire spread to the entire tank. This fire incident is a reminder to tank storage facility owners on the importance of rim seal design, roof earthing assembly and associated fire protection provision.

Source : Reaction 2016 Rescuers in action publication by SCDF

Incident learning:

Countries like Singapore are subjected to high lightning strike rate, where each square kilometre of land can be struck up to 16 times annually. Therefore, extra considerations should be provided for floating roof earthing design and rim seal fire protection on low flash point liquid storage tank facilities.

Design of storage tanks should consider the following fire scenarios:

1. Rim Seal Fire

A rim seal fire takes place where the seal between the tank shell and floating roof has lost its integrity and releases flammable vapour. If the vapour is exposed to an ignition source, a fire will start.

2. Boil Over

Boil over may occur when there is a fire in a storage tank storing heavy hydrocarbons or a blend of hydrocarbon liquids (e.g. Crude). The heat from the fire at the top is transferred downwards and converts water, which settled at the bottom of the tank, into steam. The water boils and expands 1,500 times and rises, carrying burning crude with it. A boil over in tank covers an area of approximately 10D(iameter) of the tank in downwind direction and 5D(iameter) of the tank in crosswind directions.

3. Slop over

It is a phenomenon which occurs when water is applied to full surface tank fire. The water gets accumulated at the bottom and subsequently results in overfill of the tank.

4. Vent Fire

Vent fire takes place in fixed roof tank when one or more vents is ignited during flammable vapour release. The presence of flammable vapours is mainly either due to tank filling / emptying operation or tank's breathing cycle. Most causes of vent fires are due to lightning strikes or some ignition source nearby.

5. Full Surface Fire (Fixed Roof Tank)

A full surface fire of fixed roof tanks may develop due to vent fire escalation. A Vapour Cloud Explosion (VCE) can occur if tank vapour space is within the flammable range during the flame flashback and when flame arrestors / Pressure Vacuum Vents are not in working condition. For tanks constructed as per API 650, the roof should be separated from the shell at weld seam during an internal explosion. Depending on the force, the roof may be partially separate ("fish mouth" opening) or fully blown-off from the tank.

6. Full Surface Fire (Open Floating Roof Tank)

Full surface fire occurs when the tank floating roof has lost its buoyancy and the entire liquid surface has been exposed and involved in the fire.

For more information:
Fire case studies, refer to Singapore Civil Defence Force (SCDF)'s website (https://www.scdf.gov.sg) under "Rescuers in action" (technical publication that invoke thought provoking discussions and interesting case studies).

Process Safety is Everybody's Responsibility!

An initiative of the Process & Engineering Committee

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