

Explosion in a Floating Roof Tank under Construction

Introduction

A fire incident followed by explosion took place at a project site of a refinery while making holes on the channel for fixing the primary roof seal on tank, which was under construction.

Four contract workers got injured in the incident. Two contract labourers died in the episode one at the spot while other subsequently at Hospital. The helper of gas cutting operation died on the spot on the floating roof tank due to explosion.

OISD personnel were deputed to investigate the cause of the accident and suggest suitable remedial measures to prevent recurrence.

The Incident

The incident of fatality occurred while making holes on the channel for fixing the primary roof seal of floating roof tank. Due to explosion in the chamber of pontoon roof, one helper of gas cutting operation died on the spot with burn injuries. Other three workers who received burn injuries were shifted to hospitals for treatment and subsequently one of them succumbed to injuries later.

Investigation Modalities

Investigation was carried along with the team of Refinery Management:

- Site visit to the concerned refinery.
- Interview on the incident with the Sr. executives of the refinery, Contractor & its supervisor, Safety officer and other personnel.

Sequence of Events

The sequence of the events are:

- A numbers of storage tanks were under construction.
- Works in the storage tank started as per practice in the morning.
- Painting in three chambers of pontoon of floating roof tank started in the morning. Simultaneously various other activities viz. gas cutting, drilling, seal job were also going on.

- After completing the painting job, the workers came out and were taking rest near shell of the tank. The containers containing paints were left near the chambers itself.
- During the same time one gas cutter with his helper was making holes in the channel with the help of gas cutter.
- Suddenly there was an explosion in the chamber of pontoon and paints got scattered on the floor. The helper got engulfed in the fire & died on the spot.
- Four injured workers including gas cutter were removed from the site of incident & taken to hospital for treatment. One worker was released after first aid treatment and other workers were referred to city hospital.
- The seriously injured gas cutter succumbed to his injuries subsequently.

Observations

- At the time of incident 21 people were working on the roof of the tank for various activities viz. gas cutting, painting, drilling, and seal jobs.
- The Paints viz. Epoxy Primer and Epoxy Zinc Phosphate Primer, used are highly flammable in nature.
- The thinner which is also used in the painting job is highly volatile and inflammable.
- Application of the paint was done through paint gun i.e. spray painting in the confined space.
- Since sufficient time was not given for paint to dry/aeration to dilute the atmosphere inside the confined pontoon chamber, the paint vapors formed an explosive mixture.
- Three workers of painting contract were taking rest near the shell of tank after the painting job inside pontoon chamber. The containers used for painting were kept near the manhole of the chamber.
- The gas cutter was making holes in the channel (situated very close to the chamber manhole) without knowing that it is dangerous to carry out hot job in presence of containers containing liquid paints which is flammable.
- The extent of explosion after the fire resulted in rupturing the top plate of the pontoon chamber at two locations.

Root Cause of the Incident

Many jobs were taking place simultaneously in the tank including hot job near to the pontoon chamber which is highly unsafe.

The series of events that resulted in fire and subsequent explosion is explained below:

- Sufficient time was not allowed for the wet paint to dry. Vapour formation took place and was confined inside the pontoon chamber.
- Thinner which is applied to the paint is highly volatile and inflammable formed an explosive mixture. Normally mineral turpentine oil is used as thinner which is volatile and inflammable. Due to hot climate outside, the thinner got evaporated and formed explosive mixture.
- The hot job in the nearby vicinity acted as an ignition source and triggered the explosion.
- The casual labour did not have any knowledge on this phenomenon.
- Supervisor for the entire job was also lacking in knowledge.
- There was no tool box talk prior to commencement of the job.
- There was lack of coordination.

The escaping vapour from the container formed an explosive mixture and the gas cutting operation acted as ignition source. The ignition of mixture travelled to the pontoon chamber and resulted in explosion rupturing the top plate of the pontoon chamber along the weld of deck of floating roof. The impact also damaged the adjacent chambers' beams.

Recommendations / Learnings from the Incident

- "Tool Box" meeting must be conducted by the Supervisor/Area in Charge at the site prior to start-up of the work.
- Regular safety briefing to the workforce must be carried out prior to start of the jobs on each day both by Contractor and Consultant.
- Proper coordination is a must while so many activities are undertaken at a time.
- Permit for working in a confined space should be taken including that for carrying out the hot job.

- Hot job should not be allowed unless ensuring the absence of explosive mixtures in the confined space.
- Supervisors should be trained adequately to handle critical jobs & emergency situations on day to day basis.
- Job safety analysis by a team of multidisciplinary personnel should be ensured for all critical jobs.