

CASE STUDY

OISD/ CS/ 2025-26/ P&E/ 10

Dt.: 15/09/25

INTRODUCTION

Title: H₂S exposure & fatality on external floating roof tank deck

Location: Oil Movement & Storage area of Refinery

Loss/ Outcome: 2 Fatalities

BRIEF OF INCIDENT

In the morning shift, an OM&S area operator was sent to inspect the slop tank roof to check for rainwater accumulation on the floating roof deck. As there was no contact from him for quite some time, another operator was sent to find him. 2nd operator informed on walkie-talkie that 1st operator has fallen on roof deck of the slop tank. He attempted to evacuate the first operator by going onto the floating roof deck. 3rd Operator, who was in near-by area, rushed to top of slop tank and saw both operators lying on the floating roof deck. He communicated the same on walkie-talkie and asked for emergency assistance.

Both operators were rescued and administered life-saving measures at OHC & nearby hospital. The two were declared dead subsequently.



OBSERVATIONS / LAPSES

1. The concentration of H₂S on slop tank was observed to be quite high (in the range of 40 ppm at the top platform of the tank) even 48 hours post-incident.
2. Presence of oil was observed on the tank floating roof deck, indicating slippage/ escape of tank contents onto the roof floating deck upper side.

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3. The sample from the tank, that was isolated after the incident, was collected for analysis 11 days after the incident. 890 ppm H₂S was reported in the top sample.
4. The Initial Boiling Point (IBP) and Final Boiling Point (FBP) of the sample was 37°C and 355°C respectively, suggesting that the tank mainly contained Naphtha/ Diesel range intermediate streams.
5. Many units were restarted after turnaround few days prior to the incident and were under stabilization. Un-stabilized or un-stripped mid streams like Naphtha/ Kerosene/ Diesel from hydrotreating or hydrocracking units containing high H₂S were probably routed to the tank during their start-up and stabilization.
6. During the time of incident, floating roof deck was about 5 m below the top platform creating a confined space area.
7. In night shift prior to the incident, it was raining heavily. Slop tank level was observed rising and perceived to be fluctuating by OM&S panel officers.
8. All units shift-in-charge had informed the Refinery Shift Manager that no slop routing was being done to O&MS and the slop line battery limit valves of respective units were closed. Closing of slop line battery limit valves was not evident from logbook records of some units.
9. A previous experience of an EFR tank roof tilting during monsoon had occurred in the Refinery. Hence, the level rise being in contradiction to communication regarding slop pumping, led the OM&S Shift in charge and DCS panel officers to assume that the slop tank level rise and fluctuations were due to rainwater accumulation on the tank roof deck.
10. Night shift field operator who was sent onto the top of slop tank, to check for rainwater accumulation, noted in the logbook that he had felt foul smell near dip-hatch area. Also, he had mentioned in the logbook about presence of oil near foam dam area of the floating roof deck and a dead peacock on the south-side of the top platform.
11. Night shift field operator and both victims were not equipped with personal H₂S responders or other essential PPE for confined space. Also, no confined space entry permit was issued.
12. Tank was not originally designed for low flash point products or sour service (H₂S). Prior indication of H₂S presence was evident from the various inspection reports of the tanks.
13. As per inspection reports, slop tanks had a history of wet H₂S corrosion failures. Metallurgy upgradation to SA516 Gr.60, which is resistant to HIC (Hydrogen Induced Cracking) and SSC (Sulphide Stress Cracking), was recommended by inspection. But the same was deferred citing high cost and COVID-19 during M&I, opting instead to retain original metallurgy with epoxy lining protection.
14. A modification was implemented to route settled water of the slop tanks to the Sour Water Stripper (SWS) unit via an oil separator system. No Management of Change (MOC) documentation could be produced for this modification. In the OM&S operating manual, the reason for the modification was mentioned that high H₂S concentrations were observed during water draining from the slop tanks to the oily water sewer (OWS).
15. Despite prior knowledge of H₂S presence in the tank, the operating procedures did not mandate the use of personal H₂S responders while approaching or working on/ around the tank during activities such as gauging, sampling, water draining etc.
16. Though volatile products like naphtha were stored in slop tanks, they were not covered under Leak Detection and Repair (LDAR) program.
17. Slop tank was of single deck floating roof type, and its emergency roof drains were not removed in recent M&I.

REASONS OF FAILURE / ROOT CAUSE

The immediate cause of the fatalities was acute inhalation of H₂S gas at concentration above immediately dangerous to life or health (IDLH). The injured person had entered the confined space without the necessary permit/ OISD standard prescribed precautions.

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Various factors in the past as well as on the day of incident indicated presence of dissolved H₂S in the content of the slop tank and in the confined space above the floating roof deck enclosed by the tank shell. However, no cognizance of the fact was taken. Hence, suitable risk management measures were not identified/ implemented.

RECOMMENDATIONS

1. Installations shall identify H₂S rich streams that are frequently routed to slop tank and implement suitable measures to prevent the same.
2. A detailed inspection of the slop tank shall be carried out to assess the integrity & healthiness of floating roof & its appurtenances in case presence of oil above the floating roof deck is observed.
3. Installations shall carry out a comprehensive review of all storage tanks to ensure stored products compliance with design, adequacy of design and metallurgy for intended service, and conformance with applicable OISD standards.
4. Entry onto a floating roof tank when the roof is more than 3 meters below the top is classified as a confined space entry. Installations shall strictly enforce the Work Permit System to control an unauthorized descent onto the floating roofs deck. Prior to such entry, all safety precautions stipulated under clause no. 9.2 of OISD-STD-108 shall be complied.
5. Marking/ painting at 3-meter level (from the top of the tank) on the interior side of the tank shell shall be provided in all floating roof tanks to alert personnel about the confined space.
6. Hazardous areas where personnel could be exposed to H₂S, should have fixed H₂S detectors with audio visual alarm devices and should be supplemented with portable gas detectors.
7. Display of warning signages shall be done around the areas where potential of H₂S presence exists. HIRA shall be conducted in such areas and list of mandatory PPEs for the same shall be included in PPE policy and mandated.
8. Slop tanks that are intended to store/ receive volatile products should also be covered for monitoring the emissions through Leak detection and repair (LDAR) programme as per the stipulations laid out in G.S.R. 186 (E) & OISD-STD-224.
9. Awareness shall be created regarding potential areas of H₂S presence, associated hazards, and precautions to be taken through regular and refresher trainings.
10. Regular drills for H₂S exposure scenarios shall be conducted to familiarize personnel with the do's and don'ts in such cases.
11. Standard Operating Procedure shall be established and followed for monitoring and recording of slop transfer/ pumping by various units. Procedure shall include prior intimation to the OM&S department regarding quantity and quality of products being sloped by the concerned unit, enabling OM&S staff to ensure necessary safety measures in job associated with the slop tanks.
12. Provision of flow transmitter and temperature transmitter on slop lines of respective units shall be envisaged to facilitate identification and recording of quantities being sloped.
13. Emergency roof drains of all external floating roof tanks with single deck shall be blinded and removed in next available opportunity as per clause 4.9.3 of OISD-STD-108.
14. Management of change in line with OISD-STD-178 shall be followed for all changes inclusive of change in the material to be stored in tank (service).

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