

Case study: Confined space fatalities due to hydrogen sulphide

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This is a brief summary of a recent case report on confined space fatalities on board an oil rig during work involving gas sampling/monitoring inside the “spud cans” of the rig.

IOGP Life Saving Rules:



Confined space

What happened?

The summary is included as a reminder of the danger of Hydrogen Sulphide and as a means to facilitate discussion. The full case study, prepared by Dr Ajit C Kulkarni, of Hyperbaric Solutions, Mumbai, India, can be found [here](#).

The legs of a jack-up rig were fully retracted and the “spud cans” or feet of the legs were above the water and accessible for man entry. They were dewatered and forced ventilated for two days. A “gas free”, i.e. no H₂S present, “safe to enter” certificate had to be generated before a marine surveyor could enter for inspection.

The onboard diving team (three divers and a diving supervisor) was tasked to enter the “spud can” and obtain gas samples.

A diver using SCUBA (self-contained underwater breathing apparatus) equipment and a life-line, climbed down a 5m ladder and went into various corners. He was attended by another diver at the bottom of the ladder, also wearing BA. This diver was visible to the supervisor above. The third diver was a “stand by” diver dressed and ready to intervene – but not yet wearing BA.

Shortly after starting the operation, the dive supervisor saw the attendant at the bottom of the ladder collapse. On seeing this, the supervisor impulsively climbed down the ladder to assist, without wearing a BA set. Before he could reach the attendant, he too collapsed.

The alarm was raised and the ventilation rate was increased to drive out the “sour gas” from inside the spud can. As soon as this was done, a large quantity of gas emerged out of the narrow opening of the spud can and the “stand by” person was affected and collapsed.

All three persons who entered the spud can died; the “stand by” person was resuscitated, evacuated and admitted to intensive care at hospital.

What went wrong?

- Cause of death as determined by the Coroner as asphyxia. Circumstantial evidence pointed to inhalation of H₂S anticipated in the spud can. Spud can is almost 5 m in height and because of its typical internal construction, has numerous poorly ventilated nooks and corners.

- In addition, there were puddles of mud sludge which contain dissolved H₂S. The first person who went inside the spud can stirred up the collected H₂S in low areas and also the sludge containing dissolved H₂S. Being exposed to this, he became unconscious and collapsed.
- Ventilation exhaust could escape through a single opening only. The attendant who was at the bottom of the ladder was affected by the toxic gas produced and collapsed.
- The supervisor entered the spud can without BA and collapsed immediately.
- The “stand by” person, not wearing BA, was affected by the gush of gas coming out of the opening due to forced ventilation but being in the open, quantity of gas inhaled was much less and this person survived.

Hydrogen sulphide

Hydrogen sulphide is a highly toxic, colourless, combustible gas. It has the unmistakable odour of rotten eggs at low concentration. However, the sense of



What caused the fatality?

- Incorrect Breathing Apparatus (BA) – SCUBA diving equipment – was being used.
 - This is entirely – and in this case lethally so – inappropriate for use other than underwater. For enclosed space entry, self-contained breathing apparatus (SCBA) should be used; the face mask is gas tight, preventing entry of toxic gas, fumes etc. from entering. The face mask used in SCUBA underwater breathing apparatus is not tight fitting and some water gets inside and equalises pressure under the mask. If the mask was tight fitting, as the diver descends in water and there is an increase in ambient pressure, the mask will squeeze the face.
 - The two kinds of face mask look similar but are fundamentally different. [IMCA notes: there is a human factors lesson there for us all.]
- The team doing the job was not trained for the job and had no idea of the risks involved.
- There was no risk analysis of the job, no tool box meeting was held, no contingency plan prepared.
- The team doing the job was from a third-party contractor and was not inspected, audited or checked after arriving on the rig.

Possible solutions identified by author

- Proper planning and appropriate training for enclosed/confined space entry, particularly for third-party contractors.
- Such training should include:
 - Active monitoring for H₂S gas, including both personal and area monitoring.
 - Understanding of the dangers of H₂S and how it behaves.
 - Where to wear personal detection monitors, preferably over the chest pocket or on the collar, i.e. as close as possible to the nose.
 - Proper use of correct breathing apparatus.
 - Use of the “buddy” system.
 - Training and drilling of emergency response team.
 - Proper use of Permit to Work system and safe systems of work.

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