Accidents during Tanker Accident in Confined Spaces

Omar Mohamed Fouad Farid
Maritime Safety Institute, AAST & MT, Alexandria 1029, Egypt

Abstract: One of the major hazards when working onboard Tankers is working in confined spaces, improving the procedures in working in such spaces is obvious, but developing the equipments used in rescue operation is rare to happen, that’s why this paper is focusing on differentiating between the manual & more developed equipments used specially in rescuing the crew in such an adequate time, to save the workers’ life. The manual way is called “MUCKY CRANE” which is used for rescue purposes onboard tankers, in any of the confined spaces, should be replaced by excel crane which is air or hydraulic driven machine, to achieve better results. As safety precautions measures taken in such tasks are not enough for the required objective achievement. Such safety procedures have been discussed and critical situations have been pointed out.

Key words: Hazards, tankers, confined spaces, equipment development, rescue operations, mucky crane, excel crane, safety precautions measures, critical situations.

1. Introduction & Literature Review

Past accidents revealed the last 2 years, that many of accidents happened in different enclosed spaces. I managed to trace two cases, within the past 2 years, it was my hope to collect information as much as possible from these relevant accidents to be analyzed, drawn in different curves, diagrams, figures or pictures, charts in order, to become obvious that such accidents happen very frequently.

The first accident was in 2008 (www.maib.com), the victim intended to enter the pump room and fell down, on slipping from very high position close to the hatch opening. The second accident was in 2009 (www.maib.com). It happened in a similar way of the first one, but instead of the pump room, it happened inside a ballast tank, fortunately, the casualties were saved and still alive, after rescue operation took place as discussed below.

2. Legal Requirements

SOLAS Chapter II-4

(1) For tankers of 20,000 tones deadweight and upwards, the protection of the cargo tanks shall be achieved by a fixed inert gas system in accordance with the requirements of the Fire Safety Systems Code.

(2) The inert gas system shall be capable of inerting, purging and gas freeing empty tanks and maintaining the atmosphere in cargo tanks with the required oxygen content and shall be designed, constructed and tested in accordance with the Fire Safety Systems Code.

(3) Tankers fitted with a fixed inert gas system shall be provided with a closed ullage system (SOLAS 1974).

3. Controlling Atmosphere in Confined Spaces

3.1 A Confined Space

Confined space has limited or restricted means of entry or exit, is large enough for an employee to enter and perform assigned work, and is not designed for continuous occupancy by the employee. These spaces may include, but are not limited to, underground vaults, tanks, storage bins, pits and diked areas, vessels, and silos [1].

3.2 Flammable Limits

A mixture of hydrocarbon gas and air cannot ignite,
unless its composition lies within a range of gas in air concentrations known as the “flammable range”. The lower limit of this range, known as the “lower flammable limit” is any hydrocarbon concentration below which there is insufficient hydrocarbon gas to support combustion. The upper limit of the range, known as the “upper flammable limit”, is any hydrocarbon concentration above which there is insufficient air to support combustion.

The flammable limits vary somewhat for different pure hydrocarbon gases and for the gas mixtures derived from different petroleum liquids. In practice, however, the lower and upper flammable limits of oil cargoes carried in tankers can be taken, for general purposes, to be 1% and 10% hydrocarbon by volume, respectively [1].

3.3 Effect of Inert Gas on Flammability

(1) When an inert gas is added to a hydrocarbon gas/air mixture the result is to increase the lower flammable limit concentration and to decrease the upper flammable limit concentration. These effects are illustrated in Fig. 1, which should be regarded only as a guide to the principals involved.

(2) Any point on the diagram represents a hydrocarbon gas/air/inert gas mixture, specified in terms of its hydrocarbon and oxygen content. Hydrocarbon/air mixtures without inert gas lie on the line AB, the slope of which shows the reduction in oxygen content as the hydrocarbon content increases. Points to the left of AB represent mixtures with their oxygen content further reduced by the addition of inert gas.

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**Fig. 1** Curve of controlling atmosphere.
Table 1  International chamber of shipping, ISGOTT 5th edition, OCIMF.

<table>
<thead>
<tr>
<th>O2 content</th>
<th>Effect on human body</th>
</tr>
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<tbody>
<tr>
<td>19%</td>
<td>The minimum required content for normal breathing</td>
</tr>
<tr>
<td>16%</td>
<td>Difficult breathing</td>
</tr>
<tr>
<td>15%</td>
<td>Deep breathing with high pulse rate</td>
</tr>
<tr>
<td>11%</td>
<td>Very hard breathing with sluggish movement</td>
</tr>
<tr>
<td>10%</td>
<td>Pale complexion, unable to move</td>
</tr>
<tr>
<td>7%</td>
<td>Start panting, fast pulse beats, complexion as ash, mental damage</td>
</tr>
<tr>
<td>6%</td>
<td>No reaction in muscles, unconscious</td>
</tr>
<tr>
<td>Less than 4%</td>
<td>Fall down in a faint in 40 seconds without any sign.</td>
</tr>
</tbody>
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Table 2  International chamber of shipping, ISGOTT 5th edition, OCIMF.

<table>
<thead>
<tr>
<th>IG content</th>
<th>Effect on human body</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO2 (50 ppm)</td>
<td>Allowable concentration 5 ppm(13 mg/m3), toxic by inhalation</td>
</tr>
<tr>
<td>CO (traces)</td>
<td>Allowable concentration 25 ppm(55mg/m3), poisonous as it prevents O2 delivery due to its combination with blood hemoglobin.</td>
</tr>
<tr>
<td>CO2 (13%)</td>
<td>Allowable 5000 ppm(9000mg/m3), not poisonous but causes death by suffocation due to lack of O2</td>
</tr>
<tr>
<td>N2 (83%)</td>
<td>Not poisonous but drives the air away.</td>
</tr>
<tr>
<td>HE (traces)</td>
<td>No significant poison.</td>
</tr>
</tbody>
</table>

gas. It is evident from Fig. 1 that as inert gas is added to hydrocarbon/air mixtures the flammable range progressively decreases until the oxygen content reaches a level generally taken to be about 11% by volume, at which no mixture can burn. The figure of 8% by volume specified in these guidelines for a safely inert gas mixture allows some margin beyond this value.

(3) The lower and upper flammability limit mixtures for hydrocarbon gas in air are represented by the points C and D. As the inert gas content increases, the flammable limit mixtures change. This is indicated by the lines CE and DE, which finally converge at the point E. Only those mixtures represented by points in
the shaded area within the loop CED are capable of burning. Changes of composition, due to the addition of either air or inert gas, are represented by movements along straight lines. These lines are directed either towards the point A (pure air), or towards a point on the oxygen content axis corresponding to the composition of the added inert gas. Such lines are shown for the gas mixture represented by the point F.

4. Confined Space Checklist

(1) Has a risk assessment been carried out and documented?

(2) Cargo tank fan(s) started a minimum of 15 minutes prior to entry?

(3) Has the officer of the watch been informed?

(4) Are adequate communications available and tested?

(5) Has the frequency of reporting been established? (max. 10 min interval)

(6) Are personal gas monitors issued and operational?

(7) Have all enclosed space entry procedures been followed?

(8) Are emergency evacuation procedures fully understood?

(9) Have necessary initial atmosphere checks been carried out and recorded?

(10) Is there a system of recording who is in the tank?

(11) Record of gas tests;

(12) Oxygen: % (Vol.) Time H2S: % (PPM) Time;

(13) Hydrocarbon: % (LEL) Time Other: % (PPM) Time;

(14) Instrument(s) used calibrated [1]

Checklist technique is widely used allover ships at sea in different operations which proof adequate accuracy to avoid accidents caused by human element errors caused by avoiding one important step of the procedures resulting in an exact proper accident.

Checklist is composed of pre-planned step by step procedures, based on wide experience and leads to proper solution for any one operation problem. It can be laid down either preparation before, during or after certain operation checklists.

5. Problem Solution & Equipments

5.1 Rescues from Enclosed Spaces

When an accident involving injury to personnel occurs in an enclosed space, the first action must be to raise the alarm. Although speed is often vital in the interests of saving life, rescue operations should not be attempted until the necessary assistance and equipment has been mustered. There are many examples of lives being lost through hasty, ill-prepared rescue attempts.

Whenever it is suspected that an unsafe atmosphere has been a contributory factor to the accident, breathing apparatus and, where practicable, lifelines must be used by persons entering the space.

The uses of Excel Floor Cranes can be found in varied industrial applications from vehicles workshops to industrial factory. Its innovative design makes it a compact free standing unit, which helps in saving place when not in use.
The features of Excel Floor Cranes are as follows:

1. Robust construction;
2. Manufactured from hollow steel box section for superior strength & lightness;
3. Fitted with a safety relief valve for preventing overload;
4. Fitted with quality hydraulics piston rod;
5. Precision built hydraulic ram & pump;

Due to large volume of cargo tanks in VLCC (very large crude carrier), complete control of atmosphere is absolutely difficult, as measuring atmosphere contents inside the tanks is available in one position only, therefore, it is not possible to assure complete control of such atmosphere. This is the main reason for accidents involving improper control of atmosphere inside tanks.

After a checklist procedure and permit which has been issued a man can be allowed to enter such a space for some good reason, such as inspection, repair and maintenance. It happens all of a sudden that this person may drop at once fainted and unconscious. Complete rescue operation is alerted to save him, during rescue operation another accident may take place, if procedures are very slow or inaccurate to achieve proper operation.

Fig. 2 Excel floor crane.
Accidents during Tanker Accident in Confined Spaces

Fig. 3a  Manual mucky winch.

Fig. 3b  Manual mucky einch vela company VLCC photo.
6. Conclusions

- A mucky crane is not sufficient solution for emergency procedures in confined spaces.
- Slow handling of survivals can lead to death.
- Minimum number of personal entering the void space should not be less than 3 persons instead of 2, in order to ensure fast rescue operations prompted.
- Training of personal is most vital in such emergency procedures (max. every 3 months).

7. Recommendation

It is obvious to say in my opinion that fitting tanks with such recommended crane mentioned above, is very vital in emergency procedures, therefore the Egyptian administration should take notice of such recommendation to take necessary actions to inform Marine Safety Committee M.S.C of the International Maritime Organization I.M.O to spread such new requirements.

References