CHEMICAL TANKERS CARGO TANKS ATMOSPHERE CONTROL

Dobrin Ruselinov Milev

Naval Academy "Nikola Vaptsarov"

PhD, Associated Professor

Abstract: The chemical tankers intend to carry dangerous chemicals as well as flammable and other liquid products. For precautions of control and safety, there's no difference between general oil tankers and chemical tankers in principle, since general oil tankers intend to carry liquids with flammable hazards. Accordingly, precautions by safety and emergency for general oil tankers should apply to chemical tankers as basic. This is regarding the control of the atmosphere in the cargo tanks for flammable and toxic vapors. The vessel has the appropriate technical equipment to minimize the risk and potential hazards of the cargo handled. It is the crew on the management level that has to be familiar with the safety procedures and practices.

Keywords: chemical tankers, cargo tanks, inert gas, atmosphere control

1. Introduction

Chemical tankers are much more complicated than ordinary tankers. They usually have more cargo tanks, more valves, more pumps, more blanks, more lines. They may have onboard many different kinds of chemicals as cargo at the same time [3,5]. These cargoes may be bulk liquid substances, solvents, lubricating oils, vegetable and animal oils, petroleum products, and other such liquids. Care is absolutely essential throughout the whole operation. Not all of these cargoes are dangerous, but more of them will have some hazards connected with them. Vessel's crew must follow standing instructions at all times, whether or not cargo is dangerous [11,12]. One of these major pillars is the control of the tanks atmosphere. Precautions for cargo vapors are not different from those of general oil tankers in principles, in terms of inert gas systems (IGS). However, the chemical tanker may have much more hazards from cargo vapors than the oil tanker for their particular properties such as wide range of densities, less allowable concentrations for toxic vapors etc.

2. Means of Controlling the Cargo Tanks Atmosphere

There are four types of cargo tank atmosphere control:

- Inerting.
- Padding or blanketing, which is the process of filling the cargo tank and associated piping system witha liquid, gas or vapour which separates the cargo from the air.
- Drying which is the process of filling the cargo tank and associated piping system with moisture-free gas or vapour with a dew point of -40°C or below at atmospheric pressure[2].
- Ventilation forced or natural.

2.1. Inerting

The ships crew and responsible officer for cargo operations must have in mind the following:

- ✓ Agree and arrange the type and purity of inert gas required for the voyage with the ship's operator well before loading.
- ✓ Do not assume that the ship's inert gas system will be suitable for the chemical cargo to be loaded. In case of cargo contamination, it might be required to isolate the IGS from the cargo[8].

2.2. Padding/ Blanketing & Drying

- ✓ If possible, introduce the compressed gas into the cargo tank through a connection at the top of the tank feeding directly into the ullage space.
- ✓ Do not introduce it through the manifold or pump stack due to the risk of cargo displacement into the venting system and of tank over-pressurization.
- ✓ Ensure that the gas flow rate and pressure does not exceed the capacity of the venting system.
- ✓ Fit an operational pressure gauge at each tank.
- ✓ Record tank pressures on a daily basis.
- ✓ If an external source of gas is used for padding or drying, carry out a pre-transfer meeting with terminal to discuss and agree on the following:

- Gas volumetric flow rates (max and min)
- Intended gas pressure and allowed range.
- Method of line clearing.
- Amount of ullage space that is available for the line displacement.
- Size and type of connections.
- Valve alignment
- Sequence of events.
- Measuring units.
- Anticipated time of operation.
- Personnel roles.
- Safety measures to be implemented.
- Personal Protective Equipment (PPE) to be used.

3. Safety Precautions when using Nitrogen for padding or drying

Nitrogen is classified as an asphyxiate, since it displaces oxygen in high concentrations and creates an oxygen deficient (< 20.9%) atmosphere without any significant physiological effects[9].

One deep breath of 100% N2, is fatal. 100% N2, displaces CO2, and O2, completely from the lungs, resulting to immediate death, even when the person has been removed to clean air.

Nitrogen can be used for:

- As an inert gas medium:
  - In cargo tanks for blanketing;
  - During tank cleaning operations involving low flashpoint cargoes.
- Blowing cargo lines and cofferdams;
- Stripping operations.

Supply of Nitrogen may be done via:

- Nitrogen generators;
- Nitrogen storage tanks on board;

- Bottles;
- Shore supply.

3.1. When using Nitrogen:

- Confirm that Nitrogen is compatible with the Ensure crew is aware of hazards associated with nitrogen and actions in case of Nitrogen inhalation;
- Ensure personnel are aware that an oxygen-deficient atmosphere may be formed even on an open deck depending on the weather and the wind conditions;
- Use breathing apparatus when working in an area that could be exposed to Nitrogen;
- Display notices at the gangway and in other locations, as appropriate, warning personnel when nitrogen operations are taking place;
- Provide personal gas detection equipment measuring Oxygen level to all persons in the vicinity of cargo tank openings on deck;
- Do not use filter masks;
- Restrict access to the main deck area to personnel not directly involved in the operations;
- Carry out venting only above deck level, via P/V valves, gas-free pipes or mast riser;
- Fit a pressure gauge to each tank (minimum range -0.5 to 1.0 bar);
- Ensure oxygen resuscitation equipment is readily available in case of hypoxia due to nitrogen inhalation;
- Before entering any enclosed space that contained Nitrogen, follow procedures as per IMO MSC.1/1401 "Guidelines on Tank Entry for Tankers Using Nitrogen as An Inerting Medium"[4].

It is prohibited to pressurize a cargo tank more than its P/V(Pressure/vacuum) valve pressure setting.

3.2. Receiving Nitrogen from shore:

- Agree with terminal on maximum pressures and flow rates and safety precautions to be implemented;

- Avoid over pressurization of cargo tanks by:
  - Supplying Nitrogen though the vapour system rather than through the cargo lines, if possible;
  - Controlling the flow of the gas through a small diameter line fitted with a ball valve. Do not control the flow through the main cargo or vapour line manifold valve;
  - Ensuring delivery rate of nitrogen does not exceed the operational limits of the vessel's venting system.

3.3. Handling Nitrogen during voyage:

- Observe regulatory requirements and charterers instructions for maintaining the Nitrogen blanket;
- Record the tank pressure and Oxygen content on a daily basis;
- If necessary to maintain a Nitrogen blanket with positive pressure, maintain a pressure above 500 mm Water Gage, unless otherwise instructed by charterers[10];
- Add Nitrogen to maintain positive pressure as necessary.

4. Conclusion

The chemical tankers are the most complicated type of ships from operational point of view. This fact lead to extreme safety precautions especially regarding to flammable and toxic vapors which have to be monitored and controlled through all the means available onboard [1,6,7]. Therefore the managing crew have to be familiar and aware of the processes and technical equipment. All the practices have to be implemented in a manual for procedures and arrangements, regarding the safe operation and maintenance of the equipment.

References

1. Калинов, К., Колев, К., Станчев, О., Велинов, В. (2011). Управление на риска в морската транспортна система, Морски научен форум, том 2, ВВМУ „Н. Й. Вапцаров“, ISSN 1310-9278

2. Chemical Hazards Response information System (CHRIS), available at: https://www.govinfo.gov/app/details/GOVPUB-TD-PURL-LPS28226

3. Dimitrakiev D., Kostadinov O., Atanasova C. (2023). Interaction between management units of shipping companies via blockchain technology, Nase more 2023, 3rd International Conference of Maritime Science & Technology, University of Dubrovnik, Maritime Department, ISBN 978-953-7153-71-7

4. IBC Code, International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, Edition 2020, IMO

5. KORITAROV, T., (2021). Application of virtual online techniques in maritime education in a pandemic – new pedagogical environment and issues, International Scientific Conference Innovative Education for Emerging Maritime Issues, 25.02.2021 (NVNA) Varna; MINE-EMI - project 2019-1-TR01-KA203-077463. pp. 63-69. ISBN 978-619-7428-59-9. COBISS.BG-ID – 49809928

6. KORITAROV T., (2021). Approaches to the application of unmanned aerial systems in the field of maritime industry and education, NOTICES OF THE UNION OF SCIENTISTS – VARNA, ISSN 1314-3793 pp. 26 – 32, https://www.su-varna.org/izdanij/2021/2021_Proceedings_Morski-nauki_final.pdf

7. KORITAROV, T., DIMITRAKIEV, D., (2021). Unmanned aerial vehicles in port operations - use cases and benefits, International Scientific Conference Innovative Education for Emerging Maritime Issues, 25.02.2021 (NVNA) Varna; MINE-EMI - project 2019-1-TR01-KA203-077463. pp. 70-78. ISBN 978-619-7428-59-9. COBISS.BG-ID – 49809928

8. MARPOL Annex II, Consolidated edition 2022, IMO

9. Tanker Safety Guide (Chemicals), 5th Edition , ICS – International Chamber of Shipping

10. 46 CFR 150 – Coast Guard, Department of Homeland Security

11. Velinov, S. (2024). DECARBONIZATION OF MARITIME INDUSTRY, Списание Морско право и индустрия, брой 2, 2024, ВСУ “Черноризец Храбър“,

ISSN: 2815-5130, c.183-191, https://maritime.vfu.bg/files/Svilen%20Velinov,%20Decarbonization%20of%20Maritime%20Industry%20(%D0%92%D0%92%D0%9C%D0%A3).pdf

12. Velinov, S. (2013). MEASURES TO ENHANCE SAFETY OF CONTAINERIZED CARGO TRANSPORT BY REVIZING STANDARDS FOR CARGO INFORMATION AND EDI BAPLIE AND MOVINS MESSAGES STRUCTURE, Journal of Marine Technology and Environment, ISSN 1844 – 6116, Year V, 2/20, pp. 115-121.