

TANKER SHIP'S DISCHARGING OPERATION AND CRUDE OIL WASHING

MERCHANT MARINE ACADEMY OF MACEDONIA

SUBJECT:

**TANKER SHIP'S DISCHARGING
OPERATION AND CRUDE OIL
WASHING**



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**ΑΚΑΔΗΜΙΑ ΕΜΠΟΡΙΚΟΥ ΝΑΥΤΙΚΟΥ
Α.Ε.Ν ΜΑΚΕΔΟΝΙΑΣ**

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**ΘΕΜΑ: TANKER SHIP'S DISCHARGING OPERATION AND CRUDE OIL
WASHING**

ΤΟΥ ΣΠΟΥΔΑΣΤΗ: ΖΙΓΚΑΣ ΘΕΟΦΑΝΗΣ

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Abstract

In this particular essay we will discuss the discharging operation of tanker ships, and the crude oil washing operation.

We will examine thoroughly all the process from the point the ship is approaching the dock, as well as the preparation of the ship before its arrival. Finally, we will analyze all the devices that are used in the operation and are of great importance to the crew members regarding the completion of the task.

The need of transferring crude oil throughout the world for processing and consumption is essential even at the poorest countries.

With such leaping technological evolution and the increasing demands of humans, the need for transportation of the goods has arisen accordingly. So has the maritime technology, in order to cover such demands, from the first stages of transferring crude oil with barrels, to a point of constructing Super Tankers with high capacity tanks, able to carry huge amount of crude oil in bulk form.

With the construction of such large tanker ships, new safety measures had to be introduced in order to preserve the integrity of the ships and the environment. An example of a measure that was introduced is I.G.S. (Inert Gas System) which is produced onboard and flows into the tanks to preserve the tank's atmosphere with oxygen levels below 8% so that the crude oil

cannot be ignited by any cause and the possibility of explosion of the vessel that could lead to destruction of the hull and leakage destroying environmental resources are zero.

Crude Oil Washing (C.O.W.) was introduced to the tanker ships in order to maintain clean tanks after every cargo operation so the contamination of the cargoes is zero.

Introduction

Tanker ships are a type of vessel which are designed and developed for transferring liquid cargos in bulk condition. The major characteristic that outstands from others types of vessel is that tanker ships are constructed with tanks instead of holds (that exist in bulk carrier vessels) and multiple pipe nets for operational purposes.

The first types of tanker ships were constructed in the late 19th century and since then, the most of them are active today. They differ from each other as far as size is concerned. Small capacity vessels for national transfers and bigger (VLCC) that have a carrying capability of 600.000 tons of cargo for international ones.

A tanker ship is the only vessel that carries liquid cargo in bulk state so that any movement of the cargo has a serious effect in the balance of the ship. For resolving such issues, the tanks are designed in separate pieces of the hull. So loading different quantity of cargo at different tanks can affect the balance and give the officers a huge advantage comparing to having a single tank.

The engine room is located is the aft part of the ship not only for balance issues, but also it is a way to isolate the tanks and the pump room in the front part of the vessel. With that being said, even if we have a fire at the machinery space, the cargo and the integrity of the ships can remain intact.

1. Preparation

Information Exchange Prior Arrival

To the first chapter we look at the preparation of the cargo operation as well as the information exchange that is made between the shore and the ship. This is of great importance because the ship has to be ready for the cargo operation from every aspect

Prior to the ship's arrival at the port of call the following information is being exchanged between the port authorities and the ship:

Ship To Authorities:

- Name, Call Sign, Port of Registry, Ship's Particulars
- E.T.A.
- Quantity of Cargo to be discharged
- Cargo's Temperature (Heated Cargo)
- Quantity of sludge
- Details for the ship's manifolds, distance manifolds to fore and aft parts
- The possibility of Bunker Intake and Quantity of bunker OB

Authorities To Ships:

- E.T.A. of the pilot boat and information for anchorage areas
- The possibility of delays at birthing as per birthing schedule
- Ship's side of birthing
- Number of cargo hoses or arms that will be connected
- Any restrictions for mooring plan
- Max discharging rate
- Detailed Information for tides at the times of birthing and nautical tables specified
- Any miscellaneous for master's information

Information Exchange For Discharging Operation

Ship To Terminal Station:

After the boarding of Cargo Master/ Terminal Master, he is accompanied by the Chief Officer and they check the following parameters, organizing the discharging operation:

- ✓ The specifications of cargo to be discharged
- ✓ The temperatures of cargo if heated
- ✓ The quantity of the cargo at each tank and in total
- ✓ Any Sludge to be discharged
- ✓ Any changes at the Tank's Ullages comparing to the Ullage Report from Loading Port
- ✓ The percentage of water per each tank
- ✓ In case of coexistence of 2-3 cargos OB, the turn of discharging of each cargo
- ✓ The Maximum Discharging rate
- ✓ The Maximum Pressure at each cargo lines that are nominated to use
- ✓ The possibility of C.O.W. (Crude Oil Washing) operation
- ✓ The possibility of bunker intake during the discharging operation

Finally, the Chief Officer hands over a copy of Discharging Plan, as organized and signed by all the officers on board.

Terminal Station To Ship:

After the completion of ship's checking, the Cargo Master/ Terminal Master provides the following information to the chief officer:

- The turn of cargos to be discharged
- The maximum approved discharging rate and the maximum approved pressure at the cargo lines as per shore request
- The possibility of running of the booster cargo pumps as per shore
- The number and the size of the actual cargo hoses/arms that are to be connected to the ship
- The requirements for COW operation and the ventilation of the cargo tanks as per shore regulations.

Preparation prior Entering the Port

The exchange of information has been done prior to ship's arrival at the port, as the N.O.R. (Notice of Readiness) has been applied, too. With the

N.O.R., the ship is ready for cargo operation as per charter party and owners have agreed.

The Captain via communication with the agent is informed about the commencement of approaching of the port, as well as for the arrival of the pilot and the ship's side of the operation.

Prior to the arrival of the vessel at the port all the mooring equipment and the cargo equipment must be ready for use, to avoid any delays in the operation.

Finally the Captain must make sure that the temperatures of the cargo are as agreed otherwise, heating equipment is used.

Gas Measuring Equipment

General

There are plenty gas measuring devices on board, fixed or portable, for measuring the atmosphere at places where the crew works, or for prevention of explosion. So the safety of the crew and ship is always guaranteed.

Fixed Measuring Equipment

Fixed measuring devices are installed in many parts of the ship for monitoring purposes. Sensors, read the state of the atmosphere, and analyze the concentration of gases indicating any divergence from normal. Alarms are set to ring at either the cargo control room or the navigating bridge in case of abnormal readings. Such devices can detect the specific gas which has abnormally high concentration and alerts the crew members in time.

Portable Devices

The user of every portable device for gas measuring must read the user manual, understand the function of them and operate it accordingly.

They have to know the functional checks of every device as well as the way that every portable instrument is calibrated as per user's manual. The list of Portable Devices that are being used onboard includes:

- Explosimeters
- Tankscopes
- Portable Gas Detectors
- Portable Oxygen meter
- Personal Gas Detectors

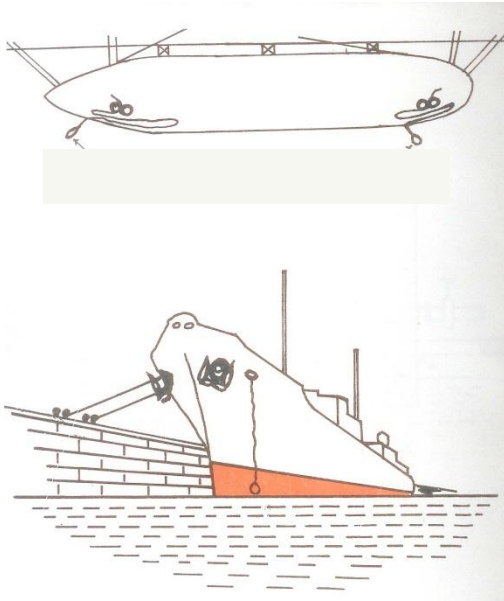
Personal Gas Detectors

On board of tankers there are personal gas detectors that read the concentration of both oxygen and one more miscellaneous gas. On board of tanker ships, this miscellaneous gas is the hydrocarbon, although there are other detectors for specific gases, attention is given to HC. The alarm goes off when the concentration of both the gases reaches to dangerous levels. These types of detectors are pocket size meaning that every worker can carry them without restriction to his movement. The newest ISGOT edition specifies the use of personal gas detectors at every possible entry on enclosed spaces or using them while working for operational purposes such as loading or discharging.

Preparation of Main Deck prior Arrival

The chief mate organizes his crew by informing the bosun the side of the ship to be attached to the harbor and he authorizes him to organize the main deck as well as the means of mooring to be ready to use. The crew will check the condition of the mooring equipment and they will lay the ropes on the main deck for further investigation. They will check the grease on the mooring wires and will inform any cracks or breaks on them. The crew under the supervision of the chief officer will prepare the fire wires. The fire wires are emergency mooring equipment. While the mooring operation is taking place, they are laid on the side of approaching. After the end of the mooring operation they are moved to the opposite side of the harbor and their edges are above the water for at least 2 meters so that in case of emergency, the

tugs that are standing by can tug the ship away from source of danger, the harbor.



After that the oil spill kits are set so that it would be ready to use to minimize the possibility of sea contamination. The oil spill kit includes foam extinguishers, barrels with sawdust, shovels and they are placed in points as shown by the mooring arrangement plan. Another sector of the oil spill kit is referred to the foam monitors that are turned to the side of the connected hoses.

In addition, at the point of the gangway, there is a check point where a crew member is standing by and any visitors provide the watch with their ID, reason for visit and the deck watch provides them with safety helmets, escorting them to the point of their interest. At the final stages of the preparation of the main deck, the pumpman prepares the cargo manifolds and sets the cargo gear as ordered by the chief officer.

Cargo Line Pressure Test

One of the most important tests that should be done before the commencement of the operation is the cargo line pressure test. That check is been done with the use of stripping pump because that is the only pump that can pressure air and it can operate without the presence of cargo. It can actually get the desired pressure in lines (in kilos) without reaching the tripping temperature.

For the completion of such test, we close the manifolds and we open any valve that is located between the manifolds and the discharging point of the stripping pump and we start to pump until the desired pressure. By the completion of pumping, the pumpman checks the connections of the cargo lines as well as the manifolds themselves for any potential leakage. That

procedure is been done for all 3 cargo lines so to certify the integrity of the cargo gear.

Entering the Harbor

By the time the ship enters the harbor, all hatch covers, manholes and the sounding pipes (cargo and ballast) should be shut and well sealed. In addition the trip-trays and the scuppers should be closed as well.

Special attention should be given to the state of the fenders of the tugboats. They should be at excellent condition in order to avoid any damage to the hull of the ship.

2. Discharging Operation

S.B.M. (Single Buoy Mooring)



Before the commencement of the mooring operation, all available equipment is checked for avoidance of any delays in operation.

When the mooring master comes onboard, the captain get informed about the details of the operation, like the number of the tugs that are going to be used, the number of mooring ropes that will be attached and any information that might be useful during the operation.

During a S.B.M. it is important to establish a well connected communication system so that any human error might

The ship has been provided with information for the location of the buoy and the type of it, so that the crew will have been informed and the chief officer would have a plan regarding the specific type.

The chief officer is at the fore part of the ship and he is constantly communicating with the captain located in the navigating bridge.

The 2nd officer is at the aft part of the ship with some crew members helping the securing of the tugboat that will provide safety against a collision at the buoy.

The SBM is a crucial operation and many errors can occur having a terrible aftermath. The ship can potentially be carried away by the strong tide and can be led directly to the buoy. This might happen to a mistake at the loading state of the ship. Additionally, many accidents can occur due to human error. Fatigue or multiple tasks are two of major sources of mistakes at those circumstances.

To avoid such accidents, the crew at the fore takes the necessary measures which some are standing at the right distance from the chains that are given from the buoy, and even leading the chain to specific routes for a stable lift.

After the completion of SBM, one person of the watch stays at the point, reporting hourly the state of the chain and lubricating the contact point. He is obliged to report any deviation from normality.

The cargo hoses are usually afloat, and with the help of the ship's lifting gear, and some personnel from the shore they are been secured at the cargo manifolds.

Mooring operation at Sea Island

The mooring operation at a sea island is different from the one we organized at the SBM. The dangers there are mostly caused from the stretching of the mooring wires due to other vessel passing near the ship while moored. In order to deal with such issue, the crew applies mooring tails at the end of the mooring wires, giving an extra elasticity to the wires. The mooring tails must not exceed 12 meters in length as they are susceptible to breakage.

Some years ago, automatic winches were introduced mostly at passenger ships, but several accidents and the complexity of their use condemned their fate.

After the completion of the mooring operation, whichever is the circumstance, breaks are applied to winches after the wires are been tensioned.

The cargo arms are given by shore and they are secured with the help of personnel from the shore

Ship To Ship Operation



By increasing the size of oil tankers, often there is a need to unload the tanker of the cargo, in another vessel or barge, to reduce network dipping and

be able to enter the port for discharging the residual charge. Yet there are ships that are called "mother ships" these tankers are usually above 350,000 DW function as Liners i.e. take a certain route, anchor outside a port in the appropriate area for transfusion (lightering) and smaller tankers come to unload.

Ships should make arrangements through the pilots who specialize in such maneuvers, to define which vessel will take the balloons (fenders). Usually the fenders are equipped at the smaller ship. The fenders must be afloat because in case they are higher than the sea level can be pushed on the deck. The balloons should be placed on curved parts of the bow and the stern where it is likely to come into contact both ships.

The officers of both ships should have been informed by the captains and the pilots to coordinate the operation. Usually the ropes that connect the ships are taken from the smaller vessel.

The last few years, the bigger ship used to drop anchor and the smaller one was approaching to her. But this tactic is disadvantageous because the smaller ship that approaches is moving under the wind and tide pushing powers. This movement of the ship makes the approach of another vessel dangerous.

Tests were conducted with VLCC vessels in the role of the bigger ship and showed that it is more secure method of approach and mooring of two vessels while both are underway and by the time of the completion of the mooring they will be driven to the transfusion area where the bigger vessel will drop her anchor. There are three types of STS:

1. Mooring while underway and anchoring by the bigger ship
2. Both Ships are drifting while STS
3. Approaching an anchored vessel by the smaller ship

Mooring Operation at the Dock

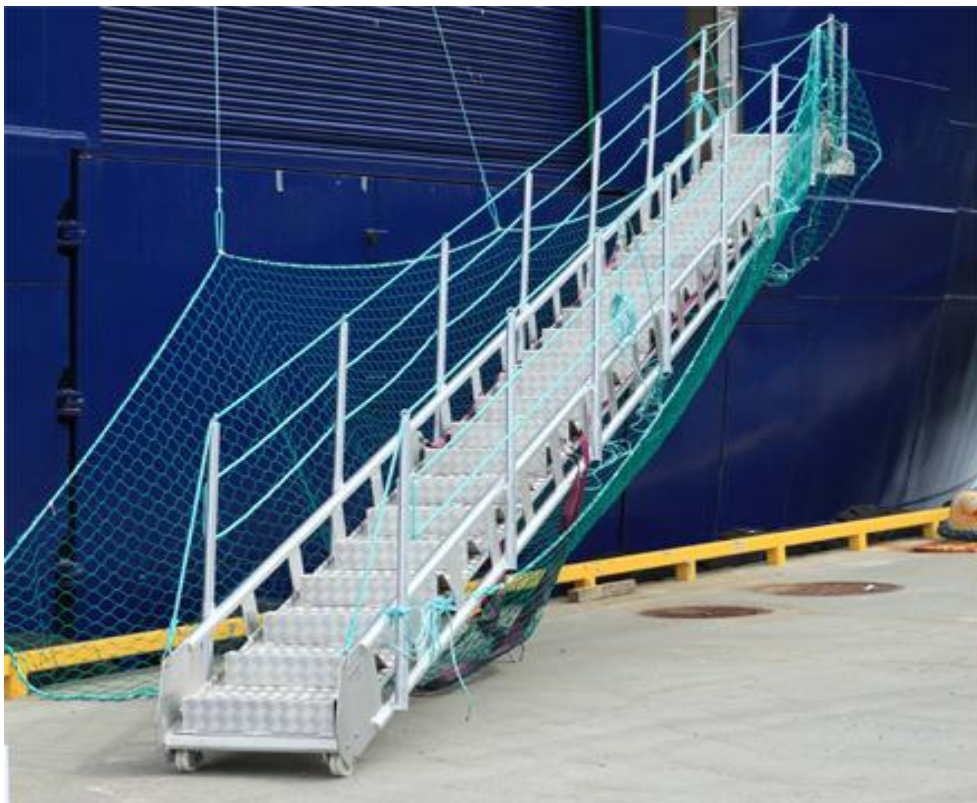
Mooring operation at the dock is a difficult act and should be done very carefully because the vessel must be tied with centimeter accuracy. Most of the docks have loading arms that can angle to 30 degrees. For that specific

reason, the pumpman is at manifolds area at the time of the mooring operation and after the completion, he consults the loading master about the manifolds to be connected.

When the spring from the fore side and the aft side are done, the pumpman informs the captain about the specific position, and the captain informs the crew via walkie talkie.

After the positioning of the vessel at correct side for cargo arms to be connected, the breast, head and stern lines are been connected as well. Next, the crew casts off the tug boats making sure that no pressure is applied on the connected lines.

Finally, the fire wires are been prepared forward and aft, and the chief officer makes a safety round to check the condition of the main deck. Then, the only entrance to the ship is been rigged, the gangway, and the crew places safety net and entering checking posts.



Ship at Discharging Operation

Once the ship is moored and all ready for the start of the discharging operation, there are some procedural matters on which the representative of the terminal installation is in communication with the chief officer as regards their:

- Warning Sings
- Accommodation
- Main Deck Scuppers
- Fire Fighting Equipment
- Communication
- Smoking Areas
- Possibility of immediate Departure
- Cargo Lines Connections
- Sings for Discharging Operation
- COLREG
- MSDS (Material Data Safety Sheets)
- Ship Shore Safety Checklists
- Cold Work Permits
- Aloft Work Permits

Safety Checks

Warning Signs

In the ship's entrance at the top of the ladder is placed a notice board with the following required phrases in English and optionally in the speaking language.

WARNING

NO NAKED LIGHTS

NO SMOKING

NO ANAUTHORISED PERSONS

Similar signs are placed in conspicuous places in order to enhance safety on board. Also in public emergency escape routes are placed signs.

EMERGENCY ESCAPE ROUTES

Accommodation

Every tanker ship is divided into a secure area comprising living quarters and engine room and a danger zone that includes other areas of the ship.

It is imperative to ensure the safe area before any load handling to be protect from the presence of gas gathered around the cargo, which are dangerous or released volatiles loads, either non- volatiles.

So the doors and other openings are closed throughout cargo handling, without causing inconvenience to the staff stay after all ships have closed circuit conditioning.

Main Deck Scuppers

All main deck scuppers are covered by the corresponding plugs and ensure the seal. Thus in the case of cargo overflow or leakage is interrupted by this plug, an alarm goes off and all the leakage is collected in containers and is dropped in the tanks again.

Fire Fighting Equipment

The fire monitors that are located on the ship are facing manifolds area and are ready for use. During the loading operation, the fire pump must maintain pressure on the entire network if possible, if not it should be on standing by mode.

Also portable extinguishers with pollution abatement equipment will be located near the load line platform.

It must be a meticulous control of fire fighting appliances and their installation in all indoor and outdoor areas to meet the plan that exists on board. The responsible officer should discuss with the agent installation actions to prevent the fire from spreading and any possible ways to avoid damages of the hull. Finally it must be made sure that an International Shore Connection is on board for supplying of fresh water.

Communications

The operation of the radio transmitter is interrupted until the departure especially if it is volatile cargo handling.

If any technical work is required must first be authorized by the representative of the shore installation.

Smoking Areas

The smoking areas are determined by the Master in cooperation with the representative of the terminal facility and marked with signs SMOKING AREA.

Possibility of Immediate Departure

The machine is always ready for immediate departure of the ship, so any work is forbidden .It can prevent, for example, Work on the main engine or steering mechanism.

Cargo Lines Connection

The cargo lines connection is checked from the terminal installation personnel or the crew, with the presence and under the supervision of the officer in charge, who will verify the flange mounting and correct connection to avoid damage, leaks and delays to the ship.

Signs for Discharging Operation

Before commencement of cargo handling, there should be established a conciliation system, which should be respected during the landing as:

- **STND BY**
- **START DISCHARGING**
- **SLOW DOWN**
- **STOP DISCHARGING**
- **EMERGENCY STOP**

COLREG

Post marks of the International Code of Signals are necessary at that point of the handling of flammable loads such as:

- During the day the letter B (red flag).
- During the night a red light.

MSDS (Material Safety Data Sheet)

The ship and shore representatives have to fill the list of questions SHIP SHORE SAFETY CHECK LIST containing 30 essential safety parts after the respective control in the presence of shore agent to follow the notices identifying smoking areas, fire instructions and other requirements of safety, compliance with which must be done right up to departure.

Connection of Cargo Hoses/ Arms

Before starting connecting or disconnecting the hoses, the valves of the manifolds must be closed. Right after that and prior to opening the line and removing the flanges should make sure that the line contains no load and is shredded. The personnel involved must wear a helmet, gloves, safety shoes and be constantly on guard, since it is located in functional range of the crane. Special interest should be given on hoses that are going to be connected, especially in the interior, which defects are not obvious. After the completion of the connection, the crane stands on top of the hoses for a more solid prop.



Tank Survey

Amount of Cargo

Before the commencement of the discharging operation, the chief mate accompanied by the Cargo Surveyor and the pumpman are taking measurements (ullages) of the cargo tanks and based on these measurements they calculate the amount of cargo that is on board and sign the relevant document (ullage report). Also, samples are taken from the ship's tanks.

Measuring by hand

A. From Hatch Covers

In older ships that are in service and on ships not carrying inflammable or toxic loads, loading and discharging is done by open system and tanks measurements are made by hand.

If the cargo level is more than 7.6 feet from the hatch cover, to measure the gap, pumpman uses a metal strip at the edge of which there is a plumb. If the distance is greater than that, they use a UTI with metal cross at

the end. The cross has a length of about 8 feet and is divided into subdivisions length measures.

The hand measurement is the most accurate and reliable method and it is preferred from the cargo inspectors.

B. From Ullage Pipes

The ullage pipe extends from the deck to the bottom of the tank. Even when the tank has little amount of cargo, the bottom of the tube is closed by the level of it. So there is no gas flow from the pipe to the atmosphere. Recommended use for volatile loads and chemical of toxicity moderate loads.

However the disadvantage to that system is that when we take measurement of the liquid level, the inert gas pressure should be reduced; otherwise the measurement will be incorrect.

C. From Sounding Pipes

The load inspectors prefer measurement by hand as the most accurate and reliable method. They also need to take the cargo temperatures, cargo samples, and to check whether there is water in the cargo. All this can be done in vessels using the closed loading / discharging system, with no release of gas from the tanks, by using a special device that applies in each tank gas control valve.

Through this device a measure tape is inserted to check the cargo level, and clarify the existence of water in the bottom of the cargo. By attaching the specific equipment we can check the temperature of the load, and take samples.

Measuring by electronic devices

When these devices first appeared there were concerns about their effectiveness. Improved technology, combined with a better understanding by the manufacturers of these devices regarding the problems encountered in ships resulted in the production of high-precision devices. For better and more accurate results two or more different devices (different systems) are placed

in every tank. There is even an alarm indicating the difference of the levels of the devices in the same tank.

Electronic Floating Device

The way the electronic floating device operates is that it floats on the cargo level and broadcasts the readings in the cargo control station. The device floats on the cargo surface and the changes of the cargo level transmit vertical movements of the device in the control room where with many calculations, the total amount of cargo is measured.

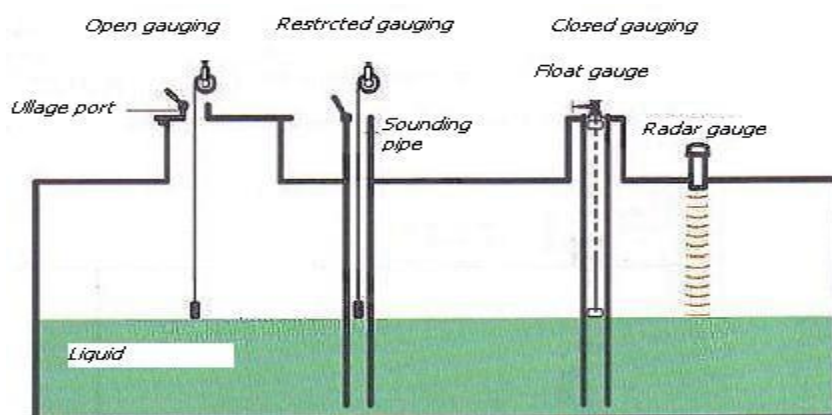
Electronic Tape "Metri-Tape"

The electronic tape "Metri-tape" is extended from the top to the bottom of the tank. There are two cables starting from the electric device sensor. The weight of the cargo that is in the tank compresses the soft walls of the apparatus and causes the contact of the two cables, with consequent change of the electric resistance of the coil wire. This change of the electric resistance is converted to a measurement indication of the gap (ullage) present in the tank.

Cargo RADARs

This device provides greater accuracy in the measurements with a maximum error of +/- 5 mm. In each tank there is a small radar apparatus positioned vertically emitting electromagnetic waves to the level of cargo to determine the distance of the liquid from the radar device, and therefore the measurement gap. The radar is safe for use in explosive gas area (intrinsically safe).

Besides measuring the vacuum is able to simultaneously provide the amount in volume of the cargo corresponding to the gap measured as well as the



pressure of the inert gas into the tank. Some devices provide even temperature of the cargo located in the tank. All these indications are provided on the console of the cargo control station.

Water Detection

Small amounts of water are often found at the bottom of the loaded cargo, into the tank. In the case of crude oil, this water present in crude oil is pumped from the oil well. Water is also present in the cargo tank from a ballast residue, washing tanks or cargo lines with water vapor liquefaction. Sometimes the amount of this water is removed from the amount of load. But we need to find how much this amount is. This procedure is in English terminology tankers called "thieving".

In order to detect water inside the tanks, the pumpman places on the edge of the metri-tape water finding paste. Such pastes, have the ability to changing color when contacted with water, while not affected by the oil cargo.

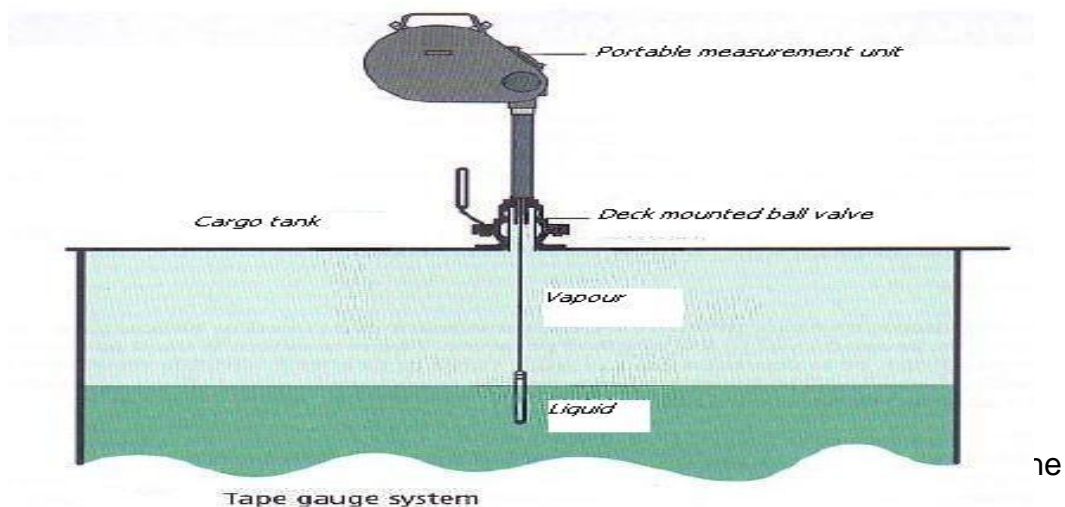
Temperature Check

Taking load temperatures is necessary in the cargo heating cases. When taken frequently temperatures the heating progress is safe and also the temperature is controlled and overheating is prevented. Also, when calculating the amount of any oil cargoes, it is necessary to know the temperature having the amount on volumetric measurement. It is known that all oil cargoes expand when heated and shrink when cooled. The oil industry has established standard temperatures under which the amounts of different petroleum types are calculated.

Temperatures may vary considerably in the cargo of the same tank between the top and bottom of the load. For this reason they should be taken temperatures of three different heights and is averaged as the tank temperature load.

There are these types of cargo temperature taking:

1. With cargo RADARs at the cargo control station
2. By controlling the temperature of the cargo at regular intervals as it passes the load line on the manifold area and calculating an average temperature for the load has passed through the line. Many ships are equipped with the necessary thermometers in manifold for this purpose.
3. With using the right electronic devices through the sounding pipes



prot

need to control the atmosphere of ship tanks with inert gas system.

Thus the inert gas system is today one of the most effective means of protecting the interior of the tanks from fire or explosion which may cause an ignition source or other unknown cause.

General Information

Atmospheric air contains 20.8% oxygen by volume, 79% nitrogen and a small proportion of noble gases such as helium. Fire or explosion cannot occur in a place where the oxygen content is below 11% even if the quantity of hydrocarbon gas in the same space is between 1% and 10% (L.F.L- U.L.F).

By putting inert gas into an area we can reduce the oxygen percentage from 21% to 11% in order to displace atmospheric air or mixtures of air and gas in a tank, and as the percentage of oxygen is been reduced the atmosphere of the tank ceases to be flammable.

IGS

During the discharging and prior to the I.G.S. We must continuously provide inert gas to the required pressure in the space created in the tanks from cargo discharging. The OXYGEN ANALYZER should show oxygen content less than 5% and the valve tissue is kept closed. In case of fan stop we postpone the discharging until rectification.

If the temperature in the extraction fans shows a small and unusual for similar regions and seasons growth without reaching the cutoff point of the system, we should at the earliest opportunity inspect the inside of the cleaning unit (SCRUBBER) to detect possible leakages in the trunks of showers.

Many times even though the system works with maximum performance capability, continuous decline in positive pressure occurs in the tank system. In this case you should decrease the discharge rate as to maintain a sufficient positive pressure in the system.

Sources of production of IG

Source of inert gas can be a genuine inert gas generator, e.g. nitrogen.

However, the most economical method is the use of the waste of the boilers, which after some processing, change in a very satisfactory inert gas and with a pipe system are passed on cargo tanks.

Goal of IGS

1. To supply the tanks with inert gas from a source and reduce the oxygen in an amount below 8% by volume.
2. To permanently maintain a positive pressure, but this pressure should not exceed the test pressure of the tank in order to prevent air entering the tanks
3. To release the empty tanks of gas hydrocarbons, so that any subsequent operations cannot create flammable atmosphere.

Pressure Vacuum Valves (PV Valves)

The principal inert gas line deck operates as a main vent line of the tanks during cargo handling and is connected with the tissues vents via valve

to the free venting to atmosphere. The vacuum pressure relief valve is disposed in parallel with the main isolating valve in the vent of the web at the output of which also is placed a fire arrestor.

Discharging Plan

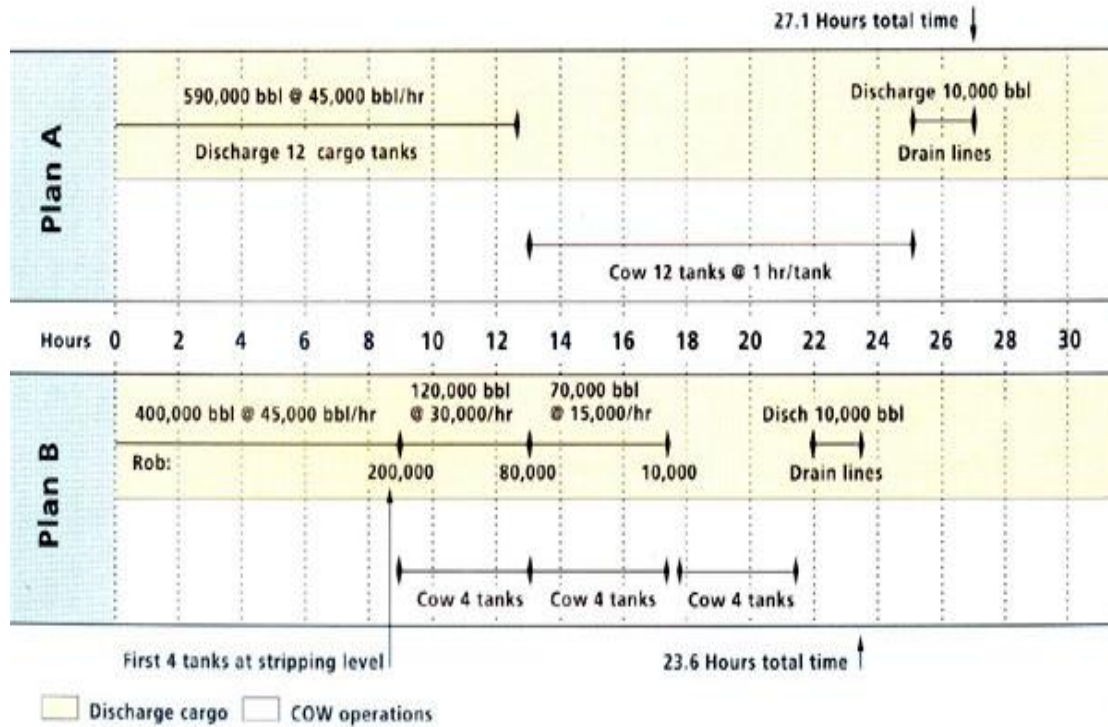
Before the arrival of the ship in the port the chief should have prepared a ship discharging plan, which will include the ship's tanks and description of discharging procedures with the timing of the various phases. In this plan also includes the process of Crude Oil Washing and the ballasting operation.

The discharging plan is accompanied by crew muster list with tasks during the landing.

The plan is set to Master for validation and then it is ready to be discussed with the Representative of the terminal facility after arrival at port.

Finally note that discharging plan includes general ship information such as:

1. Number and capacity of the cargo pumps.
2. Drainage system and its ability.
3. Inert gas system and its derivatives.



Discharging Operation

At the start of discharging the Chief Officer should consult a check- list to pay attention to the details. The loading valves(Drops) must be closed.

The valves of the load line and the pump room must be set accordingly, the last inspection of the ship-shore connections is done and the existence of the required fire-fighting equipment and marine pollution in the manifold area is confirmed.

When the terminal to inform the vessel that it is at all ready to accept the cargo, confirmed proper operation of I.G.S. and after the dry valves are opened following the opening of the valves of the ship.

With the start of discharging, the pumps start to discharge cargo slowly, the correct operation of the valves is checked as well as the sealing of the pipes and gradually increasing the discharge rate until the limit that is agreed.

Discharging starts from the bow tanks to grow the trim to aft draft to help the draining of all tanks.

On the suction and discharge of each pump are mounted gauges to show the efficiency at any given time.

The air gauge which is disposed on suction shows zero (VACCUM), i.e. the pulling power size of the cargo from the pump.

The air gauge positioned in discharging, indicates the discharge pressure (BACK PRESSURE), i.e. the size of the resistance force encountered by the pump during the thrust of cargo to land. This resistance is the sum of the created resistances from the friction of tubing after the cargo impulse resistance created by the static height of the pump until the amount of the dry tank level.

The resistance to abrasion of the pipe is proportional to the distance that would traverse the cargo in pipes and inversely proportional to the cross sectional size of the tubing.

Thus the greater the distance of the shore tanks of the vessel, the greater the discharge pressure. While the larger the diameter of the pipe passing through the cargo the less the discharge pressure.

The resistance of the thrust of cargo towards upper direction is proportional to the vertical distance between the pump and the level of cargo in the tank located in the land consequently the higher is the land tank the greater is the discharge pressure.

Thus when the tanks of the shore facilities located a long distance from the ship or on a hill, they often use one or more booster pumps (booster pumps) in shore lines at pumping stations to help reduce the discharge line depression and the acceleration of the discharging operation in total. The launch of these pumps is after discharging has started. But if we observed a sharp increase in backpressure shall immediately stop the discharging and shut the valves in manifold, because it means that land plants are put in upside down function or booster pumps instead of pulling the ship cargo, they pump cargo towards the ship.

The Chief Mate in accordance with the discharge pattern (DISCHARGING PLAN) that has established uses all three pumps (1, 2, 3C.O.P.).

Discharging starts from the tanks 1W, 2W, 4W, 5W, 6W, SLOP (P) at a low rate. After starting the discharging the crew investigates the cargo line connections and check for leaks. If the leakage is small, they just tighten the nuts around the connection, otherwise the discharging operation is been postponed in order to deal with the alarming issue.

The ship is built with segregated ballast tanks and since there is no leakage suspicion of the cargo tanks, the ballasting with the consent of all of the terminal installation can begin before the end of the discharging neatly such as to maintain the safe trim and safe conditions.

During discharging the Chief Mate from Cargo Control Room (C.C.R.), monitors the changes of the trim having the same discharging operation generated by a electronic program.

Also the Chief Officer controls the drafts, the tilt and trim of the vessel, the rate and speed of the discharge pump, the pressure in the discharge line and compares the entries to these different indicator devices on the deck.

Periodically (typically every hour), the Chief Mate completes DISCHARGING LOG, which includes turns and the pressure of each pump, and any stoppages done from the vessel or the shore. It also calculates the cargo loaded and discharged and it compares the cargo on board with the numbers given from the shore station.

The ship is automated and discharging procedures are done through C.C.R., but the Chief Officer should have good eye contact with the deck and the crew that is on it.

Discharging is continued from the tank, continuing and maintaining the good functioning of the inert gas system, because the inert gas should occupy the volume of the cargo that is being discharged without creating vacuum conditions and damage to the hull.

The officer of the watch is in C.C.R and is constantly in contact with the deck watch. When asked to take measurements from tanks with special U.T.I device, (ullage, temperature detector interface), which is adapted in the sounding pipe of each tank.

The officer of the watch monitors pressure on the cargo lines as well as if the ship is tilted and if the ship discharges normally. Also along with crew he checks ropes and cables and loose whenever necessary after the ship "rises" after discharging.

If at S.P.M. OOW must monitor the position of the buoy comparing to the vessel, and the distance of it. In both cases (dock, S.P.M.) should not be neglected loosening the fire wire, since in an emergency their role is crucial.

Besides the OOW on deck there is the pumpman that he is dealing with various tasks, such as opening or closing valves and above all descending at regular intervals (usually every hour) in the pump room, and he monitors the operation of the pumps and checks for leaks and overheating.

The pumpman and whoever else is preparing to enter the pump room should inform the chief mate and would not enter if not met the right conditions for safe entry and stay in the pump including:

1. Proper and continuous operation of the vents.
2. The absence of toxic and hazardous gases to human health. This can be seen in devices such as the hydrocarbon gas meter (explosimeter), portable oxygen meters and individual gas detection devices.
3. The existence of rescue equipment such as special stretcher, seat belts, oxygen equipment, hoists and ladders.

TANKER SHIP'S DISCHARGING OPERATION AND CRUDE OIL WASHING

During discharging various problems may arise. Some of them are: weather, high pressure in the discharge line, oil at sea, even breaking headland or rope.

In such cases the crew who is familiar with the operation of the emergency stop buttons located in C.C.R. the manifold at the inlet of the pump station and the pump room, need to immediately stop the discharge without hesitating.

When the tanks reach to 6m vacuum (ullage) performing washing with crude oil (COW) at the top of the tanks (TOP WASH) will be started after the terminal facility has given his consent and the CRUDE OIL WASHING CHECK LIST has been updated before and during the wash.

Washing the upper part includes a turn of 150° - 50° for double and triple method (MultiStage) and basic condition is vacuum of 6m in the tank.

The inert gas supplied during the C.O.W. operation the percentage of O₂ in the tanks must not exceed 8% by volume. If possible the oxygen percentage is preferably at 5- 6% by volume.

The oxygen content in the tank can be checked by the oxygen meter (oxygen analyzer).

The stripping during C.O.W. operation is performed by the educator.

Simultaneously the discharging operation is been continued in order to reach the same tanks to 10cm of content. Then the chief mate starts the bottom wash using cargo left in the slops and for this reason the Cargo Pumps are reduced to 8-10 m vacuum.

The washing of the bottom of the tank comprises two passageways 50° - 0° - 50° in the double and triple washing method (MULTISTAGE).

The time required for washing each tank is 25 minutes TOP WASH, and 20 minutes BOTTOMWASH.

The Chief Officer will use the cargo pump which gives him the opportunity to operate 4 individual washing deck washing machines with 8Bar pressure on COW line.

At the final stage, the cargo that has left in the SLOP tanks will be discharged at the end, at the same time of completing the ballasting operation.

Draining all the cargo lines would be using the eductor and their content would be provided to the SLOP tank (P) so it will be discharged last.

Draining of Cargo Lines

According to DISCHARGING PLAN after the completion of the discharging and CO.W. operation the lines and cargo pumps are drained through eductor. The remaining cargo will be led to Slop Tanks and it will be discharged.

The cargo lines will be drained using the stripping pump with small diameter line and continuous increase on the pressure.

Finally, the cargo hoses are been disconnected and the remaining cargo of them is led to the 3W tanks with the use of wilden pumps. The manifolds are been secured by the pumpman and the crew.

Cargo Tanks Survey

At the time of the completion of the discharging operation, the terminal informs the Captain about the details of the arrival of the cargo surveyor. The cargo surveyor along with the Chief mate, check manually the condition of the cargo tanks and after the confirmation of the dryness of the ship, the surveyor signs the Dry Certificate, which is a document of great importance.

3. Crude Oil Washing Operation

General

During the late 60s and early 70s the volume of crude oil transported by sea grew fast and with it increased risks and sea pollution. In 1973, under the care of IMCO convened an international conference to address the MARPOL pollution, where decisions were taken including an article saying that the new size tankers over 70.000 D.W. are going to be fitted with segregated ballast tanks (S.B.T.).

In 1978 after a series of tanker accidents the previous two years in areas of the US a meeting was organized with the care of I.M.O the International Conference on Tanker Safety and Pollution Prevention, known as «TSPP-78». In this meeting decisions were primarily based on that of MAROL 1973 plus some additional, such as requiring the use of the washing system

of crude oil tanks C.O.W. as an alternative to S.B.T. existing crude oil tankers size 40.000 D.W. or more, while for new sized ships 20.000 D.W. and above established the mandatory application of C.O.W. and S.B.T. from the date they were put into effect.

Decisions of the conference TSPP 1978 related to pollution of the sea and tankers security and they were included in the text known as «MAROL PROTOCOL» and would become mandatory internationally one year after as it accepted by 15 countries, whose total tonnage of their ships will be accounted for 50% of the world capacity.

The conference called upon all concerned to implement the decisions of MAROL PROTOCOL until June 1981 or until the date of the international mandatory. The US first implemented these decisions of 1981.

Surveys and experiments on the C.O.W. system began in the late 60s, when already they were in application the hibernation systems I.G.S. tanks and wash using with high-pressure washing devices permanently mounted (guns). These two conditions (I.G.S., Fixed tank and washing machines) are necessary for execution of C.O.W. Since 1973, the major oil companies and tanker owners began using C.O.W. as basic purification process of the bunker. It has been estimated that vessels that do not use C.O.W. and load from Persian Gulf ports for discharging in Europe and after traveling about one month, the remains in the cargo tanks amount of about 1%. Many recipients do not accept this difference and require that the difference in amount of cargo of the bill of lading and that which finally receive is no more than 0.3%.

By using C.O.W. this goal is achieved. The system of C.O.W. is applied for economic reasons and it can be an important factor for environmental protection.

Differences between C.O.W. and washing with water

After the discharging of crude oil, bottoms and the horizontal surfaces of the cargo tanks are covered by different residues which, if not removed accumulate in the next voyage, thereby preventing the draining of the cargo and reduce the capacity of the ship. In the water wash the residues are not dissolved and they must be removed by manual work (gas free). Contrary to performing COW then the residues are dissolved after shaken.

TANKER SHIP'S DISCHARGING OPERATION AND CRUDE OIL WASHING

It should be noted that in other areas of tank cleaning with water is effective only on points which the water impinges powerfully and directly from the nozzle. By using crude oil we have the same results on all surfaces, regardless of how the oil lays on them.

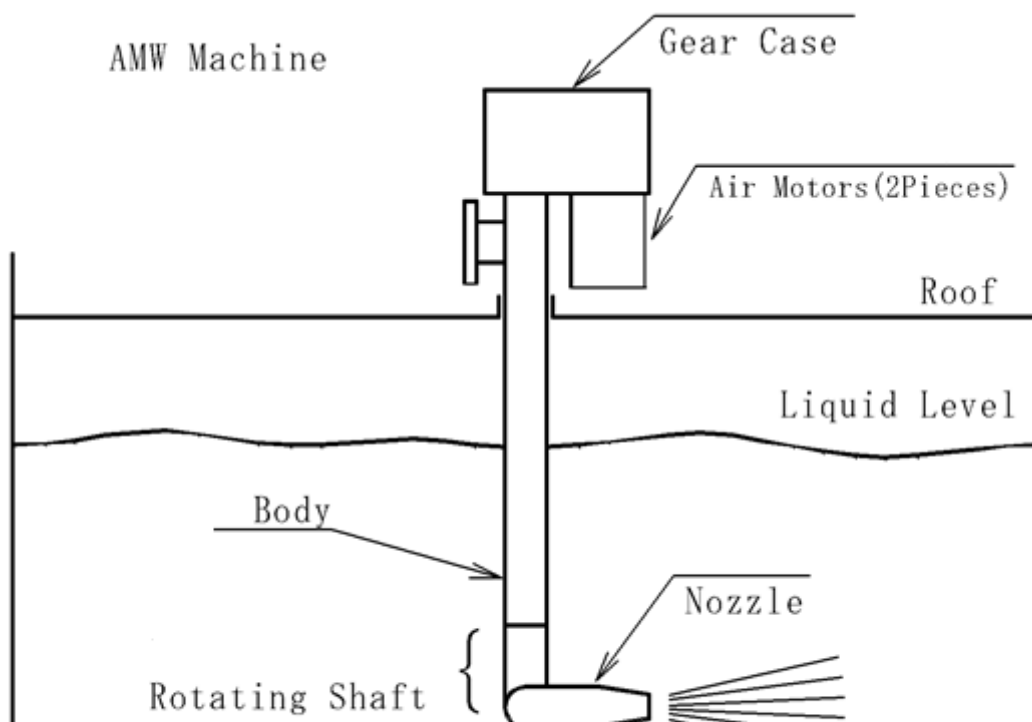
The remarkable point in respect to crude oil is the ability to be liquefied when subjected to pressure resulting in a thin layer that remains only on the walls of the tanks. The C.O.W. is performed on a surface area or covered previously by oil during and after discharging, while washing with water is performed in a dry tank area days after the discharging is completed.

The washing with water of the tanks containing oil generates oil separation problem, and this problem is more intense in VLCC wherein large quantities of water must be kept to SLOP tanks for separation and further disposal in shore facilities.

A significant delay factor is the high backpressure of land lines. During the discharging and execution of C.O.W. washing of all the tanks is done only before the docking and the last discharging before it. It is known that washing is commensurate with the requirements of the charter party. In other discharging operation it is recommended the washing ballast tanks and certain cargo tanks, so that in a period of four months all the cargo tanks would have been washed.

The captain and the chief mate are responsible for recording the actions of the C.O.W. operation in the deck logbook and the Oil Record Book to justify the quantities of products in SLOPS.

Upon washing with crude oil the tank atmosphere becomes safe and non-flammable and this is done with the proper operation of INERT GAS SYSTEM. But that does not absolve us from taking measures restricting ignition sources in the tank.



Crude Oil Washing System

General

The crude oil washing system is in tankers which have a permanent supply pipe systems and operational inert gas system.

Causes that led to the development of tank washing method is:

- The marine environment protection needs.
- The efficient operation of the ship and the load respectively.

The washing method of a crude oil of the tank is based on the deflection by the cargo which is discharged or a separate pump (Tank Cleaning Pump) powered by a full cargo tank and through the piping is provided at the washing machines tanks located on deck or near the bottom.

The jet of crude oil occurs at bulkheads and the tanks and has the effect of reducing both total cargo residues making the use of water not longer necessary, unless required to be filled with clean ballast or in case of dry-docking.

Advantages of COW

The new technique of COW operation is considered to be highly effective as the advantages are:

- Reducing pollution potential of the marine environment, since there are not generated large amounts of water; oil mixture.
- Time and cost reduction, in case of dry-docking the ship.
- Reduction cargo residue after the discharge of the cargo.
- Reduction of the emulsions generated by the water-oil mix.
- Reducing the damage of the structure of the tank.

Disadvantages of COW

Just like every technique that is applied, the COW operation has the following drawbacks:

- Increased discharging time.
- Workload increase at port.
- Increased risk of sea pollution.
- Cost increase for the maintenance of the washing machines.
- Increased staff at port (per shift) for checking the correct operation of the whole system.

Tank Atmosphere Check

The gases rising from the fuel ignited in the atmosphere because they have a sufficient amount of oxygen therein. This occurs when their percentage ratio is in the flammable zone between upper and lower limit of flammability U.F.L. and L.F.L.

These limits vary depending on the type of load, such as an average obtained by the ratio of 10% gaseous hydrocarbon U.F.L. and 1% to L.F.L. These limits refer to a mixture of hydrocarbons and air containing oxygen at 21%. If the oxygen content decreased, reduced correspondingly and the flammability limit, so that the mixture can no longer be combustible and the oxygen content below 11%, since the amount of oxygen remaining is not sufficient for combustion

The gas in which no combustion is stated as inert gas and good quality inert gas is a mixture in which the oxygen percentage is 8% or less.

Inert gas of good quality can be provide with the exhaust from the ship boilers or production mechanism thereof or both.

The exhaust gases of boilers under normal combustion conditions containing 3.4% oxygen level. If inert gas is fed in a large quantity in the tanks can displace the previous gas mixture, the oxygen will fall below 8% in volume and then the tank atmosphere becomes flame-resistant.

Washing with crude oil is not started, if not previously ensure the absence of the oxygen from of the tank, the atmosphere of which is controlled usually by devices on O₂ content ensuring below 8% readings. Inert gas is continuously supplied and the pressure in the tank is maintained positive over 250mm /W.G., to prevent air entry into it.

If for some reason the oxygen content exceeds 8% the COW is discontinued until restoration of normal for washing. After the wash, the tank is filled with inert gas to remove hydrocarbons, so that they limit below L.F.L. This ensures the flammable atmosphere even if the influx of large amounts of O₂ in the tank.

Programming of the Operation

Programming of C.O.W. happens prior the ship's arrival at the discharging port, and this to avoid delays or adverse conditions e.g. unloading all the cargo before the end of the wash.

In cases where we have two or more batches of cargo we should consider that each tank should be washed with the loading of the batch that is contained. The C.O.W. manual describes the correct washing program for each ship.

The Discharging and COW operation includes things as:

- What tanks and in what order would be washed.
- Methods of washing each tank.
- What gap (ULLAGE) we would start the wash.
- Number mechanisms would operate together.
- Quantity departure ballast.

- D.W., DRAFT, TRIM.

A discharging program and C.O.W. well prepared give those involved the possibility of easier understanding of what is happening and how it will be done. So safety is increased, so does the performance of the crew and will be reduced the likelihood of error.

Washing with Water after the COW operation

After the end of the COW operation, washing with fresh water is required only when:

- A person is to enter the tank for either inspection or repair
- Dry-docking Purposes

For proper and sufficient washing with water must be ensured, the continuous supply of inert gas, continuous and good drainage, maximum pressure in the washing line and taking samples from the drainage line.

At the end of the washing line is done with the help of water pumps that circulate inside the lines.

Sources Used

- Cadet Record Book
- ISGOTT: International Safety Guide for Oil Tankers and Terminals (5th Edition)
- Personal Notes from my service at M/T Carmel, M/T Bordeira and M/T Alicante
- Tanker Safety Guide (Full Revised 4th Edition)
- SMS of TMS Tankers Ltd. Issued in 2013

