

CAREFULLY TO CARRY



Cargo tank preparation and cleaning for general products and chemicals

Product and chemical tankers are often required to carry a wide variety of different liquid cargoes. The proper cleaning and preparation of cargo tanks and lines after one cargo and before loading a dissimilar commodity is of utmost importance if successive cargoes are to be carried without cross contamination.

MARPOL pollution categories

Tank cleaning and preparation methods are closely tied to the requirements of MARPOL Conventions, intended to prevent marine pollution.

Tanks containing residues of petroleum oil products must be cleaned out in accordance with the requirements of MARPOL Annex I. This Annex focuses on the prevention of discharge of oily residues into the sea by retaining slops on board for later disposal ashore. Annex I only allows the controlled discharge of oily wash water under the conditions set out in Regulation 34. Discharge is only allowed outside special areas under strictly controlled conditions. Full disposal records must be maintained by means of the Oil Record Book.

Tanks containing residues from cargoes of noxious liquid substances in bulk (NLS) must be cleaned in accordance with the requirements of MARPOL Annex II and the International Bulk Chemical Code (BC Code). The BC Code lists NLS according to their designated pollution category. The Code requires that tanks containing certain substances must be prewashed ashore at the receiving terminal before departure. This pre-wash is usually a relatively quick machine flush to remove most of the residues. The residues of some pollution category cargoes are permitted to be flushed into the sea under certain conditions, which may be after pre-washing. In all cases, the BC Code must be consulted for proper compliance with the requirements of MARPOL. Full disposal records of NLS must be maintained by means of the Cargo Record Book.

Tank cleaning guides

Mariners have available to them several industry standard guides to help and inform their decision making with regard to suggested tank cleaning methods, depending upon the type of cargo switch that is proposed.

At the simplest end of the scale are the tank cleaning guides produced by the oil majors. These are typically in the form of a matrix listing the typical oil product groups (Jet, Kerosene, Gasoline, Diesel Fuel Oil, etc.) and give suggested washing methods from one group to another. The matrix will suggest washing procedures, or indeed suggest when no washing is required at all. Such guides may form an integral part of voyage instructions or charter party directions when a ship is changing from carrying one listed oil product to another.

On chemical tankers the variety of cargoes likely to be carried is much more extensive and the type of washing required to remove traces of one type of cargo in readiness for the next cargo is more complex. Guides are available in book form (for example, Dr A Verwey) which details coded procedures and suggested cleaning steps, including such things as: ambient seawater flush, hot chemical recirculation, hot seawater rinsing, fresh water rinsing, ventilation, draining, mopping and drying.

The coded procedures are additionally emphasised by the use of italics or emboldening to indicate where additional or enhanced ultra-clean standard may be required. The Dr A Verwey guide makes no distinction between different coating types. Nor does the guide make any suggestion about the use of cleaning chemicals other than the generic "Teepol" as a typical, multipurpose detergent. The Dr A Verwey guide has to be used in conjunction with other cleaning considerations such as the BC Code for the pollution categories of various grades of noxious liquid substances and the MARPOL requirements.

More recently, various online, subscription-based guides have become available (Miracle and Milbro). These are interactive programs that enable the user to choose from a huge range of listed chemicals as last (From) and next (To) cargoes. The search can also be refined as to tank coating type. The suggested washing procedures between the two chosen grades are set out in steps in much the same way as in the Dr A Verwey guide. These on-line guides can also take into account the requirements of the MARPOL regulations pertaining to each commodity and its pollution category.

Some of the major parcel tanker operators have their own interactive computer-based tank cleaning guides to include similar recommendations.

Cleaning chemicals

Numerous off-the-shelf, proprietary tank cleaning chemicals are marketed on a worldwide basis. The chemicals are produced for specific purposes, which may include: alkaline degreasers for oils and fats, non-alkaline detergents, acidic based metal brighteners, etc. Each chemical will come with its own MSDS and manufacturer's recommendations. These recommendations will include the optimum dilution dosage, means of application, ideal temperature and whether to use

with salt or fresh water. The manufacturer's guidelines should be followed for optimum result.

Those responsible for tank cleaning after any given cargo should ensure that the ship is provided with an adequate stock of the appropriate chemical needed to clean from the particular cargo being carried, at least before that cargo is discharged. Many chemical tankers will hold a stock of various cleaning chemicals in drums ready for use. They should maintain an inventory of their stocks, noting the litres remaining and also including the date of receipt or manufacture. The condition of the containing drums should also be noted as steel drums can corrode to leak and/or spoil the contents.

Users must be aware of the limitations of certain chemicals in respect of their cargo tank coating types. For example, zinc silicate coatings are liable to be damaged by acidic or alkaline cleaning chemicals, so only those chemicals with an acceptable neutral pH should be considered. The coating manufacturer's recommendations and resistance lists must be consulted with regard to the cleaning chemicals as with the cargo to be loaded.

Degreasing chemicals act as surfactants to help to break down oils and fats in much the same way as washing-up detergent is used to clean greasy crockery. Heat also helps to liquify, break down and remove greasy residues. However, surfactants can cause some fats such as vegetable oils to saponify, causing unsightly white deposits. Acidic metal brighteners can be used to neutralise the deposits in follow-on washing, coatings permitting.

Tanks should be substantially cleaned by hot water washing before cleaning chemicals are employed. Their role is to remove greasiness, not to remove visible residues.

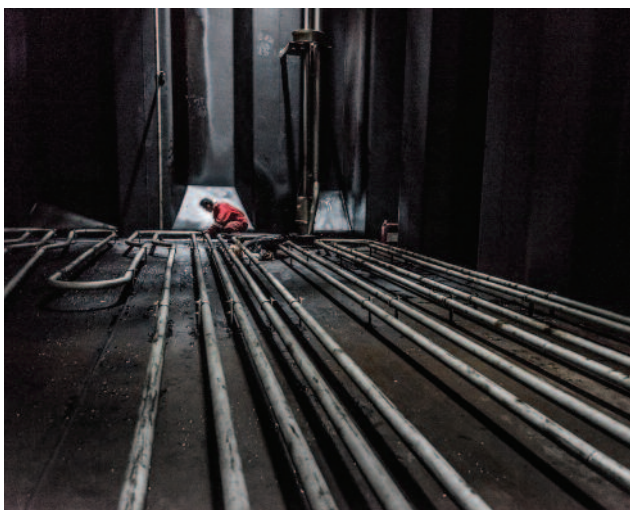


Washing methods

Physical cleaning of a cargo tank (as opposed to crude oil washing (COW) – where the cargo is used as the washing medium) is primarily carried out by water washing. Sea water is usually available in copious quantities and is the principal washing medium employed. There are limitations in its use, however as sea water can be damaging to stainless steel and should only be used in accordance with the ship builder's

recommendations. If used in a stainless steel tank, the salt from sea water should be immediately rinsed with fresh water as part of the cleaning plan. Most tank cleaning will include a rinsing stage.

Sea water is usually applied via tank washing machines. These are either fixed (as part of the tank fittings) or portable (where they are introduced on the end of a hose through tank openings). The wash water medium is introduced at pressure either from the ship's washing main or from a cargo pump (when recirculation washing is required). The machines can be programmable, where their arcs of operation can be limited (i.e. top, middle or bottom of a tank), or non-programmable where their nozzles describe an overall coverage pattern. Fixed machines should be sited at a sufficient number of locations within a tank and at such positions that shadows (areas not directly impinged by the washing medium) are minimised. Portable machines can be spotted at specific heights and locations to cover shadows, and access openings may be provided in the deck for that purpose. Shadow diagrams should be available to guide mariners as to the best coverage and positions.



In ships with no or few fixed machines, portable machines should be periodically lowered during the wash cycle (drops) to cover all areas of the tanks.

The washing medium can be applied direct (straight from sea or a fresh water storage tank) or recirculated. Direct supplied water can be ambient or it can be passed through a heat exchanger to raise the temperature, as desired. Any tank coating temperature limits will require to be observed. Water can be heated up to about 80°C: above that temperature the water can convert to steam as it leaves the washing machine nozzles, and washing effect (through mechanical impingement) will be lost. During direct washing, chemical cleaners can be injected into the washing medium downstream of the heater by means of a barrel pump. The chemical dose rate can be monitored by adjusting the injection pump rate in relation to the throughput of the washing machines in use. Dosing can be continuous or periodic during the washing cycle depending upon manufacturer's recommendations. After chemical injection has been turned off, the "clean" washing medium should be continued until all chemicals have been rinsed away.

During washing, the washed tank must be continuously stripped, so as to avoid any build-up of wash water. Any build-up can adversely affect the cleaning efficiency, especially when oils and fats are being cleaned. The spent washing water pumped out will either be stored on board (in the slop tank) or pumped overboard, directly or after decanting, depending upon the requirements of MARPOL for that particular last cargo and the cleaning chemicals used.

The action of stripping out the wash water also ensures that the pump and lines are flushed through and cleaned. This is the main way in which the inside of the cargo lines are cleared of previous cargo. During washing, all parts of the line system should be flushed, including both sides of manifolds, drop lines, drains and any connecting branches, paying particular attention to ensuring that no dead ends are left unflushed.

Recirculation washing is achieved by formulating a prepared dose of wash medium in a clean cargo tank (the recirculation tank). The wash medium can be heated, either by filling the recirculation tank via the main tank cleaning heat exchanger or by means of the heating coils within the tank. The recirculation wash medium is then pumped out to deck, where hose connection is made to the machines in the tank to be cleaned. The recirculation tank cargo pump is run at sufficient speed and pressure to drive the machines inside the tank being washed. The pump of the washed tank is used to return the medium back to the recirculation tank. The two pump speeds are regulated to ensure that the wash medium is continually stripped out of the washed tank. The volume of the recirculation medium must be sufficient to ensure that the system remains full and effective.

The advantage of direct washing is that the cleaning medium is continuously renewed with clean water. The main disadvantages are that this increases the overall volume of wash water used (which matters if the dirty water has to be stored on board) and it is more expensive in terms of heating. Conversely, the advantages of recirculation are that there is less loss of heating and that the volume of wash water is controlled and known. The big disadvantage of recirculation washing is that if the wash medium becomes too dirtied, the washing effect can be minimised, or even reversed if cargo residues are carried back into the tank being washed. In practice, some combination of direct washing and recirculation washing may be employed. This can be advantageous if only a limited cleaning chemical dosage is available and recirculation is used as the finishing cleaning effort. That is why the cleaning guides will usually specify recirculation washing only as the secondary wash after the tank has been substantially cleaned.

In either case, both methods can be applied to individual cargo tanks or groups of several tanks. Tanks can be washed sequentially in pairs in a rolling programme, so that as soon as one pair has completed a stage, that stage can be rolled forward to the next pair. If recirculation is applied to a group of several tanks, there must be sufficient volume and dosage concentration so that the final tank of the batch receives the same cleaning effect as did the first tank of the batch. The recirculation medium must be monitored to ensure that it does not become too contaminated. If necessary, the concentration of the dose can be topped up to maintain its surfactant properties.

Effective tank washing is a balance of wash water pressure, temperature and good stripping. Good pressure and temperature should be maintained by balancing the number of washing machines used at any one time. More machines means faster water throughflow with resultant reduced pressure, temperature and cleaning effect. During washing the pressure and temperature of the wash water should be constantly maintained and monitored. It is also important to regularly check that the washing machines are turning correctly. This can be indicated by the sound that impinging water makes on the ship's structure. The water level inside the washed tank should also be constantly checked to ensure that there is no build up.

Fresh water rinsing

After completion of salt water washing, and after the cleaning chemical has been rinsed out by clean salt water, all traces of salt should be removed by thorough fresh water rinsing.

After difficult cargoes (such as palm oils) fresh water rinsing can be delayed until after a cleanliness evaluation has been made. There is no point in wasting fresh water until the tank is assessed as being sufficiently free from previous cargo to move on to the next cleaning stage.

Hot washing will cause steam in the tanks and condensation on the ship's structure will assist in dropping the salt down to lower levels. However, fresh water rinsing is usually necessary as a final rinsing stage. This is accomplished by running the fresh water through the tank cleaning system. Sometimes, dedicated fresh water washing mains or lines are provided on deck for the purpose.

Some chemical cargoes (such as methanol and MEG) require the tanks to be virtually free from chlorides (a component of salt water) before loading. The chloride levels are assessed by means of wall wash testing. Fresh water usually contains some trace amounts of salts, which may mean that they are incapable of rinsing to the required very low levels of chlorides. In which case, de-ionised (DI) water, which is chloride free, is used in the final rinsing. DI water can be provided to a ship in drum form. Alternatively, it can be produced on board, by passing the ship's fresh water through special resin filters. The DI water will usually be sprayed on the tank surfaces using a barrel pump and a handheld lance to reach all surfaces from within the tank.

Steaming with live steam (steam under pressure) can also be an effective way of rinsing out salts and odours. The resulting condensation will need to be pumped away. Live steaming should only ever be attempted in gas free tanks, as it can be a source of ignition through static generation.

Inert gas

Hot water washing after flammable cargoes should always be carried out in accordance with the applicable SOLAS regulations. This will normally be either after the tank has been checked as being gas free or is properly inerted, so that the oxygen content is below 8%. In accordance with SOLAS, in tanks of less than 3,000 m³ capacity in chemical carriers, inert gas may not be required, provided the throughput of the combined washing machines does not exceed 17.5 m³/h and the total combined throughput from the number of machines in use in a cargo tank at any one time does not exceed 110 m³/h (SOLAS Chapter II-2 B Regulation 4 5.5.2.1).

After cleaning in an inert atmosphere from flammable products, and if it is required to gas free for the next cargo, the tank should first be purged with inert gas to reduce the hydrocarbon content to 2% or less by volume. This is so that, during the subsequent gas freeing operation, no portion of the tank atmosphere is brought within the flammable range.

Tank cleaning plan

Any tank cleaning operation should be well planned and there will usually be a ship-specific tank cleaning form in the safety management system. Correct use of the form can be used as evidence of the nature of washing that was carried out. The plan should set out (in the form of a Gantt chart) the various stages against a timeline. Those involved can therefore know at any point in the cleaning operation what point has been reached and the likely completion time. Copies of the plan should be circulated amongst all those involved in the operation so that everybody knows the sequence involved.

Drying and venting

As well as being properly cleaned, cargo tanks will usually need to be presented gas free and dry for the next cargo. Drying will usually require entry into the tank for hand pumping and mopping of any water remaining after stripping, and for final wiping and checking. Tank entry should only be carried out after all the proper procedures for entry into enclosed spaces have been followed.

Venting of tanks by mechanical means will not only remove previous cargo vapours and odours but will also help dry the tank coatings of humidity after washing. The pipes and lines should be opened up, thoroughly drained and also blown through as part of the tank drying process.

Tank cleaning of any sort may not be permitted alongside some oil terminals in port. Local regulations in that respect should always be followed.

Photos: Peter Cornelissen