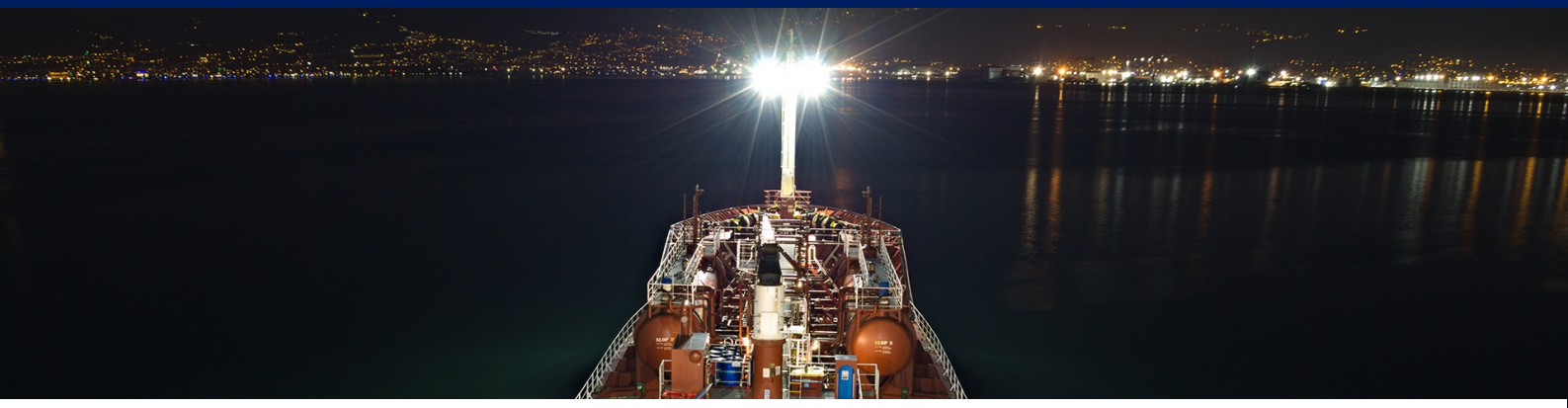


Tank Cleanliness Verification for Tankers: A Comprehensive Overview

Loss Prevention Bulletin

The pinnacle step of tank cleaning operations is verifying the condition of the cargo tanks after cleaning. A physical tank inspection is the most common approach. This may be accompanied by analytical testing by completing a wall wash test (WWT) or using the technique of wash water analysis (WWA), which is becoming increasingly more popular due to benefits it holds over traditional tank inspections.

Emma MacCarthy
(Loss Prevention Officer, West P&I)

Tank Inspection

If an enclosed space entry is to take place, all tanks must be gas free prior to entry and enclosed space entry procedures followed. For more information see our Loss Prevention Bulletin on Enclosed Space Entry.

During the tank inspection, the tank and all other equipment that was in contact with the cargo must be inspected. Inspection of the internals of the cargo lines is almost always impossible, but the cargo manifold can be opened and inspected. Inspections should be carried out jointly with a representative of the vessel present along with a charterer's representative and sometimes a cargo owner's official as well.

During the tank inspection the following must be inspected:

- Entire tank surface for visible cargo residues
- Entire tank for smells and wetness or moisture
- Bulkheads should be touched to check for cargo residues and IG soot
- Shadow areas of cleaning machines
- Underneath heating coils
- Heating coil supports
- Pump suction well (pitting and residues)
- Loading line outlet
- Tank internals: ladder, pump stack, purge pipes, sounding pipes, striking plates, tank cleaning machines, level indicators etc.
- Condition of tank coating
- Stainless steel tanks should be inspected for discolouration and pitting

Although tanks must be inspected as per Class requirements as part of the vessel's planned maintenance, it is good practice to note any defects or deficiencies during any tank inspection, such as indentation in plating or weld cracks so progressive worsening of these can be noted. Additionally, any mechanical defects can be noted and repairs made if necessary, prior to the commencing of cargo operations. This can save a mechanical issue occurring during cargo operations which is far more complex to repair when the vessel is in a loaded condition.

Wall Wash Tests

To carry out a WWT, a trained personnel must wash down the cargo tank bulkheads with solvent, allow the liquid to run down the surface, before taking samples of the liquid for analysis. Methanol is the most common solvent used, but acetone is becoming increasingly more popular. All equipment must be cleaned thoroughly before use.

As with tank inspections, WWTs should be carried out jointly with a representative of the vessel present along with a charterer's representative and sometimes a cargo owner's official as well.

Common WWTs are:

- Permanganate Time Test (PTT)

- Water Miscibility / Hydrocarbon test
- Chlorine (Cl) test
- Colour Test
- Acid Wash
- UV test - (spectrometer required)
- Non-volatile matter (NVM) test - (laboratory test)
- Chemical Oxygen Demand (COD) test - (laboratory test)

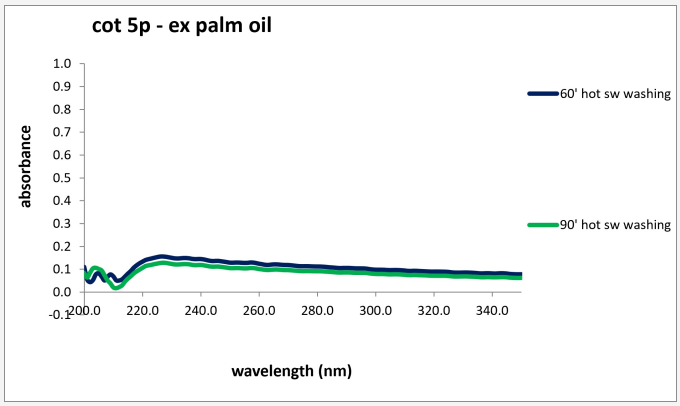
The concerns with using WWT as a cargo tank verification method are that the samples taken are random and are only drawn from the lower accessible parts of the cargo tank. As there is only a small area of the cargo tank being tested, if a WWT result shows minute traces of the previous cargo, it does not always mean that the tank cleaning has not been effective enough for the vessel to load the next nominated cargo, especially once the “dilution effect” is considered.

An additional concern for the WWT is that the test results are not repeatable. The results change with the volume of sample recovered from the tank, therefore making them subjective. As the test is random and subjective it follows that it is not reproducible, as such, they do not hold any legal standing unless the surveyor has acted negligibly.

Although wall wash testing follows recognised analytical procedures, the process is unsystematic due to its nature.

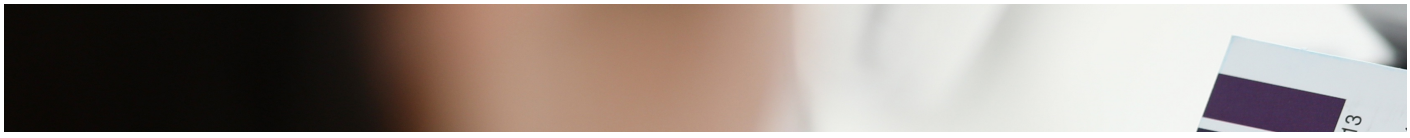
Wash Water Analysis

As an alternative to WWT, wash water analysis uses a UV spectrometer to measure the progress of tank cleaning by comparing the quality of the used washing water being pumped out of the cargo tanks and lines against a reference graph of the previous cargo. Wash water samples are drawn from the cargo lines and analysed onboard by crew trained to use a spectrometer.



The technique was developed in 2011 and introduced to the *INTERTANKO Cargo Tank Cleanliness Standards for Chemical Tankers* in 2017 as an alternative test to wall wash testing, providing a condition assessment of the cleanliness of the cargo tanks and connected systems. When there are no longer any traces of the previous cargo in the washing water, tank cleaning can be stopped, as further washing will not make the cargo tanks any cleaner.

When the UV graph from the spectrometer flatlines or there is no considerable change between consecutive samples, this is the indication that the cleaning can be stopped or that cleaning step needs to be changed as there is no longer any positive cleaning effect. When this indication is used in either manner it saves significant time, reduces costs and lessens the impact on the environment. Wash water analysis improves operational efficiency while complying with cargo quality specifications.



Some of the benefits of using wash water analysis are:

- Reductions in enclosed space tank entry for visual inspections and WWTs by surveyors and ship's crew:
  - Enhancing crew safety
  - Preserving rest hours
- Reduction in overall cost of tank cleaning by consuming less fuel and cleaning agents
- Environmental impacts:
  - Reduced CO^2 emissions (estimated 2MT for every hour of hot water washing)
  - Reduced cleaning agents disposed
- Over-cleaning:
  - Saving time
  - Prolonging tank coatings' lifetime

"As one of the pioneers of WWA, I have always been very forthright about my opinion that the inspection of any cargo tank needs to be far more representative than simply a random splashing of a solvent on 1-2M^2 of the internal surface area of that cargo tank. WWA takes into account all parts of the cargo tanks and most importantly the cargo lines, meaning it has to be better than the wall wash. I accept that WWA has some limitations, but most of these can be overcome with training, and even so, these limitations far outweigh the wall wash test."

Guy Johnson L&I Maritime Ltd.

Before implementing wash water analysis onboard, procedures need to be integrated into the ship's SMS along with a risk assessment. Training protocols for ship's crew are required and equipment must be certified and

Vegetable oils, lubricating oils and high molecular weight solvents are types of cargoes that do not have UV profiles and are largely insoluble in water. These form an oil-in-water emulsion during the cleaning phase. This is

calibrated. Sufficient supplies need to be kept onboard.

Wash water analysis needs to be agreed with the charterer and specifications for each cargo stipulated. The Master must send details of the WWA and a Tank Cleaning Certificate containing the test methods and results to the charterer prior to arrival at the loading berth. If the results are accepted by the charterer, there is no need for a third-party surveyor to attend the vessel for an internal inspection and WWT of the vessel's cargo tanks. If however the results are rejected by the charterer, a surveyor will usually be sent to the vessel to conduct an inspection of the cargo tanks, which may include a WWT. Despite this, the benefits listed above will still be advantageous for the ship owner.

Wash water analysis is most suited to cleaning stainless steel cargo tanks as there is little to no surface absorption of previous cargoes. For coated cargo tanks, WWA is carried out in the same way as it is for stainless steel cargo tanks, i.e. when all traces of the previous cargo have been removed from the tanks and lines, cleaning should stop. However, the prior cargo, the prior cargo's properties, tank coating characterises, coating condition and level of cleanliness must be considered.

This is because some tank coatings absorb certain types of cargos. The cargo residues that may be absorbed will not show on the WWA results and may subsequently desorb into the next cargo. Once this is understood, WWA techniques can still be applied on board.

Cargoes that exhibit very low or no UV profile are not suitable for testing by UV spectroscopy. These wash water samples can be tested by other means such as pH, chemical oxygen demand and total organic carbon.

measured in the wash water samples using the UV spectrometer. Cleaning with water should continue until the samples are free from emulsion. This is typically noted when a flat line runs along the baseline of the UV spectrum, or there is no significant change between two consecutive samples.

After this, the recommended cleaning continues. This often includes the use of additives to bring the cargo residues and water together, followed by a sea water wash and fresh water rinse. The end of the cleaning is typically signified by a flat line running along the baseline of the UV spectrum.

When cleaning from volatile cargoes, that is, cargoes with a vapour pressure of more than 5 mBar at 20^{o}C, it is quite normal to observe significant volumes of vapour during tank cleaning operations. This vapour will show up in the washing water data and may produce a result where the previous cargo concentration is higher than expected in the last wash water sample. INTERTANKO has stated that if the last wash water sample contains between 100mg/L - 250 mg/L of the previous cargo, that there will be no residues of the previous cargo remaining.

The decision to use WWA is decided in the tank cleaning planning stage.

Things to consider:

- Previous cargo compatibility with test
- Next cargo quality requirements
- Tank coating
- Length of time last cargo was in the cargo tank
- SMS procedures
- Risk assessment
- Equipment needed and availability
- Crew experience
- If the 100ppm standard is equivalent to the corresponding WWT
- Charterer's requirements
- Tank cleaning procedure

If a large time has passed between cleaning and loading, combined with external factors of temperature and high humidity, the vessel may require additional precautions.

"The challenge of changing a procedure (wall washing) that has been used for many years, apparently very successfully, is the fear of change. Apparently, because cargo interests still absolutely believe that every time a cargo tank that has been inspected by wall wash, loads successfully, this is undeniable proof of the validity of the wall wash. It is not. Firstly, it is the dilution effect that is the reason why vessels load successfully and secondly because if the wall wash did provide undeniable proof of cargo tank suitability, there would never be incidents of off specification cargo; and there are."

Guy Johnson L&I Maritime Ltd.

Comparing WWT to WWA

Compared to WWTs, wash water analysis eliminates the repeated need for entry into enclosed space. This saves time and costs prior to loading the vessel. It also removes the exposure of the crew and shore personnel to a possible flammable and toxic environment. WWTs require the use of methanol as the wall wash solvent, classified as a toxic chemical which is dangerous and hazardous to the seafarer's heath. WWA reduces over-cleaning of the cargo tanks which will prolong the life of tank coatings. Reducing cleaning time in turn has the potential to reduce the volume of cleaning slops and cleaning chemical mixtures that are discharged overboard or ashore. Reduced cleaning time will also cut costs with less cleaning chemicals and MGO (marine gas oil) used for hot water washing, steaming and running the IGG (inert gas generator). This will reduce the amount of CO^2 emissions the vessel produces, which in turn can have a positive effect on the vessel's Carbon Intensity Indicator (CII).

WWA has been used on product and chemical tankers alike. However, it must be remembered that when dealing with coated tanks, extra precautions should be taken when considering the complex relationship between the coating and certain cargo groups, in the same manner that would be considered when carrying out tank cleaning and WWTs.

Members requiring further guidance should contact the Loss Prevention department.

Members requiring any further guidance are advised to contact the Loss Prevention **department.**

Emma MacCarthy
Loss Prevention Officer

M +44 7747 214981

Emma is a Senior Deck Officer and has a BSc (Hons) in Marine Operations Management and another BSc (Hons) in Mental Health Nursing. She has served aboard product and chemical tankers, bulk carriers, ro-ro passenger ferries, passenger ships, offshore vessels and tall ships during her ten year seagoing career. Emma joined the Club in 2020 directly from sea and attends to Loss Prevention matters.