



Carefully to Carry

Bulk oil cargoes – shortage and contamination claims

Over recent years there has been a marked increase in the incidence of claims arising from the carriage of oil cargoes. The claims are often substantial and may allege either shortage or contamination or both. In the past it was believed that measurement inaccuracies and all the problems related to the carriage of oil in bulk were understood. Recent research and advances in technology and analytical techniques have uncovered information which is of considerable significance. The purpose of this article is to provide guidance on how tanker operators can minimize the risk of cargo loss or damage and defend themselves should claims arise.

Oil shortages

In general, oil shortage claims are based upon a discrepancy between the quantity of cargo as stated in the bill of lading and the outturn quantity as calculated in the discharge port. Both these figures are frequently derived from shore-tank calibration data. The most common arguments are that:

- The ship is bound by the figure stated in the bill of lading.
- The shore tank calibrations are more accurate than the ship's tank calibrations.
- The oil has become contaminated by water after loading.
- Some oil remains onboard the ship.

The carrier's defence is commonly based upon the accuracy of the ship's cargo figures and seeks to demonstrate that they were comparable with the bill of lading figure, that there was no significant in transit loss, that any onboard quantity (OBQ) prior to loading has been taken into consideration and that all the cargo has been discharged with none remaining onboard (ROB).

In the following pages each phase of a typical tanker voyage is followed chronologically and likely causes of difficulty are considered.

Before arrival at the load port

The correct preparation of the cargo tanks in readiness for the grade of cargo to be carried is covered in the section dealing with contamination claims. Aside from ensuring the minimum safe quantity of clean ballast for arrival, the cargo officer should prepare a loading plan taking into account stability, trim and stress. Where draft restrictions permit, it may be advisable to plan for leaving the loading port with a trim that avoids the need for internal transfers of cargo during the loaded passage. The inert gas system, if fitted, should be fully operational in readiness for the forthcoming cargo operation. The oxygen content of the cargo tanks should be as low as possible before arrival and a record of all tank readings should be maintained.



"The carrier shall properly and carefully load, handle, stow, carry, keep, care for and discharge the goods carried."

Hague Rules,
Articles iii, Rule 2

Carefully to Carry Advisory Committee

This report was produced by the Carefully to Carry Committee – the UK P&I Club's advisory committee on cargo matters. The aim of the Carefully to Carry Committee is to reduce claims through contemporaneous advice to the Club's Members through the most efficient means available.

The committee was established in 1961 and has produced many articles on cargoes that cause claims and other cargo related issues such as hold washing, cargo securing, and ventilation.

The quality of advice given has established Carefully to Carry as a key source of guidance for shipowners and ships' officers. In addition, the articles have frequently been the source of expertise in negotiations over the settlement of claims and have also been relied on in court hearings.

In 2002 all articles were revised and published in book form as well as on disk. All articles are also available to Members on the Club website. Visit the Carefully to Carry section in the Loss Prevention area of the Club website www.ukpandi.com for more information, or contact the Loss Prevention Department.

On arrival at the berth

Once the ship is securely moored it is important to arrange liaison with representatives from the shore loading facility and to ensure continued good communications throughout the loading. All relevant information must be exchanged between ship and shore including details of the ship's loading plan, maximum loading rates, shutdown procedures, safety regulations and cargo data.

Before loading

After all ballast has been discharged other than any permanent ballast which may be discharged simultaneously with the loading of the cargo, the ship's cargo valves and pipelines should be correctly set for the reception of cargo and the relevant tank valves opened. Any residual ballast water should be pumped or drained from the pipeline system either overboard in the case of clean ballast or into a suitable slop tank but always in compliance with the local oil pollution regulations. Before loading, it is customary for a joint inspection of the cargo tanks to be made by shore representatives and ship's officers to confirm that the tanks are properly drained of water and in a suitable condition to load the designated cargo. In general, the completion of such an inspection does not relieve the owner of his responsibility to ensure the correct condition of the cargo tanks. In large tankers and where tanks are inerted, such inspections are difficult and it may be necessary to rely on the ship's gauging equipment rather than any visual inspection. Preparations for the loading of multigrade cargoes are dealt with under the section covering cargo contamination claims. The measurement of any OBQ should be carefully undertaken preferably jointly with the shore representatives. The depth of any residues should be measured at as many locations as possible and at least at the forward and after ends of the tanks. Tank cleaning hatches should be utilized as appropriate.

During loading

The loading sequence of tanks should be planned in advance with the ship's stability and stress conditions in mind. It is customary to begin loading at a slow rate but once it is established that cargo is entering the correct tanks and that there are no leaks from hose connections or any other difficulties, the rate is increased to the maximum. It is recommended that at an early stage the cargo officer should satisfy himself that the correct grade of cargo is being loaded, either by checking the specific gravity of a sample or at least by visual means. In modern tankers the ship's instrumentation may facilitate remote monitoring of temperatures during loading but in any event it is essential to measure accurately and to record the temperature in each tank during loading. It is wise not to use an average of the tank temperatures since this leads to inaccurate cargo figures.

The loading rate should be monitored and it is recommended that ullages and the corresponding tank volumes be recorded in the deck log at least at hourly intervals. Any changes in the loading rate or any stoppages must also be recorded. During the final stages of loading the rate should be reduced to a minimum in order to permit measurement of the quantity of cargo so far loaded and to calculate the correct finishing ullage in the last cargo tank.

On completion of loading

Before the cargo hoses are disconnected, the ship's figures must be calculated in order to check that the correct quantity of cargo has been loaded. Whilst it is in the ship's interests to measure the cargo onboard ship, it is customary for various witnesses to attend this operation and in some cases to make independent calculations. These witnesses may include representatives from the loading terminal, the shippers and the charterers. It is of prime importance that the measurements of ullage, temperature and where appropriate, water dips are agreed by all concerned, although it must be accepted that the methods of calculation employed thereafter may not always be consistent. It is generally accepted that the latest edition of the API/IP Petroleum Measurement Tables are more accurate than the old tables, but it should be borne in mind that all tables are based on the average characteristics of a range of oils. Where a surveyor is attending on the ship's behalf he should collaborate with the ship's officers in order to ensure that no inconsistencies arise in the calculations.

Ship's tanks may be calibrated using imperial or metric units of volume and the quantity of cargo may be expressed in various units including long tons, tonnes or barrels. Whichever units are applied, it is essential to compare like with like. The use of standard volume may be considered preferable as it is less susceptible to misinterpretation by observers or laboratories. The appendix to this article shows the various terms used in the measurement of liquid cargoes and the abbreviations in common use.

At this point it may be worth considering in some detail the degree of accuracy which may be expected when ullaging tanks, measuring temperatures, taking samples or quantifying free water.

Ullaging

This is the measurement of the distance from the datum point at the top of a tank to the surface of the liquid cargo. This is usually done by means of a steel tape fitted with a weighted brass bob. Many tankers have fixed gauging equipment in each tank and electronic measuring devices are also available. Ullaging is best carried out when the ship is on an even keel and with no list: otherwise inaccuracies may creep in despite the application of trim corrections. A ship whether afloat, alongside a jetty, at anchor or at sea, is a moving platform. Whilst it is not implied that ships necessarily roll heavily when berthed, nonetheless slight movement will affect the accuracy of measurement. In any single tank, a difference of one inch in the ullage may involve a volume of several hundred barrels.

Some factors may affect the calculation of onboard quantities particularly residues on tank floors and structures, which will vary with the age of the vessel and previous cargoes carried. It is not unusual for ullages to be recorded for the purpose of determining ROB and OBQ when the trim of the vessel, at the time of survey, is such that the ullaging tape or sounding rod is not perpendicular to the ship's tank bottom on contact. In such cases it follows that the depth of ullage obtained must also be inaccurate. Clingage is a further area for consideration because whilst crude oil washing (COW) reduces clingage with most crude, there are a few types of crude where the reverse is true.

Water dips

Free water beneath a crude oil cargo is normally measured with a sounding rod. Using water-sensitive paste, the presence of water can be detected by a change in the color of the paste. Interface tapes may also be used for the detection of free water. Unfortunately, neither of these can be used to distinguish accurately between an emulsion and free water. Each method involves the risk of inaccuracies which can only be determined by proper sampling and analysis techniques.

Temperature

The temperature of liquid in a vessel's tank is generally obtained by the use of a cup case thermometer, although some vessels are now equipped with electronic temperature sensing devices. Cup cased thermometers are unreliable and errors of ± 2 to 3°C are not unknown. When taking temperatures, great care should be exercised to ensure that the thermometer is not affected by the environmental temperature after it has been removed from the oil.

The vertical positioning of the thermometer in a vessel's tank particularly at the discharge port is critical because significant temperature variations can develop within the cargo tanks during the voyage. Furthermore, as temperatures vary from tank to tank, calculations of quantity must be calculated using individual temperature corrections for each tank. The use of an arithmetical average for the whole ship is, as previously mentioned, inaccurate and contributes to 'paper losses'. An error of 1°C in temperature produces an inaccuracy in the volume at standard temperature of approximately 0.1%.

Sampling

The ship when calculating cargo quantities, has to rely upon certain data supplied from the shore, in particular the density of the cargo which is calculated after the analysis of samples. Shoreline samples may however contain inaccuracies and cannot always be accepted as being representative of the cargo loaded. It is recommended that with crude oils, the standard sampling 'thieves' should not be used but that clean sample bottles be used for individual samples from each level, (i.e. top, middle and bottom of each of the ship's tanks) and clearly labeled. Regrettably, sampling is often undertaken using a one litre 'thief', each sample being decanted into a larger sample can.

During such an operation volatile fractions may be lost to the atmosphere and the density established from the final mix does not represent the true density of the cargo in each tank. This, in turn, may later have a significant effect upon the calculation of weight and bottom sediment and water. The importance of sampling as a measure to counter contamination claims is dealt with later in the article.

Measurement errors

Studies by a major oil company revealed that a measurement error of $\pm 0.21\%$ may occur when calculating the measurement of volumes and an error of $\pm 0.25\%$ when calculating weights. Thus, measurement errors may easily account for what has previously been termed a 'measurement error loss' or 'measurement tolerance'.

Completion of documentation

Once the calculation of the ship's figures has been completed, the shore installation will provide a shore figure. It is generally this figure which is used on the bill of lading. For the reasons given in the section dealing with cargo measurement, it is most unlikely that the two figures will precisely coincide. In practice, and in the vast majority of cases, the discrepancy is small and of no great significance and the master of the ship will have no difficulty in reconciling the figures nor in signing the bills of lading. In each case, the gross figures should be compared and the ship's experience factor should also be taken into consideration.

On those occasions when there is an exceptional difference between the bill of lading figure and the ship's figure, the master should decline to sign the bills of lading. He should insist on a thorough check of all measurements and calculations, including those ashore, in order to ascertain the cause of the discrepancy. When checking the shore figures difficulties may arise because the measurements taken in the shore tanks before loading cannot be verified once the cargo has been transferred. The checking of the shore figures may, therefore, depend upon the accuracy of the records kept in the shore terminal. In the majority of cases this investigation is likely to be successful and the figures will be corrected and easily reconciled. The reasons for gross inaccuracies may include:

- Ullages wrongly measured.
- Tanks filled but not taken into account.
- The contents of pipelines not allowed for.
- Wrong temperatures or densities.
- Cargo mistakenly loaded on top of ballast.
- Cargo lost in the shore installation.
- Incorrect meter proving.

On occasions, despite such exhaustive checks it may be that the two calculations cannot be reconciled and the master then finds himself in a dilemma. On the one hand, he will doubtless be mindful of the Hague Rules which provide:

"No Carrier, Master or Agent of the Carrier shall be bound to state or show in the bill of lading any marks, number, quantity or weight which he has reasonable ground for suspecting not accurately to represent the goods actually received for which he has had no reasonable means of checking."

On the other hand, he will be conscious of the commercial pressures which dictate that the berth must be vacated and that the voyage must not be delayed. There is no inflexible rule to be followed which will apply in every case.

The master should note protest. He should certainly notify the ship's agents and instruct them to urgently inform the owners of the problem as well as the charterers, the shippers and any consignee, or notify party named on the bill of lading. The master should give full details of the available figures and ask the parties notified to inform any potential purchaser of the bill of lading of the discrepancy. It may be difficult for the master to contact all the parties named but the owner should do this at the earliest possible opportunity. Ideally, the master should be able to clause the bills of lading but in practice this creates many difficulties.

He should, therefore decline to sign the bills of lading or withhold authority for anyone else to sign until the dispute has been resolved. In any event the master or owner should immediately contact the Association or the Association's correspondents.

Early departure procedures

In certain busy oil ports, it is the practice, in the interests of expediting the turnaround of tankers, to offer the master the opportunity to utilise the 'early departure procedure'. This system was devised in the light of many years experience of tanker operations and shore figures after loading. On arrival at the loading berth the master agrees that on completion of loading, the loading hoses will be immediately disconnected and the ship will sail. As soon as the bill of lading figures are prepared, they are cabled to the master who then, provided he is satisfied, authorises the agent to sign the bills of lading and other related documents on his behalf. On no account should the master sign the bills himself before sailing without the correct figures being inserted.

Shipboard records

It is essential for the defence of possible cargo claims that the ship maintains certain documentary records of cargo operations. Time charterers, particularly the oil majors, are likely to place onboard their own documentation which they will require to be returned promptly at the end of each voyage. Typical returns would include:

- A voyage abstract (deck and engine).
- Notice of readiness.
- A port log.
- Pumping/loading records.
- Stowage plan.
- Loading and discharge port calculations.
- Details of any cargo transfers.

They may also include records of all oil transfer, whether loading, discharging or internal and including bunkering operations. It should be noted that such records will assist not only with the defence of shortage and contamination claims but with handling of other possible disputes including performance claims and demurrage and dispatch disputes. The need to keep full records of bunker quantities and to properly maintain the oil record book cannot be over emphasised.

During the voyage

SProvided the ship's fittings are properly maintained, the cargo will require little attention during the voyage unless heating is required. In such cases, it is important to follow the charterer's instructions particularly bearing in mind the specifications of the cargo carried. In some cases failure to heat the cargo properly may lead to severe difficulties. When crudes requiring heating are carried, particularly those with high wax content, it is important that the charterers provide clear instructions for heating both on the voyage and throughout discharge. Often, heating instructions are not sufficiently precise with the charterers relying on the experience of the master. Usually, it is wise to heat early

in the voyage in order to maintain the temperature rather than to be obliged to raise the temperature of the cargo significantly at the end of the voyage. If there is doubt about the heating instructions, the master should check with the charterers. The tank temperatures should be recorded twice daily.

Attention should be paid to the condition and operation of the pressure-vacuum valves on the tank venting system in order to ensure that they are functioning correctly. Failure to operate these valves properly may lead to a significant loss of product during the voyage.

Finally, as mentioned earlier, the loading has been carefully planned, there should be no necessity to transfer cargo between cargo tanks during the voyage. Indeed this should be avoided unless absolutely necessary as differences between ullages and soundings taken before and after the voyage invariably lead to disputes when defending shortage claims. Ideally, the two sets of readings should not differ to any degree. Owners should discourage the practice and insist that any transfers which the master considers urgent and essential be reported and properly recorded in the oil record book. Many charter parties do in fact require the master to notify the charterers of any cargo transfers.

Before arrival at the discharge port

A proper discharging plan should be prepared, taking into account any restrictions or requirements. It must include a careful check on not only the trim condition during discharge but on the stress conditions. Care should be taken to ensure that the parameters laid down by the shipbuilders are adhered to. It is also important to take into account the required discharging temperature and the need to maintain this temperature throughout the discharge. When discharging in ports where low sea temperatures prevail, this may require considerable vigilance. In those tankers fitted with inert gas and COW it is wise to ensure in advance that the systems are fully operational in readiness for the forthcoming discharge.

On arrival at the discharge port

On completion of the arrival formalities, the need to communicate with representatives of the discharging facility is no less important than at the loading port. Full liaison should include the exchange of all relevant information about the cargo, including the maximum discharge rates, the discharge plan, safety procedures, shutdown procedures scheduled shore stops and any local regulations. If the ship is fitted with COW it must be clear whether COW is to be carried out, particularly bearing in mind any Marpol requirements.

Before discharge

As in the loading port, the measurement of the cargo is undertaken in the presence of the cargo receivers and possibly other interested parties or their surveyors and including customs authorities. The remarks in the section on cargo measurement apply equally in this instance. The utmost care should be taken in checking and double-checking the measurements. The measurement of

temperature merits particular care especially where heated cargoes are concerned. Again it is stressed that apparently small discrepancies in temperature can lead to significant differences in the final calculations and the temptation to 'round off' temperatures or to use convenient averages should be discouraged. It is essential to note the ship's trim and list at the time of ullaging – the ideal trim is with the ship on an even keel and with no list. When sampling cargo before discharge and particularly in the case of heated cargoes, samples should be taken from the top, middle and bottom of the cargo tank.

On completion of cargo measurement, a comparison should immediately be made with the loading ullages tank by tank, in order to see whether there have been any appreciable changes since leaving the loading port. Should any differences be noted, then the reasons should be immediately investigated and fully recorded. The ship's responsibility should begin and end at the fixed manifold and the owners have no liability for measurements taken once the cargo has entered the complex of piping which forms the average receiving terminal. Claims are frequently presented on the basis of shore figures which are inaccurate and the most effective and economical way of repudiating liability may be to recalculate these figures correctly. It would be beneficial for a surveyor representing the ship-owner to check the shore reception facility, where he may be able to witness the taking of shore measurements. He may also be able to check the pipeline system, to verify its size and length and the method by which its contents are ascertained before and after discharge as well as noting any valves which lead off those pipelines which are in use. Some shore facilities are reluctant to allow ship's representatives to make full checks in their terminals. It should be recorded if an inspection of the terminal or its operations is refused.

Where shortage claims arise, they are usually based on the shore figures and the owner must defend himself not only on the basis of the accuracy of the ship's figures, but also by challenging the accuracy of those shore figures. It will greatly assist if the owners' surveyor has made a thorough inspection of the terminal at the time of the discharge.

During discharge

Once the necessary preparations have been completed aboard the ship and the shore installation has confirmed that the discharge can commence, the cargo pumps are started in sequence. Where one or more grades of cargo are carried, it may be possible to discharge each grade simultaneously subject to stress and trim considerations and any other restricting factors including the design of the ship's pipeline system. Once it has been established that the cargo is flowing correctly, the discharge rate should be increased to the agreed maximum. The rate may be restricted either by back pressure or by the capacity of the ship's pumps. The rate of discharge should be carefully monitored throughout and recorded at intervals of no more than one hour. These records should show not only the amount of cargo discharged by volume but also the shore back pressure, the pressure at the ship's manifold, the speed of the cargo pumps and steam pressure or, in the case of electrical pumps, the amperage. If COW is being carried out, this operation must be closely monitored.

Careful recording of the discharge in the ship's logs is essential if claims are to be successfully defended.

The effective stripping of the tanks is important since claims will undoubtedly be made against the owner for quantities of cargo remaining onboard. Provided the ship has a good stern trim, the tanks have been well cleaned and prepared prior to loading and provided also that the ship's pumps and pipelines are in sound condition, it should be possible to ensure that a negligible quantity is left onboard. In the case of light or clean products there should be no problem although where heavier or heated cargoes are concerned, there will inevitably be some clingage and perhaps some sediment remaining. COW will help to reduce these quantities and care should be exercised when stripping heated cargoes to ensure that the tanks are drained quickly, since once the level of the cargo falls below the heating coils, heat will be lost quickly and difficulties may be encountered.

Whatever type of oil is carried, it will be necessary to be able to demonstrate that ship's valves, lines and pumps were in good condition at the time of discharge, because this has an impact on the question of 'pumpability'. It might be assumed that oil is pumpable or unpumpable in the sense that it is liquid or not liquid. From the point of view of cargo claims however, it must also be considered whether, even if the cargo was liquid, it could be pumped by the vessel's equipment. It is possible that small quantities of oil, particularly where high gas cargoes are concerned, cannot be picked up by the pumps without the pumps gassing up. It could be that due to sediments from the cargo or shore restrictions on trim, the oil is liquid but cannot run to the suction. The master should call in a local UK Club surveyor if he experiences difficulty in obtaining a suitable dry tank certificate. If pressure is applied to the ship to sail before the surveyor can attend, the master should protest to the receivers and to the receivers' surveyor. If the surveyors are not prepared to certify cargo remaining onboard as unpumpable, they should be invited to inspect the ship's pumps. The receivers should be informed that if they consider the cargo to be pumpable, the ship is prepared to continue to attempt to pump it until the UK Club surveyor arrives. Owners should ensure that the maintenance records for the cargo pumps are carefully preserved and that they are available when such disputes arise. Surveyors who certify cargo as pumpable should be required to prove that they have tested the nature of the cargo and have ascertained that it can and does reach the suction in the cargo tank.

ROB claims may therefore arise in three different ways:

- By loss of heating or inadequate heating onboard ships, sometimes coupled with low ambient temperatures at the time of discharge.
- The physical properties of the oil and the ability of the pumps to pump it. The possibility of pumps gassing up and loss of suction must be taken into consideration.
- Cargo sediments or trim restrictions which prevent the free flow of oil to the tank suction.

In the case of crude which does not require heating or which has a high vapour pressure, good crude oil washing and a good stern trim will overcome most problems.

Frequently the charterparty will call for COW 'in accordance with Marpol' and will allow additional time for discharge when COW is performed. Naturally, if the receiving installation will not allow satisfactory stern trim or if they refuse COW either in whole or in part then the master should protest to the terminal and to the charterers, stating that the vessel cannot be held responsible for any resulting cargo losses.

On completion of discharge

When the cargo has been completely discharged with all tanks and pipelines well drained, the cargo system should be shut down and all tank valves closed. A final tank inspection is then carried out and inevitably particular attention will be paid by the shore representatives to any cargo remaining onboard. All void spaces, including ballast tanks and cofferdams should be checked to ensure that no leakage of cargo has occurred. This is particularly relevant on OBO vessels.

Dry tank certificate

After discharge, a dry tank certificate will ideally be issued, signed by an appropriate shore representative describing any remaining cargo as 'unpumpable' and carrying an endorsement that the ship's equipment was in good working condition. In many places, shore cargo inspectors are reluctant to describe oil as 'unpumpable' and may prefer to use the terms 'liquid/non-liquid'. This is not satisfactory and should be avoided if at all possible because it leaves cargo owners in a position to claim pumpability and to attempt to activate a charterparty retention clause, albeit unlawfully, if the clause requires the cargo to be pumpable.

It is strongly recommended that masters contact their UK Club representative and the ship's operators for advice if a dry tank certificate showing oil remaining onboard as being unpumpable cannot be obtained.

Ballasting

Where permanent ballast tanks are fitted, it is normal practice for these to be filled during the discharge in order to expedite the ship's departure. It is, however, recommended that other ballast tanks not be worked simultaneously with cargo operations as this will certainly entail the risk of contaminating the cargo. Should ballast, in addition to the permanent arrangements, be required then such ballasting is best completed after the discharge and after the inspection of the cargo tanks.

In-transit losses and their potential causes

In the past the standard defence put forward by a shipowner to a cargo shortage claim was that the loss was below or equal to 0.5% of the total cargo. This figure, which originally stemmed from the cargo insurance deductible, has been used by shipowners and cargo insurers as a yardstick for transit losses for many years. However, a number of courts, particularly in the United States, have rejected the concept of an automatic 'loss allowance'.

Nonetheless, there is every indication that the same Courts would allow a $\pm 0.5\%$ 'measurement tolerance'. In transit losses and their causes can be considered under four headings:

- The true in-transit losses during the voyage where the ship's gross volume at standard temperature on loading is compared with the vessel's gross volume at standard temperature prior to discharge.
- Theoretical in-transit losses when the comparison of net volume onboard at standard temperature on completion of loading is compared with the net volume onboard prior to the commencement of discharge.
- Emptying and filling losses. This is particularly pertinent where a part discharge may take place into a lightering vessel or barge.
- Additional losses which may occur as a result of crude oil washing.

The third and the fourth items become apparent when accounting for volumetric losses on outturn.

Various factors including permutations of tanker design, cargo density, Reid vapour pressure, cargo temperature, ambient temperature and general weather conditions, may combine to cause a release of gasses and an increase in pressure within the cargo tanks which, combined with the inert gas pressure, may cause venting through the pressure vent valves and consequent loss of product.

Losses during discharge

The largest volumetric losses are likely to occur when there is transfer from one container to another. This means that quite large losses can occur when pumping the cargo from the ship to the shore. Where lightering is involved there will, inevitably, be a greater risk of volumetric losses between the ocean carrying ship and the shore tanks. Where COW is performed, the potential for volumetric losses is greater since the cargo is being formed into a high pressure spray and partially atomised.

The shore installation

When assessing a claim for short delivery of an oil cargo, the ship's calculation and figures are scrutinised. It is equally important to examine the shore calculations at both the loading and discharge ports. As mentioned earlier, the carrier's liability does not extend beyond the ship's manifold, and claims for apparent oil losses can sometimes be resolved by recalculation of the shore figures. The cargo interests should be asked to provide full details of the shore installation including a plan showing all the storage tanks and the inter connecting pipelines as well as the position of isolating valves. They should be able to verify the maintenance of all their equipment and demonstrate that, for instance, all the isolating valves were tight and properly operating at the time of discharge. They should also be asked to demonstrate that the storage tanks were properly calibrated and show that the calibration was accurate. In some oil installations the accuracy of the tank calibrations may be doubtful particularly if they are of older construction or built on unstable sites. A small measurement

inaccuracy may correspond to a substantial change in volume. Temperature measurements should also be closely considered: temperature gradients may exist when oil is stored in a large tank and in certain climatic conditions there may be significant variations in the temperature within the tank. In a cold wind, there may be a horizontal temperature gradient as well as a vertical gradient. In many countries the measurements taken at the time of custody transfer are witnessed by customs officials and if appropriate, the official customs documents should be produced.

Oil contamination claims

Many oil shortage claims arise from the presence of excessive quantities of water found in crude oil cargoes at the discharge port after settling out during the voyage. Oil contamination may occur in petroleum products but a cross contamination between two grades of crude oil would, in most cases, not lead to a cargo claim. Crude oil cargoes are regularly blended before refining and generally for a cargo contamination to arise, a large cross contamination would need to take place. This is not true of all grades of crude as there are a few which have particular properties and which must not be contaminated in any way.

Many modern refineries, designed for the reception of cargoes carried by sea have desalination facilities in order to protect the distillation columns and refinery equipment from excessive corrosion. Such facilities, however do not always exist. The presence of water in certain crude oil cargoes may also cause emulsions to form with the hydrocarbons. This in turn may cause ROB volumes to be excessive and possible sludging of land tanks if efficient water draining is not carried out.

It is quite possible that any alleged contamination could have taken place ashore before loading. A prudent owner is therefore recommended to protect his interest by ensuring that a ship's staff take cargo samples from each tank after loading and at the ships manifold during loading, as a matter of routine, so that hard evidence is at hand to refute claims of this kind. Contamination claims are more likely to occur in the white oil trades where it is common for a number of grades to be carried simultaneously. As many as eight or ten grades are commonly carried simultaneously and on a modern purpose-built product carrier, fitted with deep well pumps and dedicated loading line, it may be possible to carry a different grade in each tank with complete segregation.

Aside from leakage which may occur between cargo pipelines or cargo tanks and which may result in contamination, the most likely cause of a product being off specification is failure to properly prepare the tank or associated pipelines after a previous incompatible grade.

Precautions before loading

Every care should be exercised to ensure that proper tank cleaning procedures are rigorously carried out and that tank coatings are in a suitable condition for the intended cargo. Particular care should be taken to ensure that all traces of the previous cargo are removed in the cleaning process.

When carrying multigrade cargoes, effective segregation is a prime importance. When preparing the loading plan, allowances must also be made for trim and draft restrictions, it is not uncommon for multigrade cargoes to be loaded in more than one port and for several discharge ports to be involved. In some cases, additional cargo may be loaded during the voyage after the discharge of other products. Careful planning is advisable taking into consideration the quantity of cargo to be loaded and discharged, draft, trim and stress considerations as well as the consumption of water and fuel.

Before loading, all those concerned should have a clear knowledge of the intended loading plan and the pipelines and valves must all be carefully set and double-checked. Because product cargoes generally have a low specific gravity, it is likely that the ship may not be loaded down to her marks even with all cargo tanks filled to the maximum permissible. When loading for a voyage which entails passing through areas where higher sea temperatures are expected to be encountered, it is advisable to take into account the expansion of the cargo which will occur as a result of those higher temperatures.

During the loading of sensitive products it is common for 'foot samples' to be loaded and for samples to be taken and analyzed before the rest of the product is taken onboard. When carrying multigrades it is an excellent practice to have as many samples of the cargo as possible taken at various stages of the loading and discharge, including samples taken from the shorelines. If claims for contamination arise, the analysis of such samples will often identify the source of the problem and may assist the shipowner in rejecting liability.

A more detailed article on the sampling of liquid cargoes is included later in this Section, and a careful study of that article is recommended.

Conclusion

If the following points are borne in mind by owners and masters there will be a much greater chance of success when defending oil cargo claims.

- Careful attention should be paid to all onboard surveys when loading and discharging with a view to avoiding 'paper losses'.
- After discharge try to ensure that a dry tank certificate is issued showing all cargo remaining onboard to be unpumpable and endorsed to confirm that the ships equipment was working correctly.
- Employ properly qualified surveyors and protest if it can be demonstrated that a surveyor employed by cargo interest is not qualified or lacks experience.

Appendix: definitions of terms used

API = API GRAVITY

Petroleum industry expression for density of petroleum liquid expressed in API units. API gravity is obtained by means of simultaneous hydrometer/temperature readings, equated to, and generally expressed at 60oF. The relative density to API gravity relation is:

$$\frac{141.5}{- 131.5}$$

Relative density 60oF

AUTOMATIC SAMPLER

A device installed for indicating the level of product from a location remote to the manual gauge site.

BARREL

Petroleum industry measurement unit equal to 42 US Gallons.

CLINGAGE

That oil remaining adhered to the inner surface and structure of a tank after having been emptied.

CRUDE OIL WASHING (COW)

The technique of washing cargo tanks of oil tankers during the discharge of crude oil cargoes.

DENSITY

The density is the mass per unit volume at a specified temperature used to determine weight for a volume at a standard temperature.

DIP

Is depth of liquid = to American expression: gauge.

FREE WATER

The quantity of water resulting from measurements with paste or interface detector, i.e. not entrained water present in oil.

GAUGE REFERENCE HEIGHT

The distance from the tank's strike point to the bench mark or reference point.

GROSS OBSERVED VOLUME (GOV)

The total volume of all petroleum liquids, excluding S&W, excluding free water, at observed temperature and pressure.

GROSS STANDARD VOLUME (GSV)

The total volume of all petroleum liquids and S&W, corrected by the appropriate temperature correction factor (Ct1) for the observed temperature and API gravity, relative density, or density to a standard temperature such as 60°F or 15°C also corrected by the applicable pressure correction factor.

LOAD ON TOP (LOT)

The concept of allowing hydrocarbon material recovered during tank washing to be commingled with the next cargo.

NET OBQ

OBQ less free water in cargo, slop tanks and lines, and water in suspension in slop tanks.

NET OBSERVED VOLUME (NOV)

The total volume of all petroleum liquids, excluding S&W, and free water at observed temperature and pressure.

ONBOARD QUANTITY (OBQ)

Cargo tank quantities of any material onboard a ship after de-ballasting immediately prior to loading. Can include oil, oil/water emulsions, water, non-liquid hydrocarbons and slops.

REMAINING ONBOARD (ROB)

Cargo or residues remaining onboard ship after discharge.

SEDIMENT AND WATER (S&W)

Non-hydrocarbon materials which are entrained in oil. Material may include sand, clay, rust, unidentified particulates and immiscible water.

SHIP'S COMPOSITE SAMPLE

A sample comprised of proportional portions from running samples drawn from each tank on the ship.

SHIP FIGURES

Stated volume extracted from ship's calibration tables based on measurements taken from cargo tanks.

SLOP TANK

A tank into which the tank washings (slops) are collected for the separation of the hydrocarbon material and water; the recovery most often becoming LOT (load on top).

TOTAL CALCULATED VOLUME (TCV)

The total volume of the petroleum liquids and S&W, corrected by the appropriate temperature correction factor (Ct1) for the observed temperature and API gravity, relative density, or density to a standard temperature such as 60°F or 15°C and also corrected by the applicable pressure factor and all free water measured at observed temperature and pressure. (Gross Standard Volume plus free water).

TOTAL DELIVERED VOLUME (SHIP)

It is defined as the Total Calculated Volume less ROB.

TOTAL OBSERVED VOLUME (TOV)

The total measured volume of all petroleum liquids, S&W, and free water at observed temperature and pressure.

TOTAL RECEIVED VOLUME (SHIP)

It is defined as the Total Calculated Volume less OBQ.

ULLAGE (OUTAGE GAUGE)

A measurement taken from the gauge reference point to the liquid level.

VOLUME CORRECTION FACTOR (VCF)

The coefficient of expansion for petroleum liquids at a given temperature and density. The product of the petroleum liquid volume and the volume correction factor, equals the liquid volume at a standard temperature of either 60oF or 15oC.

WATER (DIP) GAUGE

- a) The depth of water found above the strike point, or
- b) To gauge for water.

WATER FINDING PASTE

A paste, which when applied to a bob or rule, is capable of indicating the water product interface by a change in colour at the cut.

WEDGE CORRECTION

An adjustment made to the measurement of a wedged shaped volume of oil, so as to allow for the vessel's trim.

WEIGHT CONVERSION FACTOR (WCF)

A variable factor related to density for use to convert volume at standard temperature to weight.