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ESSENTIAL GUIDE TO UNDERSTANDING CARGO VENTILATION

MANY CARGO CLAIMS RESULT FROM MOISTURE DAMAGE, OCCURRING DUE TO THE DEVELOPMENT OF CONDENSATION ("SWEAT").

Proper ventilation is instrumental in preventing the deterioration of cargo, by removing excessive moisture and minimising the formation of sweat.

Ventilation is also required for some cargoes to disperse hazardous gases emitted by the cargo, such as carbon dioxide, carbon monoxide and methane.

TRIGLAV Maritime

OUR PARTNER FOR THIS ISSUE

Triglav Maritime provides bespoke, comprehensive consultancy services focusing on risk management, loss prevention, as well as marine vetting and assurance matters.

The founder, Capt. Ostrowicki has 34 years of combined command and shore-based experience. He has sailed on bulk carriers, general cargo and container ships. His shore-based experience includes ship operations and marine vetting of dry cargo ships, tankers and gas carriers, as an operations manager, marine vetting director and loss prevention manager.

Capt. Ostrowicki provides expert advice on risk management and safety management processes. In addition to marine incident and claim investigations, he performs management reviews, ISM and TMSA audits and in-depth risk assessments through data analysis. He has also authored several publications.

FOR SOLID BULK CARGOES, THE REQUIREMENTS OF THE INTERNATIONAL MARITIME SOLID BULK CARGOES CODE (IMSBC CODE) APPLY.

In addition to specific cargo schedules, the general requirements of IMSBC Section 3 regarding ventilation relate to:

- Attention which should be paid to cargoes depleting oxygen and emitting toxic gases
- Preventing formation of explosive or flammable atmosphere in cargo holds
- Prevention of ventilation (other than surface ventilation) in cargoes which may spontaneously heat
- Protection of personnel from hazardous gases, vapours or dust.

Cargo ships are provided with natural, or mechanical ventilation systems. It is essential that the ship's master and officers have thorough understanding of the design and operation of the ventilation system to use it correctly and to full capacity.

In a **natural** ventilation system, the circulation of air is achieved without mechanical power, by pressure differential resulting from relative wind, or by thermal differential between the ambient air and the air inside the cargo hold.

A typical **mechanical** ventilation system is open circuit, where supply fans draw the ambient air into the cargo hold which, after passing through the headspace over cargo, exits the cargo hold through exhaust vent openings.

There are also other designs and arrangements to remove excessive moisture from within cargo holds. Such arrangements may involve the use of **dehumidifiers** (a fixed installation or portable devices). They are typically used where open circuit ventilation is impossible, or insufficient to prevent cargo damage – for example, on ships carrying steel cargoes loaded in winter for discharge in warm conditions.

PRINCIPAL TERMS RELATED TO HUMIDITY

WATER VAPOUR, AS THE GASEOUS STATE OF WATER, IS GENERALLY INVISIBLE IN THE AIR.

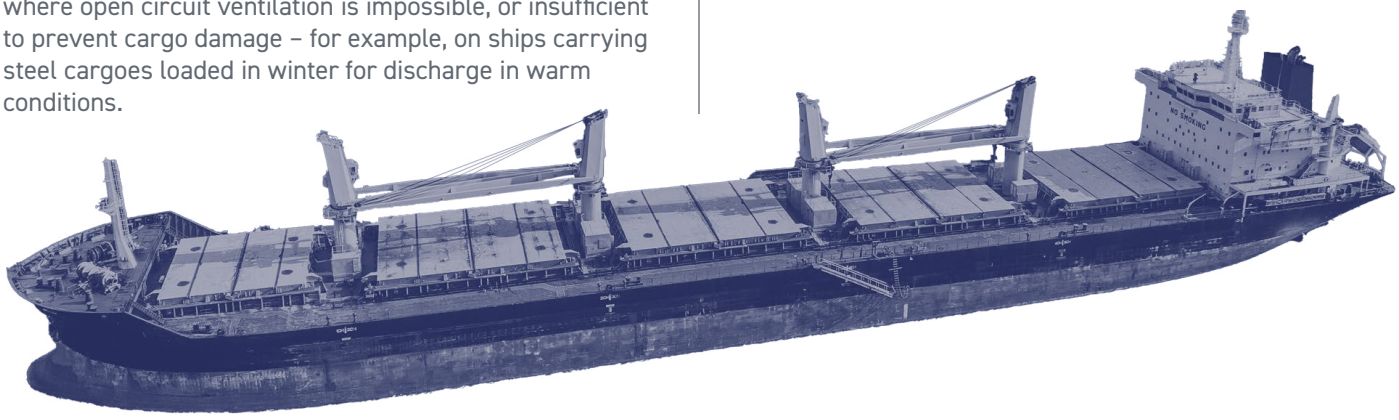
Relative humidity (RH) expressed in %, is the amount of water vapour present in the air, compared with the maximum humidity the air can hold. When RH reaches 100%, the air is **saturated** with water vapour.

Warm air can hold more water vapour than cold air. If the air cools down, its RH will eventually increase to 100% and **condensation** ("dew") will form on the surrounding surfaces or particles. **Dew point (DP)** is the temperature at which the air becomes saturated.

THE MORE MOISTURE THE AIR CONTAINS, THE HIGHER THE DEW POINT.

For example, at 20°C humid air with 90% RH will condensate on surfaces which are 18.3°C or less (so the surface needs to be only a little cooler for condensation to occur – like a steamy mirror in a bathroom). However, dry air with 60% RH would only condensate on much colder surfaces, which are 12.0°C or less.

DP is a key metric when determining the risk of condensation forming inside the cargo hold.



MEASURING DEW POINT (DP)

RELATIVE HUMIDITY AND DEW POINT ARE MEASURED WITH **HYGROMETERS**. A **PSYCHROMETER** IS A TYPE OF HYGROMETER THAT CONSISTS OF TWO THERMOMETERS, WITH THE BULB OF ONE THERMOMETER KEPT WET WITH A PIECE OF WET WICK (CLOTH) WRAPPED AROUND IT.

The wet-bulb thermometer will show a lower temperature due to evaporation. A DP value can then be obtained from **dew point tables** by entering temperature readings from both thermometers.

The most popular type is a hand-held **sling (or whirling) psychrometer**. Spinning the psychrometer provides an air flow around the thermometers, evaporating moisture from the wick for a correct wet bulb reading.

FIGURE 1 Sling psychrometer
SOURCE Zeal Ltd

Whilst sling psychrometers are inexpensive and simple, they have several disadvantages:

- They need to be spun by hand, therefore requiring direct access to the cargo space for measurement. Lowering the psychrometer to the cargo space will not produce an accurate measurement. However, access to the cargo space is often impossible
- Thermometers must be calibrated
- A small error in reading temperature of either bulb may translate to a larger error in dew point calculation.

Some of these disadvantages have been addressed in **aspiration psychrometers**, where the air flow is generated by a mechanical fan, typically spring-loaded.

Aspiration psychrometers do not require direct manual action and can be lowered into the cargo space. They are generally more accurate than the sling type, however they are also more expensive and are not easily repaired if they sustain damage.

FIGURE 2 Aspiration psychrometer
SOURCE NovaLynx Corp

Electronic hygrometers have distinct advantages and are widely available in various configurations, from standalone handheld devices to wired probes, or remote sensors which can remain inside the cargo hold. They may also enable recording of measurements along with a time stamp.

FIGURE 3 Electronic hygrometer
SOURCE Senseca Germany GmbH

As with any device, the accuracy of electronic hygrometers depends on the quality and calibration of the sensors. Good quality electronic hygrometers are generally more accurate than sling psychrometers, whilst being safer and more convenient to use.

The choice of an appropriate hygrometer will depend on the operational and safety requirements of the ship and cargo, such as the ability to access the cargo hold.

DP and RH measurements will be recorded in the **ventilation log** and may become instrumental in defending a cargo claim. Therefore, it is essential that these instruments are **certified, calibrated and well maintained**, and that their records are kept in good order. Users should be provided with appropriate **training** before taking and recording measurements.

CARGO SWEAT AND SHIP SWEAT

IF THE TEMPERATURE OF THE SURROUNDING SURFACES OR THE CARGO IS LOWER THAN THE DEW POINT OF THE AIR INSIDE THE CARGO HOLD, CONDENSATION WILL OCCUR.

CARGO SWEAT is condensation which forms directly on the cargo. It may take place if warmer and more humid air is introduced into a hold with colder cargo.

This scenario is broadly captured in the rule of thumb "Cold to Hot – Ventilate Not". Ventilating cold cargo with air having a DP above the cargo temperature is likely to result in formation of cargo sweat, and subsequent cargo damage.

SHIP SWEAT is condensation which forms on surfaces surrounding the cargo, such as the ship's steelwork. It occurs when these surfaces are colder than the DP of the air inside the cargo hold. Typically, ship sweat occurs when cargoes loaded in warm climates, are carried to a colder climate. As moisture and heat pass from the cargo to the air in the headspace, condensation can occur on any adjacent cooler steelwork. In such cases, the cargo may become damaged by water dripping down from the steelwork.

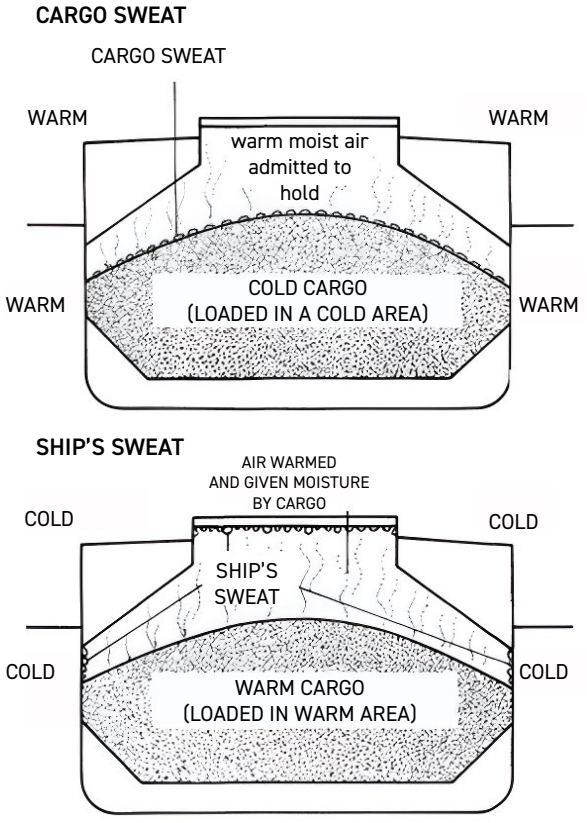


FIGURE 4 Cargo sweat and ship sweat
SOURCE Capt J. Isbester "Bulk Carrier Practice", 1993

Cargoes with inherent moisture content like grain can release a relatively large amount of moisture. For example, the reduction of moisture content from 14% to 13.5 % in 500 tons of grain close to the cargo surface could release 2.5 tons of water vapour. This amount of moisture, circulating in the headspace above the cargo, may result in continual, localised condensation and significant cargo damage.

Ship sweat should be prevented by appropriate ventilation, replacing the mass of warm and humid air above the cargo with less humid, ambient air (with lower DP than that inside the cargo hold). As the moisture will continue to transpire from the cargo, ventilation should also continue whenever possible. The corresponding rule of thumb is **"Hot to Cold – Ventilate Bold"**.

CARGO DAMAGE AND VENTILATION

DEPENDING ON THE SPECIFIC CARGO PROPERTIES, IT CAN BE SUSCEPTIBLE TO DAMAGE BY VARIOUS FACTORS:

BIOLOGICAL DEGRADATION

Agricultural cargoes contain mould spores, as well as yeast and bacteria which remain inactive only if the cargo temperature and moisture content (MC) are low enough. Otherwise, microbiological activity in the cargo will eventually occur with sufficient intensity to cause cargo damage through mould growth, putrefaction and/or fermentation. Correct ventilation can prevent or slow down these processes by lowering the MC of the cargo. However, it should be noted that the ventilation of grains and other bulk cargoes typically does not permeate deeply into the cargo. Instead, it is generally limited to the surface of the cargo.

See also Britannia Loss Prevention Insight carriage of grain and oilseed cargoes.

SELF-HEATING

Biological and chemical reactions in cargoes, combined with the insulating properties of cargoes such as grains, oil seeds, as well as coal may lead to self-sustained reactions producing heat, resulting in severe cargo damage and the potential risk of fire. These processes require oxygen, therefore when self-heating occurs, continued ventilation may worsen the situation.

See also Britannia articles heat damage to agricultural cargoes and how to avoid it and guidance on the carriage of coal cargo.

RUST DAMAGE

Typically affecting steel product cargoes if it comes to formation of cargo sweat, or cargo exposure to ship sweat (for example, dripping onto the cargo).
With such cargoes, the purpose of ventilation is to avoid rust damage by preventing the formation of sweat.

See also Britannia Loss Prevention Insight handling and carriage of steel.

STAINING OR DISCOLOURATION

With improper ventilation, staining is typically caused by rust particles or dirt washed into the cargo by condensation. Cargo staining may cause cargo rejection or prompt a damage claim.

CAKING AND CLUMPING

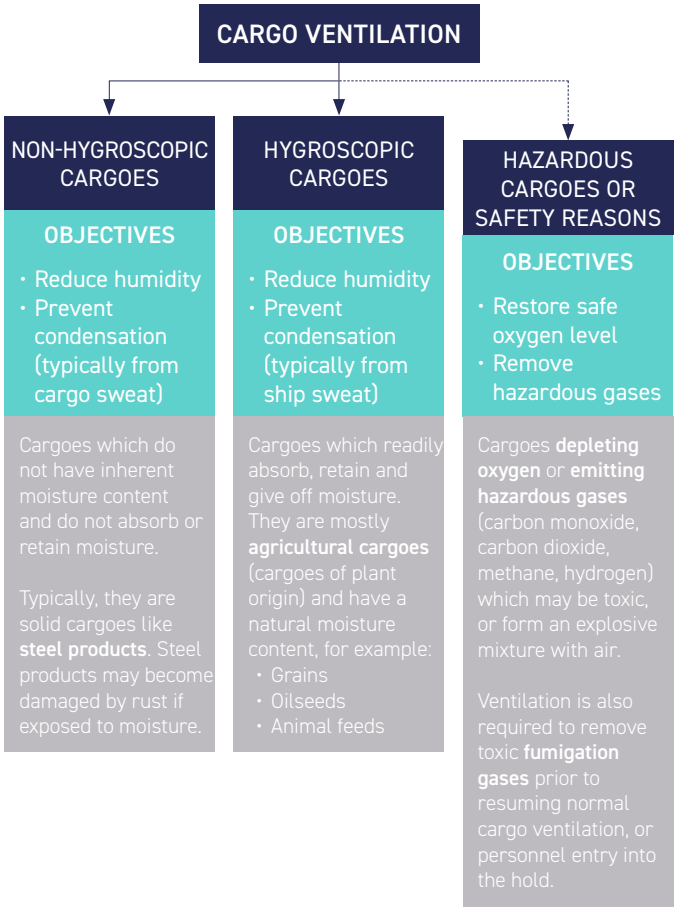
Some hygroscopic cargoes, such as fertilisers, are shipped in granular form. Excessive moisture or wetting of the cargo may cause the particles of the cargo to bond and cake. This in turn may cause operational issues upon discharge, as well as result in a damage claim as non-free flowing cargo may not be suitable for the intended use.

DAMAGE TO PACKAGING OR STOWAGE MATERIAL

In addition to aesthetic damage, packaging affected by condensation may lose its protective and mechanical properties which can also result in cargo collapse and further damage.

The main cargo property dictating ventilation requirements and strategies is hygroscopicity (ability to acquire or pass moisture from/to the adjacent air – explained further in more detail).

Ventilation may be necessary due to the hazardous nature of the cargo, or for safety reasons:



For solid bulk cargoes other than grain, careful attention should always be given to the cargo's **IMSBC Code** schedule, which serves as the primary regulatory reference for identifying hazards and ensuring safe carriage.
The IMSBC Code schedule may contain very specific requirements regarding ventilation (for example for seedcakes), and incorrect ventilation may contribute to self-heating or other hazards.

In addition to the regulatory requirements for the safe carriage of the cargo, ventilation instructions provided in voyage orders and/or charter party should be carefully reviewed.

If there is any conflict between the instructions and regulatory requirements, or the ship's technical capability and procedures, it should be clarified and addressed in advance.

WHEN TO VENTILATE?

THE FOLLOWING SHOULD BE CONSIDERED PRIOR TO DECIDING WHETHER TO VENTILATE:

- CARGO PROPERTIES AND REQUIREMENTS FOR THE SAFE CARRIAGE
- TEMPERATURE, DP AND RH OF THE AMBIENT AIR
- TEMPERATURE AND MOISTURE CONTENT OF THE CARGO, AND/OR
- TEMPERATURE, DP AND RH OF THE AIR INSIDE THE CARGO HOLD (SEE FURTHER COMMENTS REGARDING VENTILATION RULES BELOW)
- SEA WATER TEMPERATURE, PARTICULARLY IN CARGO HOLDS OF OPEN FRAME TYPE WHERE SHIP SWEAT CAN EASILY FORM
- BALLAST WATER TEMPERATURE WHERE A FILLED TANK IS ADJACENT TO THE CARGO
- EXPOSURE OF THE VENTILATION SYSTEM TO RAIN, WAVES AND SPRAY.

As ventilation directly impacts the safe carriage of the cargo, the Safety Management System (SMS) should provide robust guidance to the crew. Whilst it may re-iterate general industry practice, the SMS and operational procedures should also reflect the requirements of the company considering its trading and operational profile (for example, steel trade in winter areas).

VENTILATION RULES

THERE ARE TWO BASIC VENTILATION RULES WHICH ASSIST MARINERS WITH THE DECISION WHETHER AMBIENT AIR IS SUITABLE FOR SAFE VENTILATION OF THE CARGO:

DEW POINT RULE

THREE DEGREE RULE

Decisions to start or stop ventilation should be carefully recorded in the ventilation log.

DEW POINT RULE

"VENTILATE IF THE DEW POINT OF THE OUTSIDE AIR IS LOWER THAN THE AIR INSIDE THE CARGO HOLD".

Dew Point rule refers directly to measurements at the time of decision: if the DP of the ambient air is lower, it is less humid than the air inside the hold. It is easy to understand but may be more difficult to apply.

Firstly, accurate DP measurements are required in spaces where access is restricted due to fumigation, safety reasons or subject to the enclosed space entry protocol. Taking DP measurements in cargo holds filled to coaming height may also be physically impossible, with the headspace between the cargo and hatch cover sealed by the coaming. In such case, air pockets in hold ends (accessible by manholes) are not connected with the main headspace above the cargo and cannot provide representative DP measurements.

HATCH COAMING SEALED BY CARGO

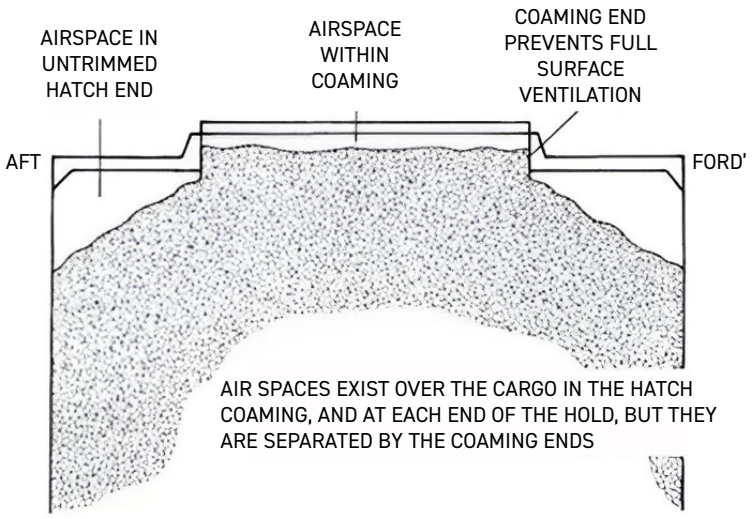


FIGURE 5 Hatch coaming sealed by cargo
SOURCE Capt J. Isbester "Bulk Carrier Practice", 1993

Secondly, there may be insufficient personnel to measure as often as required (recommended at least every four hours or once per watch) – with measurements to be obtained in each cargo hold (good practice recommends obtaining two measurements at each point, to validate the reading). Furthermore, ventilation should be stopped for some time, or the measurement will be affected by outside air.

The above mentioned difficulties are also often the reason for inaccuracies or apparent errors seen in ventilation logs, when retrospectively reviewed in case of cargo claims.

THREE DEGREE RULE

"VENTILATE IF THE TEMPERATURE OF THE OUTSIDE AIR IS AT LEAST 3°C LOWER THAN THE TEMPERATURE OF THE CARGO."

The Three Degree Rule for use with hygroscopic cargoes can be applied without the need to repeatedly access cargo spaces, or to stop ventilation for measurements. The cargo temperature is assumed to remain constant during the voyage, due to its large mass and thermal inertia. The ambient air temperature can be measured frequently, easily and with good accuracy.

However, it is important to understand the requirements and limitations of this rule:

- The rule applies to hygroscopic, mostly agricultural cargoes such as grain. The rule assumptions do not fully apply to non-hygroscopic cargoes
- It requires a reliable temperature measurement of the cargo upon loading. For this, a surveyor may need to be appointed - the ship may not have sufficient access, or the appropriate equipment. Different parcels may have different temperatures, so accurate sampling is required
- If the cargo temperature reduces during the voyage, for example due to intensive ventilation with very cold air, or a voyage delay in cold weather, the original rule assumptions for the cargo may become invalid. Performing another cargo temperature measurement may not be practical or safe.

EXPLANATION OF THE THREE DEGREE RULE

Agricultural cargoes are dried prior to loading to a transportable moisture content to slow down biological processes and prevent spoilage. Once loaded, the cargo will affect the air adjacent to it inside the hold, until an equilibrium is reached. Generally, the air will achieve temperature close to the cargo temperature and relative humidity (RH) of around 70%. The DP of air at RH of 70% will be about 6°C below the dry bulb (air) temperature[1]. The RH of outside air at sea level is typically around 80%. In most temperatures, at RH of 80% the DP will be at least 3°C below the dry bulb (air) temperature[1].

The combination of the above approximations means that if the ambient air is at least 3°C colder than the temperature of the cargo, the DP of the ambient air will be lower than the DP in the cargo space.

1 Wikipedia, "Dew point: Simple approximation," [Online]. Available: https://en.wikipedia.org/wiki/Dew_point#Simple_approximation. [Accessed 2024].

PRACTICAL VERIFICATION OF THE THREE DEGREE RULE

Using RH tables and the rule assumptions regarding the equilibrium RH, the rule can be verified step-by-step for specific temperatures:

- Air inside the cargo hold at 20°C (same as cargo) at 70% RH has DP of 14.36°C
- Outside air at 17°C (three degrees less) at 80% RH has DP of 13.52°C, lower than in the cargo hold. Ventilation is allowed.

BEHAVIOUR OF CARGOES IN THE PRESENCE OF MOISTURE

Although this guidance is intended to be as simple as possible, the following terms are important to understand cargo behaviour and ventilation.

HYGROSCOPIC CARGOES

Hygroscopic cargoes have a natural moisture content, either acquiring moisture (absorption) from or passing moisture (desorption) to the adjacent air. Each cargo has a specific sorption behaviour.

The humidity and temperature of the air remaining in a small unventilated headspace above a loaded bulk cargo, are strongly affected by the cargo[2]. Because of the risk of ship sweat (see "ship sweat" above), hygroscopic cargoes such as grain generally require ventilation whenever possible. This is due to the virtually unlimited moisture gradually transpiring from the cargo, compared with the volume of the air remaining in the headspace. Without ventilation, the air circulating in the headspace may continually transport moisture to where it condensates, leading to ship sweat constantly dripping onto the cargo. This may in turn lead to localised wetting of the cargo and damage/deterioration.

In solid bulk and grain cargoes, ventilation is only likely to affect a relatively thin layer of the cargo surface. If a cargo such as grain or agricultural products is shipped with excessive moisture content, proper ventilation may not prevent it from deteriorating during the voyage. However, appropriate ventilation should be carried out and recorded in any case, so that the ship/carrier can demonstrate due care – which will help defending against a cargo claim.

2 TIS GDV: Transport Information Service of German Insurance Association, "Hygroscopicity/Sorption Behaviour," [Online]. Available: https://www.tis-gdv.de/tis_e/misc/hygro.htm/. [Accessed 2024].

EQUILIBRIUM RELATIVE HUMIDITY (ERH)

A hygroscopic cargo will either acquire moisture (absorption) or pass moisture (desorption) to the adjacent air. In the enclosed space above the cargo inside a cargo hold, the transfer of moisture will continue until an equilibrium is reached, the air adjacent to the cargo will have reached Equilibrium Relative Humidity (ERH). Each cargo has its own, specific ERH.

MAXIMUM EQUILIBRIUM MOISTURE CONTENT

When ERH is reached in the cargo hold air, the moisture content (MC) of the adjacent cargo will also reach an equilibrium. However, if this is too high, it may lead to cargo damage (such as in grain cargoes containing fungal spores – mould will activate and grow if the cargo moisture content is high enough).

The maximum equilibrium moisture content (MC) is the threshold beyond which cargo deterioration or damage may occur. As such, it is one of the key properties of cargoes such as grain.

See also Britannia Loss Prevention Insight carriage of grain and oilseed cargoes.

CRITICAL RELATIVE HUMIDITY (CRH)

The critical relative humidity (CRH) is relevant to hygroscopic cargoes such as urea, ammonium sulphate etc. If RH of the surrounding air reaches CRH, the cargo may begin to rapidly absorb moisture and in result sustain caking, clumping or other forms of deterioration.

Cargoes with CRH are generally shipped with very low inherent moisture content and are not ventilated during the voyage. However, if they are exposed to humidity during loading (especially if loaded hot), caking may still occur. Therefore, it is important to be aware of the CRH specific for the cargo/temperature and ensure these cargoes are loaded in suitable conditions.

NON-HYGROSCOPIC CARGOES

Non-hygroscopic cargoes do not have inherent moisture content, and they do not absorb/desorb moisture. However, if exposed to condensation they may also be prone to damage from rust or staining. Non-hygroscopic cargo may include dunnage, packaging and other materials which are hygroscopic or are sensitive to moisture.

With non-hygroscopic cargoes loaded in cold weather and transported to a warmer climate, ventilation is not likely to be necessary and could result in formation of cargo sweat (in line with the earlier mentioned rule of thumb "Cold to Hot – Ventilate Not").

Non-hygroscopic cargoes carried from warm to cold weather may only occasionally require ventilation to prevent formation of ship sweat.

If the ship is equipped with dehumidifiers, they may be used to withdraw any excess moisture from the hold, for example from wet dunnage or snow deposit on the cargo.

MIXED HYGROSCOPIC AND NON-HYGROSCOPIC CARGOES

If a combination of hygroscopic and non-hygroscopic cargo is stowed together in one cargo space, possibly with different temperatures at the time of loading, they may have different ventilation requirements. Consequently, it may be impossible to provide appropriate ventilation for both cargoes and during the ventilation of hygroscopic cargo, cargo sweat may form on non-hygroscopic cargo. Stowing mixed cargoes together should therefore be avoided as far as possible.

PRACTICAL ASPECTS OF CARGO VENTILATION

CHARTERERS/SHIPPERS INSTRUCTIONS AND INDUSTRY PRACTICES

Attention should be paid to possible discrepancies between good industry practice and the operational/technical capability of the vessel, and the content of voyage orders or charterers/shippers instructions. Any inconsistencies should be proactively addressed.

As an example, if the ventilation rule (Dew Point/Three Degree) is stipulated in the instructions, it should be considered whether it is applicable/practical with the cargo. If the ventilation requirements cannot be complied with, they should not be accepted.

VENTILATION AT NIGHT OR IN THE RAIN

The analysis of ventilation logs often indicates that ventilation was carried out during the day only. However, ventilating only during daytime may significantly reduce the time available for ventilation, especially with cargoes which should be ventilated whenever possible.

It may be insufficient to ventilate during sunny and pleasant weather although this is the intuitive definition of "good weather". The best time to ventilate may be during the hours of darkness, when temperatures are at their lowest. However, due attention should be paid to the practical challenges regarding crew availability and ensuring safety if deck access is required at night.

Ventilation can also continue in the rain, providing the requirements of the relevant rule are met, and that the ventilation system on board prevents rain water ingress.

VENTILATION AND FUMIGATION

Fumigation is generally used in ships carrying cargoes prone to insect infestation. Cargoes are fumigated in port or during the voyage by releasing toxic gases into the cargo hold. The hold then must remain closed for a prescribed amount of time. During this time, the cargo cannot be ventilated. Once the fumigation is completed and the holds are certified as gas-free, normal ventilation can resume.

Fumigation requirements will therefore prevent the cargo from being ventilated whilst the cargo space remains closed – resulting in a situation where the moisture transpiring from the cargo (e.g. grain) will not be removed by ventilation and consequently, the cargo may become damaged by ship sweat.

Due to the apparent conflict before fumigation and ventilation requirements, including the potential for cargo damage, charterers and/or shippers should provide clear instructions to the ship in this regard. Agreeing to withhold ventilation should be subject to the ship not being held responsible for any resulting damage to the cargo. However, it can be challenging to differentiate between cargo damage caused during the fumigation period and damage resulting from improper ventilation at a later stage. Therefore, it is recommended to assess the risk of cargo damage occurring during the period of fumigation, considering information such as cargo properties, actual temperature and moisture content, as well as the expected duration of the voyage.

MINI CASE STUDY

A ship carried soya beans from Brazil to China. On completion of loading, the cargo was fumigated with aluminium phosphide. The ship was instructed to seal the hatches for ten days, during which no ventilation was allowed. Only after that time, the cargo holds were ventilated in accordance with Three Degree Rule. Despite ventilation, the cargo sustained damage due to ship sweat. Prolonged, localised dripping of ship sweat resulted in damage extending deeper into the cargo.

A cargo claim followed with an allegation of insufficient ventilation. Although not possible to conclusively prove that the damage occurred whilst ventilation was prohibited during fumigation, the ship could present ventilation logs demonstrating that proper ventilation was carried out once it was allowed.

See also Britannia Loss Prevention Insights Fumigation and Carriage of Grain and Oilseed Cargoes.

LIMITATIONS OF VENTILATION

There may be instances when appropriate ventilation, carried out whenever possible and to the maximum capacity of the ship, will be insufficient to prevent cargo issues. For instance, if grain cargo has excessive moisture content, it may undergo biological deterioration despite continuous ventilation. Additionally, for solid bulk or grain cargoes, ventilation primarily impacts the headspace above the cargo, affecting only a small portion of the cargo directly.

The above does not change the responsibility of the carrier for appropriate ventilation and documenting their best efforts in the ventilation log, as well as the need to proactively address any concerns with charterers/shippers, for example if it appears that the condition of the cargo may expose the cargo to deterioration despite ventilation.

HYGROSCOPIC BAGGED CARGOES

Bagged cargoes such as rice have particular carriage requirements and the potential for very large cargo claims. The major issue with bagged rice cargoes is the formation of mould or caking, attributed among others to inadequate ventilation.

Three Degree Rule is recommended for hygroscopic bagged cargoes (where the woven bags are not hermetic, and the cargo can still absorb/desorb humidity). Suitable dunnaging is required to minimise the risk of sweat damage. Charterers/shippers instructions may also require ventilation channels to be provided within the stow during loading.

See also Britannia Loss Prevention Insight Carriage of Rice.

IMPORTANCE OF VENTILATION LOGS

THE SHIP (THE CARRIER) IS RESPONSIBLE FOR VENTILATING THE CARGO IN ACCORDANCE WITH ALL APPLICABLE REQUIREMENTS: **REGULATORY, CHARTERERS/SHIPPERS INSTRUCTIONS AS WELL AS GOOD INDUSTRY PRACTICE.**

Ventilation logs should be carefully maintained to demonstrate that these requirements have been met in case of a cargo claim.

The following should be recorded or noted in the log:

- The rule applicable to ventilation during the voyage
- For the Three Degree Rule, cargo temperature at loading
- At least once per watch:
  - for the Dew Point Rule: ambient air DP and DP in each cargo hold, along with dry and wet bulb temperatures
  - for the Three Degree rule: ambient air temperature
  - whether ventilation is needed
  - seawater temperature
- Time for starting and suspending ventilation in each cargo hold, including reasons for suspension and details of the conditions that preclude ventilation.

Even if ventilation could not be carried out, the log should be continued in detail (as evidence it was not possible). If possible, there should be photographic evidence of the prevailing weather conditions, in particular sea water or spray being shipped on deck.

See also Britannia Loss Prevention article Cargo Ventilation Logs.