The London P&I Club

LP Focus

FEBRUARY 2016 | ISSUE 2

Bulk Carrier Ventilation

Moisture damage is the source of a significant number of cargo claims. Claimants allege that this is brought about by the ship's failure to ventilate correctly, resulting in the development of condensation (known as "sweat"). This sweat can lead to the deterioration of a number of bulk cargoes such as grain, seedcake and steel surfaces. All modern bulk carriers are fitted with some form of ventilation, either natural or mechanical, which can be used to minimise the formation of sweat.

Ventilation can also be used for the removal of taint, fumigate gases, or other gases as directed by the shipper. These forms of ventilation only provide surface ventilation, i.e. lacking the ability to penetrate a bulk stow, and therefore cannot continue to maintain an equilibrium in conditioning a cargo such as grain within a silo.

Natural hold ventilation within hold pontoon

Cargo Sweat

Cargo sweat is condensation forming on the surface of a "cold" cargo as warm, moist air enters the cargo hold. For example, if a cargo of steel is loaded in winter in North China for discharge in Singapore, the temperature of the cargo will be low. If warm moist air is later introduced in the cargo hold, condensation takes place as soon as it comes into contact with "cold" cargo. To avoid the possibility of cargo sweat, ventilators should be closed and no ventilation carried out. However, if the moisture content of the cargo is high, extraction of the moist air from within the cargo holds may be required.

Mechanical ventilation (Mushroom vents)

Ship Sweat

Ship's sweat is the result of condensation forming on the ship's structure as the ship becomes colder moving from a hot to a cold climate. The warm moist air within the cargo compartment condenses as it comes into contact with the cold structure of the ship. For ship sweat to occur, the dew point in the cargo hold must exceed the temperature of the ship's structure. To eliminate ship sweat, the cargo should be ventilated if the ship is moving from a warm to a cold climate.

Cargoes can be:

1. Hygroscopic: mainly agricultural products containing natural moisture. They may absorb, retain or release moisture, depending upon the surrounding atmosphere. Examples include grains. On a voyage from cold to hot regions, these type of cargoes need no ventilation, but surface ventilation is needed from hot to cold regions.

2. Non-Hygroscopic: solid cargoes which contain no moisture such as steel; however, these cargoes are very likely to be damaged by cargo sweating. To avoid cargo damage no ventilation is required.

Air is said to be saturated if it can no longer absorb any moisture. If it is then cooled it will start to cause condensation. The temperature

Steel cargo with surface rust brought about by cargo sweat

LP FOCUS IS PRODUCED BY THE CLUB'S LOSS PREVENTION DEPARTMENT AND EXAMINES IN DETAIL TOPICAL ISSUES REQUESTED BY MEMBERS.

this occurs at is known as the dew point temperature. To determine the amount of moisture in the air (the relative humidity), a wet and dry bulb thermometer is used in an instrument known as a `hygrometer'. It is important to ensure a flow of air across the two thermometers in a hygrometer to obtain correct readings. In a cargo hold where there is no air flow, a whirling hygrometer is used to measure the two temperatures. A table is then used to find the relative humidity at the time of observation. If proper ventilation procedures are not followed moisture damage is likely.

Shipper's Instructions

Any shipper's instructions should be complied with and the following factors considered:

1. Ensure that the shipper's declaration contains sufficient information about the cargo, particularly moisture content (MC), transportable moisture limit (TML) and ventilation requirements, and/or if the commodity is not normally carried or the areas of trade are uncommon.

2. Claims for moisture damage to cargo can only be defended if supported by properly maintained documentation. It is critical that records of hold temperatures, humidity and durations of ventilation are maintained.

3. The dew point temperature of the cargo hold and outside air should be compared. If the outside dew point temperature is lower or equal to that within the cargo hold, then ventilation should be continued. Since measurement of temperature in a cargo hold loaded with bulk cargo may not always be possible, a comparison should be made between the temperature of cargo at the time of loading and the outside temperature. If the dry bulb temperature of the outside air is 3°C or more, higher than the cargo temperature, then continue ventilation (see 'Dewpoint: A 3°C rule of thumb' on next page).

4. Ventilation not only serves to control sweating, it can control the gases or odours emitted from cargo.

5. If there is a risk of seawater spray or rain entering the cargo holds, all ventilation should be stopped and times noted until conditions change to allow resumption of ventilation.

6. Ventilation should be continued even at night if required.

7. If circumstances allow, there should be regular inspections of the cargo space for any signs of condensation, e.g. on the underside of the hatch access covers. If condensation is found, ventilation should be continued.

8. A complete record of cargo hold temperatures and ventilation should be kept.

Low Inherent MC Cargoes

For a hold loaded exclusively with cargoes containing no inherent moisture (e.g. steel) the only moisture available for condensation is ship's sweat and will be a comparatively minute amount in the small mass of the volume of air within the hold. It is therefore highly unlikely that ship's sweat formation sufficient to drip back onto a cargo will ever occur under any voyage circumstances; the safest option for these types of cargoes is not to ventilate.

High MC Cargoes

Cargoes in the high MC category are usually hygroscopic (e.g. grain, seedcake) – that is they can absorb or release moisture into their immediate surrounding atmosphere depending on the moisture content of the cargo and the concentration of moisture in the immediate surrounding atmosphere. Thus, the relative humidity and also the temperature of the atmosphere in a hold containing these cargoes is principally controlled by the moisture content and temperature of the cargo as loaded. (A proviso here is that these latter parameters are numerically suitably low for the cargo to be inherently stable, hence precluding the possibility of any significant self-heating in transit due to microbiological activity).

It will be appreciated that the substantial amounts of inherent moisture even in stable cargoes of this type provide an enormous "reservoir" of moisture for potential release into the associated atmosphere within a ship's hold. This applies to a much lesser extent to cargoes in the low moisture category where the risk of any substantial ship's sweat formation is therefore correspondingly much lower. Usually, however, the same principles of ventilation apply to cargoes in the high and low moisture categories, although in the latter category there can be some exceptions.

These include some organic and inorganic fertilisers in bulk or in permeable packaging where, for special reasons which are outside the scope of discussion here, the normal criteria of ventilation may not apply and it may be appropriate to seek shipper's advice.

Maintaining accurate records when ventilation not possible

The need to ventilate especially high MC cargoes (weather and sea conditions permitting), whenever external temperatures are significantly lower than cargo temperatures – and then not only in daytime but importantly also at night. If ventilation is impossible because of prevailing sea conditions, it is of utmost importance that all relevant aspects of weather and sea conditions are fully logged.

The only other circumstance where surface ventilation, when desirable, may not be feasible is when stowage considerations in relation to the design of a ship's ventilation system preclude effective ventilation. For instance, for cargoes of grain and some similar products in bulk, it is essential for stability reasons that at least some holds are fully loaded to the tops of hatch coamings, which may render surface ventilation difficult or impossible. In all other circumstances, the text book rule concerning ventilation of the most hygroscopic cargoes containing significant amounts of moisture is to ventilate when the dew point of the external atmosphere is lower than the dew point of the atmosphere in association with a cargo within a ship's hold and, conversely, not to ventilate when the relative situation as regards external and internal

atmosphere dew points is reversed. In theory this rule is entirely correct, since dew points of different atmospheres have a directly proportional relationship to the absolute amounts of moisture which they contain.

The sole relation behind ventilating any of the types of cargo under consideration is in fact to prevent or minimise ship's sweat formation, when conditions are conducive to the occurrence of this phenomenon, and possible associated cargo damage. However, the extent of potential ship's sweat formation and whether this will be sufficient to drip back onto a cargo depends on the amount of available moisture in the atmosphere within a hold, which in turn is related to the amount of moisture in the cargo being carried. Hence, decisions on whether it is necessary to ventilate depend on consideration of the specific nature of the cargo being carried.

Surface Damage to a cargo of Grain due to Ship's Sweat

Relative Humidity

A given volume of air at a particular temperature can hold a certain defined maximum amount of moisture in the form of water vapour. The higher the temperature of air, the greater the maximum amounts of water vapour which a given volume can hold. When a volume of air at a certain temperature is said to have a relative humidity of, for example, 75%, this means that it is holding 75% of the maximum amount of water vapour, which it can hold at that particular temperature. If the temperature of that air is progressively increased, its relative humidity will correspondingly decrease even though the absolute amount of water vapour which it is holding remains constant. Conversely, if the temperature of that air is progressively decreased its relative humidity will increase (but again with the absolute amount of moisture it is holding remaining constant), until a relative humidity of 100% is attained. At that point the air is fully saturated with water vapour, and the precise temperature at which this situation occurs is the so-called dew point. Further progressive cooling of that air to temperatures below the dew point, will lead to deposition of progressively increasing amounts of liquid water from that air.

Dewpoint: A 3°C rule of thumb

It is, however, difficult to accurately measure dew points within the loaded holds. A more practicable and satisfactory rule of thumb, if the average temperature of a cargo can be determined during loading, is to apply ventilation during a voyage only if and when external air temperatures are 3°C or more below the loaded temperature of the cargo. This can be safely applied to all hygroscopic cargoes in the low moisture category (including some packaged low and zero-moisture content cargoes where it is essentially only the hygroscopic packaging which naturally contains any releasable moisture), when such cargoes are stowed singly in a particular hold.

However, different rules may be applicable when, for example, mixed hygroscopic and non-hygroscopic cargoes are stowed in the same hold – appropriate recommendations concerning ventilation may then vary according to specific circumstances. It is the responsibility of the Master to ensure that entries are made correctly in the deck log book concerning items which could affect the condition of cargo, and this will later assist the Owners in documenting their case in the event of a claim. For example, weather conditions during loading, discharging and during sea passages. Also, cargo left standing on dockside during rain, wet or otherwise contaminated/damaged cargo being placed on board or rough handling by stevedores.

The correct log book entries are extremely important, and as Master you are to instruct the Deck Officers accordingly. An appropriate starting point for those faced with decisions on when to ventilate a particular cargo is to consider what the objective of any such ventilation is. In this respect, cargo type is important, and can be broadly classified into several basic categories. For example:

1. Cargoes in bulk or in permeable packages which are liable to evolve toxic or otherwise hazardous gases.

2. Cargoes of agricultural products.

3. Cargoes in bulk or in permeable packages which do not possess the characteristics of those in categories (1) and (2) but which are liable to be damaged by wetting, or absorption of water vapour.

Hazardous cargoes

The objective of ventilating cargoes in category (1) is to minimise the concentration of hazardous gases within the atmosphere of a ship's hold. Some of these cargoes – for instance, certain types of ferrosilicon and coal – are listed in the International Maritime Dangerous Goods Code (IMDG Code) and/or in the International Maritime Solid Bulk Cargoes Code (IMSBC Code), with specific recommendations concerning ventilation.

When readily available information on any particular cargo is lacking and doubts exist, shippers advice should be sought.

By Captain Paul R. Walton
Director, London Offshore Consultants (Hong Kong)

LOC
MARINE & ENGINEERING CONSULTANTS

The London P&I Club

Published on behalf of The London Steam Ship Owners' Mutual Insurance Association by
A. Bilbrough & Co. Ltd.,
50 Leman Street, London E1 8HQ, UK.
Tel: +44 (0) 20 7772 8000
Fax: +44 (0) 20 7772 8200
E-mail: london@londonpandi.com
www.londonpandi.com