

## Statement on Humidity Management during the Transport of Goods

Corrosion, mold and condensation (“rain”) in an ocean container are responsible for tremendous monetary losses. The reason for this loss is usually a humidity found for instance in the cargo, packaging or dunnage which is too high. These losses are normally not transport losses but due to a lack of quality of the goods. The correct water content and the humidity management is an important part of ensuring the quality of the goods during transport. This is the reason why the Loss Prevention Committee is taking on this theme.

Water is a crucial component of the global transport of goods with about 80 percent of world trade done by sea. . It is also an integral part of most goods including chief agricultural commodities themselves. If green coffee or cocoa beans become too dry, they lose vital flavor along with the water and becomes worthless. However, if they become too moist, there is a risk that spoilage will occur. Similarly if fruit loses some of its water it becomes unattractive, and its taste and thus value are diminished.

### Water as a source of damage and loss

The importance of water content in certain goods is acknowledged; what however may not be so well known is that if it and the ambient conditions in which it is grown, is harvested and eventually stored and transported are not properly regulated, problems can ensue. If the moisture content is too high, there is a risk of mold, corrosion, spoilage, or the failure of packaging materials. If there is too little moisture, there is the risk of shrinkage, desiccation and loss of flavor.

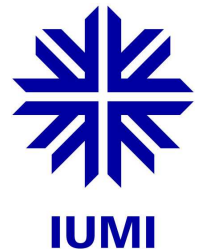
Some parties in the supply chain are completely unaware of the role played by water in regulating and guaranteeing quality of goods. The fact that such loss occurs during transport appears to be evidence enough that the cause of the loss was inadequate shipment preparation and transport arrangements. Even their inability to answer the simplest questions reveals that they often lack even the most basic knowledge of humidity management.

Identification of this problem caused the ILO working group responsible for drafting the CTU Code<sup>1</sup> to add an improved annex to the code. This annex "Beware of Condensation" deals exclusively with this issue. It is available for download free of charge from the ILO Website<sup>2</sup>.

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<sup>1</sup> CTU Code Annex 3(IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units) \*\*

<sup>2</sup> <http://www.imo.org/en/OurWork/Safety/Cargoes/CargoSecuring/Pages/CTU-Code.aspx>



### The effects of water content on goods during transport

The ability of air to absorb and release water vapor varies according to its temperature. The warmer the air, the more water vapor it can absorb, and if it cools down, its ability to absorb water vapor drops again. The water content of the air is therefore given relative to the temperature, which is why we speak of **relative humidity**. The variation in this property of air is cyclic- as the temperature fluctuates between day and night, the cycle is repeated many times during transport of the goods. There is also the additional aspect of crossing through different climatic zones, which can result in significant fluctuations in temperature, some of which can be sudden.

Problems arise when the relative humidity exceeds the following thresholds over a day/night cycle:

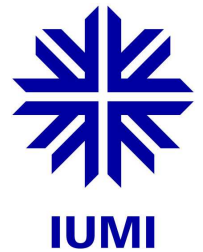
- **Corrosion threshold**. This threshold lies at a relative humidity of 40 %. At a relative humidity of 40 %, **the risk of corrosion** increases dramatically.
- **Mold growth threshold** commences at a relative humidity of 75 % and can only develop at this level or above.
- **Dew point**, at 100 % relative humidity. At a relative humidity of 100 %, the air can absorb no more water vapor. It becomes **saturated**. The slightest drop in temperature causes the water to be released and it begins to precipitate. It appears to "rain" in the packaging, the ocean container or the hold. This is known as the **ship's sweat** or **container sweat**.

One **problem** is the fact that the thresholds are always associated with the relative humidity of the air. If the air warms up, it can absorb more water vapor and the relative humidity drops. If the air cools down, it loses its ability to absorb water and it becomes more humid or the water vapor is released and it begins to precipitate.

The greater the humidity of the air or the higher the water content of the goods, the higher the water vapor pressure and hence the relative humidity. Water vapor always tends towards a uniform pressure. If the water vapor pressure in the goods is higher, vapor will pass from the goods to the air until the pressure is in equilibrium, like a wet cloth gives its moisture to dry air (**desorption**). This is known as the **equilibrium moisture content**. In the case of dry goods, the process is reversed and the goods absorb water vapor until the equilibrium moisture content is achieved, like a dry cloth takes on moisture in humid air (**absorption**).

### Sorption behavior

Goods that are capable of absorbing and releasing (desorbing) water are referred to as **hygroscopic**. Given the same water content, they establish different levels of equilibrium moisture content with the ambient air. This behavior is specific to the hygroscopic goods and depends on the temperature. It is represented in the form of **sorption isotherms**. These sorption isotherms can be used to determine the relative humidity that will be established at a given water content of the goods. Conversely, this means that the producer of the goods can manipulate or govern the relative humidity in



the hold, the container, or the packaging by means of the moisture in the goods. Therefore, reaching or exceeding the corrosion or mold growth thresholds or the dew point is no longer simply a matter of chance. Instead, it is a property of the goods themselves, an inherent property of the goods even before transportation begins.

#### The consequences for

- Corrosion prevention:** In order to remain below the corrosion threshold, desiccants are used inside an airtight packaging that immediately absorb and bind the moisture from the air.
- Mold prevention:** In order to remain under the mold growth threshold, the goods have to be dried as indicated by their sorption isotherms so that a relative humidity of 75 % is not exceeded, despite the expected fluctuations of the day/night cycle. This state is known as "transport dry" or "container dry". For many goods, this state is achieved when the goods have a water content equivalent to a relative humidity of 60 %.

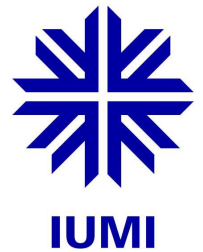
#### Recommendation of the IUMI

IUMI is taking up this issue to provide shippers with the knowledge they need to ensure the desired level of quality and a loss free transport. Anyone who brings hygroscopic goods onto the market must know their sorption properties and adjust them in such a way that the goods will not spoil during the journey.

- Damage from moisture during transport is due to shortcomings in the condition of the goods, or of the quality of their packaging and protection, provided that there has been no ingress of water from the outside.
- Packers and shippers of containers should be aware of all potential sources of moisture at the time the container is loaded with cargo. Sources of water might include warm damp air with a high relative humidity at the loading point, the cargo itself or wet, unseasoned wood pallets, packing material or dunnage with a high water content.
- Heating and cooling of the container due to the fluctuations of the day and night cycle will start the de- and absorption process. Cooling of the container at night or rapid climate change will cause container sweat and condensation damage.
- In ships' holds, active ventilation should adhere to strict specifications and rules (Mollier diagram) and can avoid or reduce condensation below deck.

#### Technical offering from the IUMI

Shippers or those who arrange for goods to be transported and introduced into the market should have knowledge of humidity management, learn such basics or take advice from experts. The concepts are explained in Annex 3 of the CTU Code. In the near future, the Loss Prevention Committee will be making an e-learning program permanently available on the IUMI Web site. Our hope is that it will be a valuable resource and result in less damage to goods in transit.



**About IUMI** The International Union of Marine Insurance e.V. (IUMI) is a non-profit association established for the purpose of protecting, safeguarding and advancing insurers' interests in marine and all types of transport insurance. It also provides an essential forum to discuss and exchange ideas, information and statistics of common interest for marine underwriters and in exchange with other marine professionals. IUMI currently represents 46 national and marine market insurance and reinsurance associations.

The roles of IUMI are to

- act as a focal point and representative voice on behalf of the marine and transport insurance industries in dialogue with all interested parties,
- share information and research that are non-commercially sensitive with regard to marine and transport insurance,
- bring together marine insurance practitioners to facilitate the exchange of technical information and best practice, and
- provide information on positions taken by IUMI.

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