



## Chapter 25 – Sugar

While sugar is found in the tissue of most plants, it is typically produced in commercial quantities from sugarcane and sugar beet. Sugar is used extensively in the production of food, medicine and ethanol. The largest sugarcane producing countries are Brazil, India, China, the United States and Thailand.

Sugar comes in different forms depending on its class, specifically white crystal, raw crystal and liquid. It is then further categorised by type.

### 25.1 Refined (Crystal) Sugar

Crystal sugar is the most refined type of sugar. Unlike semi-refined or raw sugar, refined sugar is always carried in bags weighing typically 50 kg. In the past, jute outer bags were widely used with a polythene film inner bag, but the outer bags are now typically made from woven polypropylene. The purpose of the plastic inner bag is to keep out moisture but, because the outer and inner bags are often stitched together, the seal is not always effective.

Substantial claims have arisen on shipments of bagged refined sugar, where the complaint often relates to stickiness or caking of the product, sometimes wrongly attributed to conditions encountered during the voyage.

Refined sugar is normally a dry, free-flowing commodity with very low moisture content.

On delivery, if the sugar is not found to be free flowing, it is important to establish whether this is due to:

- Pressure compaction
- adhesiveness (stickiness)
- caking (agglomeration).

Pressure compaction usually occurs as a result of static pressure exerted by the weight of the sugar itself, particularly when bags are stacked high. This condition can readily be corrected when the bags are handled and transported. However, adhesiveness and caking of refined sugar are both the result of too high a moisture content and possibly, to some extent, the temperature of the cargo at the time of bagging.



**Figure 25.1: Raw sugar (left) and refined crystal sugar (right).**

Adhesiveness, resulting in poor flow characteristics, occurs as a result of high moisture content, either initially or after packing. Caking may occur when over-moist sugar dries out.

If the product comes into contact with extraneous moisture such as cargo sweat, this may lead to limited, superficial adhesiveness and to subsequent caking of the sugar at the mouth of the bags. This may also occur where bags have been damaged by stevedores' hooks. Extensive adhesiveness and caking may be caused by excessive moisture at the time of packing, particularly if the caking is found at the centre, extending towards the outside of the bag, with the sugar crystals at the edges adhering. This condition may be further affected if, at the time of packing, the temperature of the sugar is high relative to the ambient temperature.

It is of crucial importance that, immediately after production, the amounts of 'free water' and 'bound water' are at satisfactorily low levels. After processing, sugar is normally left in storage for a relatively short period, with appropriate ventilation, to 'condition' or 'mature' the product. The aim of this is to ensure that, when the sugar is bagged, its moisture content is at an acceptably low level. If it is not, comparatively hard caking and

possibly some adhesiveness may be expected to occur during subsequent storage and transport. When sugar is bagged with a low moisture content (0.02% or less), there is no risk of adhesiveness or caking being caused by moisture migration.

Some sale contracts stipulate a moisture content of '0.1% maximum', but it should not be assumed that such levels are acceptable if caking is to be avoided. Adhesiveness and caking do not affect the chemical nature of the sugar but may not be acceptable for its intended end use.

## 25.2 Loading Sugar



Figure 25.2: Raw sugar in Santos, Brazil, being loaded as a bulk cargo directly into the cargo holds.



Figure 25.3: Refined crystal sugar in bags being loaded directly into the cargo holds.

The following general considerations apply:

- The ship's hold, before loading, should be clean, dry and free from any noticeable smell
- for bagged/refined cargoes:
  - bags should be loaded only if outwardly dry and with no apparent lumpiness of the contents
  - bags should not be loaded during any form of heavy precipitation, including rain or snow
  - cargo battens are not essential. Where no battens are fitted, measures should be taken to prevent damage from any protruding cargo batten hooks or fittings. A separation of polyethylene, polypropylene cloth or kraft paper sheeting between the ship's structure and the bags is sufficient
  - tight block stowage is the customary and acceptable method of stowage
  - bags loaded at substantially lower temperatures at the load port should be rapidly discharged to prevent or restrict unwanted condensation on the bags
  - if additional cargo is to be carried in the same hold as refined sugar, it should be a dry cargo
- when loading raw sugar cargoes in bulk quantity:
  - cargo should not be loaded during periods of rainfall and hatches should be closed until the rainfall subsides
  - representative samples should be taken and correctly labelled throughout the loading operation
- the hold should not be ventilated; all ventilators and other openings should be sealed
- on completion of loading, an independent surveyor should carry out a draft or tallying survey, as well as sealing the hatch covers.

The Master should ensure records of the weather conditions are maintained during loading. It is recommended that the deck watch monitors the weather for signs of rainfall throughout the loading operation.

### 25.3 Stowage and Care of Sugar

Refined sugar is typically carried in containers but can also be loaded as break-bulk depending on the availability of containers in the load port.

Raw sugar is typically carried as a bulk cargo. While sugar is classed as an IMSBC Code Group C cargo (not liable to liquefy), it must be monitored carefully during the voyage because of its high solubility (ability to dissolve) when wet. For bulk raw cargoes, the presence of large volumes of water in the hold could lead to increasing instability of the ship, as well as destruction of the cargo.

In terms of stowage of refined sugar bags, tight block stowage without height limitation is the customary and acceptable method, with the height of the stow limited only by the height of the cargo compartments. Cargo battens are not necessary as it is generally

accepted that a separation of paper, cardboard sheets, polyethylene or polypropylene cloth between the ship's structure and the bags is sufficient.

Ventilation of refined sugar is not necessary under any circumstances. The purpose of cargo ventilation is to prevent or restrict the formation of condensation or moisture on the ship's internal structure. However, such condensation originates from within the cargo and will occur only when the cargo itself is moist. Because refined sugar has a low moisture content and is enclosed in plastic film, there is no risk of sweat and so ventilation is not necessary.

Under certain circumstances, ventilation may even be detrimental, such as when holds loaded with cold cargo are ventilated with warm air, which can lead to the formation of sweat.

Sugar has low thermal conductivity, which means that during the voyage it tends to remain at the temperature at which it was loaded, at least in the interior of the stow. If the sugar is loaded cold and later discharged in a relatively hot area, there is a risk of condensation forming, during the discharge, on any bags having a temperature lower than the dew point of outside air. In such cases, rapid discharge is necessary to avoid any adverse consequences.

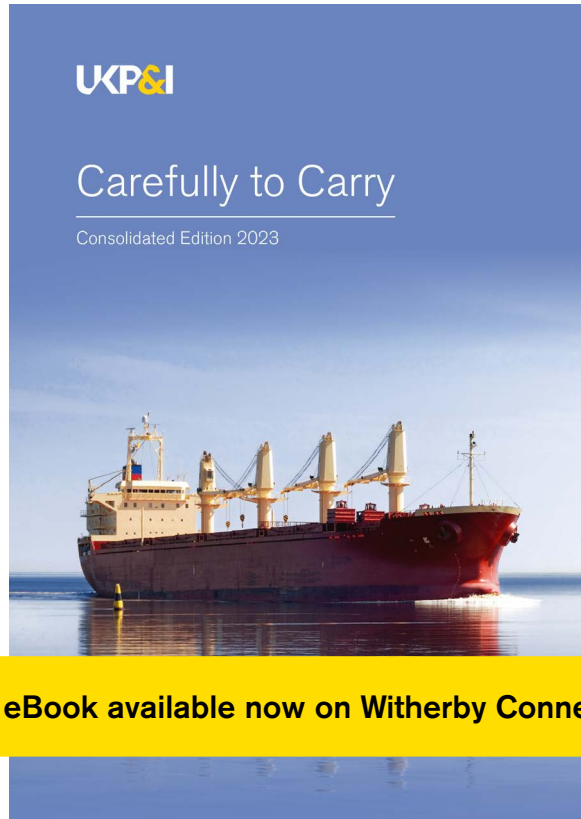
One of the most common causes of damage to sugar cane is water, particularly rainwater. To prevent this, hatch covers should be in good condition and weathertight, with a particular focus on compression bars and rubber packing around the covers.

As sugar is a seasonal trade, it is possible that smaller or older vessels are used at reduced freight rates. However, hatch covers are more likely to leak on an older vessel, so there is an increased risk of cargo damage.

A careful packing strategy should include control of stacking heights and temperature and moisture control at the producing mills, even before shipping, as this will minimise the chances of caking.



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