



# Carefully to Carry

## Mineral ore concentrates and other materials which may liquefy

This subject was previously discussed in some detail by the Committee in its seventh report. It is also dealt with in the IMO Code of Safe Practice for Solid Bulk Cargoes, (the IMO BC Code), 1998 Edition at Sections 4,7, and 8 and at Appendices A and D.

The recommended procedures for testing those materials which may be subject to liquefaction is covered in Appendix D1 of the Code.

### Points to consider

The following points should be borne in mind by shipowners and masters when contemplating the carriage of concentrates:

Many minerals which are essentially insoluble in water and which contain mainly finely divided material, may liquefy on ocean voyages if they contain an excessive amount of water when loaded or if they subsequently become wetted. This applies even though they may appear to be in the form of dry powders or granular materials. Such liquefaction is basically due to energy being applied to the cargo. This can be as a result of vibration due to a ship's engine or due to motion in heavy seas. It follows that liquefaction may become apparent at almost any stage of a voyage. Any cargo of finely divided material which tends to flatten and which develops a putty-like surface during a voyage, has started to liquefy.

The presence of water on the surface of the cargo is also indicative of liquefaction. It must be stressed however, that liquefaction can occur without liquid water being observed on the surface of the cargo. If any of the phenomena



"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](http://www.ukpandi.com) for more information, or contact the Loss Prevention Department.

described above are observed, the ship should take urgent action and should proceed to the nearest port of refuge, subject of course, to the requirements of good seamanship. It may be prudent to adjust course and speed in order to reduce the motion of the ship even if this means having to steam further before reaching a suitable port.

Liquefaction is unlikely to occur provided that when loaded it complies with the IMO requirement that the moisture content of the cargo is relatively uniform and below the transportable moisture limit (TML) in each hold. The Committee has not heard of a case of liquefaction involving a cargo which in every respect complied with the IMO requirements.

Before loading any cargo which they know or suspect may liquefy, masters should carefully check all the documentation provided by the shippers or charterers. A list of cargoes known to liquefy is given in Appendix A of the IMO BC Code, but this list is not exhaustive. This point was illustrated recently when difficulties were encountered by a Member of the Association following the liquefaction of a cargo of fluorspar. This substance is not mentioned in Appendix A. It is therefore recommended that where a master is concerned about possible liquefaction of a cargo of mineral in a finely divided form, he should insist upon a written statement from the shippers or charterers confirming that the product concerned will not liquefy if it contains an excess of moisture. Alternatively, he should obtain the required documentation to satisfy his suspicions. If he is not satisfied with the response obtained, it is recommended that the Association be consulted, either through the owners or managers.

## Documentation

After the completion of loading of materials known to liquefy and before starting a voyage, masters should be supplied with written documentation as follows:

- A certificate should be provided stating the TML for the cargo. It is stipulated by the IMO that the testing necessary for the provision of such certificates should be carried out at least once every six months (see the IMO BC Code section 4.4.1. p.15). The Committee advises masters to ensure that this certificate is dated within six months of loading and that it is issued by a laboratory on which reliance can be placed. The test procedure for determining the TML requires specialised equipment and experienced technicians to conduct the test. It is reasonable to assume that certificates issued by major shippers of mineral ore concentrates as listed in the IMO BC Code are reliable. However, the Committee recommends that where there are shipments of less common materials or where shipments are from newly developed sources, the certificates should be issued by a laboratory known to have the necessary equipment and expertise reliably to conduct the test. If there is any doubt about this matter the Committee recommends that the master should notify his owners. They should then contact the Association in order to obtain expert advice on how to check that the laboratory has the necessary equipment and expertise.
- The master should also receive before loading commences, a letter from the shippers indicating that he will be supplied with certificates stating the average moisture content of the cargo loaded into each separate hold. It

will be appreciated that sampling before shipment except in climates where there is no rainfall is not satisfactory. Many of the larger shippers use an automatic sampling procedure during loading in order to obtain satisfactory samples for moisture content measurement. Under these circumstances, actual figures for the average moisture content of cargo loaded into each hold can only be given at the end of the loading period.

## Careful examination

Notwithstanding any evidence provided by the various certificates discussed above, masters are strongly advised to examine stockpiles of cargoes before loading. Water draining from such stockpiles must be considered to indicate the probability that a part of the material in the stockpile has a moisture content above the TML. A watch should be kept on the condition of the cargo being loaded. Any obviously wet material should be rejected as such cargo might form a shear plane on which a basically sound cargo loaded subsequently, might slide.

If masters are doubtful about the condition of a cargo, they can conduct a 'can test' described in the IMO BC Code, Section 8.3 at Page 24. It must be stressed however, that although an adverse result from this test indicates that the material tested is probably unsatisfactory for ocean carriage, the test cannot be used to confirm that the material tested is safe for carriage. The Committee wishes to warn masters specifically about the risk of loading cargo at sub-zero temperatures when cargo may contain ice crystals but not appear to be damp. It is recommended that when cargo is loaded under such conditions, samples are drawn from various levels including the bottoms of piles and that these are warmed and then tested by the can test.

The Committee also advises that under no circumstances should masters agree to the erection of shifting boards or other temporary arrangements in order to carry cargoes loaded at moisture contents above the TML. The Committee has heard of an incident where longitudinal shifting boards of six inches thickness secured to nine inch square posts were smashed by a shifting concentrates cargo. If bulkheads are to be erected to facilitate the carriage of this type of cargo, they must be constructed strictly as required in Section 7.2.2 at Page 22 of the Code.

It cannot be too strongly stressed that when carrying cargoes of this nature, failure to ensure that they are accompanied by the correct reliable documentation and to ensure that they are in generally uniform condition at the time of loading can, and has on a number of occasions, resulted in the loss of both a ship and its crew.



*Liquefied ore concentrate in ship's hold*

## **Dangerous reactions**

There are two other dangers associated with concentrate cargoes. The first is that some concentrates may heat. Shippers should always be asked specifically about this possibility. Stows of such concentrates should be trimmed roughly flat using a tracked bulldozer or similar machine which also compacts the cargo. It is sometimes helpful to sheet such materials with heavy gauge polythene film which further restricts the rate of air penetration into the cargo.

The second danger arises from the fact that even if concentrate cargoes do not heat, they absorb oxygen such that the atmosphere above the cargo in a hold which is inadequately or not at all ventilated may become deficient in oxygen and enriched with nitrogen. Air contains roughly 79% nitrogen and 20.8% oxygen and as the oxygen is absorbed by the cargo, so the oxygen content may fall to as low as 4%. The minimum concentration of oxygen required in the atmosphere in order to support life for only a few minutes is 10%. There have been fatal accidents where persons have entered fully closed holds loaded with concentrates where the oxygen content was too low.