



Direct Reduced Iron (DRI)

A selection of articles previously
published by Gard AS

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Understanding the different direct reduced iron products

Gard News 178, May/July 2005

The term direct reduced iron, or DRI, has a generic meaning which covers a number of products with a variety of properties and hazards.

There has been a disturbing increase in the number of potential life threatening incidents involving the carriage of direct reduced iron (DRI). Gard Loss Prevention Circular No. 07/2003 provided general advice on the carriage of this product.¹ Since this circular was issued Gard has received several enquiries from members and clients asking about the carriage of this cargo and the actions to be taken to prevent any problems occurring during the voyage.

Disturbingly, some enquiries relate to types of DRI which charterers and shippers do not consider as dangerous or restricted in any way. The terms used include "HBI", "hot briquette", "fines", "remet" and "metallic fines". These terms may well be an accurate description of the specific product but they are often used to avoid limitations agreed in charterparties for the carriage of dangerous cargoes.

It is important to note that the term DRI, generally used in charterparties, has a generic meaning, covering a number of products with a variety of properties and hazards. It also covers a technical description of a specific type of refined iron ore.

These products must be grouped under the genus of direct reduced iron (DRI BC 015 or HBI BC 016) for the purposes of the IMO Code of Safe Practice for Solid Bulk Cargoes (BC Code). This article is intended to help masters and owners understand what may or may not be offered to them and what precautions should be taken.

DRI – DIRECT REDUCED IRON

Normally in the form of sponge pellets or lumps varying between 6 and 25mm nominal diameter, but often 8 to 12mm diameter. The IMO BC Code classes this product as "a material that is hazardous only when in bulk" (MHB). It can be found under the BC Code as BC015. If this product becomes wet it can significantly overheat and emit hydrogen gas. Thus it must be carried under inert conditions. Nitrogen gas is normally used and is applied to the holds by way of a temporary manifold fitted to the tank top prior to loading. Thermocouples must also be positioned in the cargo on the tank top and elsewhere throughout the stow at different heights to monitor the temperature. Gas monitoring of the holds, normally for hydrogen and oxygen, must also be undertaken throughout the voyage. The product must be kept dry at all times prior to and during carriage. The product should be treated as DRI, BC 015.

HBI – HOT BRIQUETTED IRON

This material is manufactured from DRI product, which is compressed at temperatures exceeding 650° C to form briquettes between about 90 and 130mm long, 80 to 100mm wide and 20 to 50mm thick. This product is a much safer form of DRI than DRI pellets. It is far more resistant to overheating if it becomes wet. During a voyage it can still generate small amounts of

hydrogen. Inerting is not required by the BC Code but adequate surface ventilation is required. It should be treated as HBI BC 016, provided there is no additional qualification to the HBI (see below).

CBI – COLD BRIQUETTED IRON

CBI is manufactured from the various residual products produced during the manufacture of associated ferrous products and semi-refined raw materials including DRI (DRI fines but also other residuals). Some manufacturers cold briquette their own DRI pellets so that they can be fed into their particular furnace. CBI briquettes are produced at temperatures below 650°C and a binder is often used. Because the briquetting operation is carried out at a temperature lower than is used for HBI, some of the critical characteristics of DRI, such as porosity, relatively large surface area and a reactive surface, remain in the CBI to some degree. Thus essentially CBI can have the same or very similar properties to DRI pellets and should be treated in exactly the same manner, as the propensity to overheat and generate hydrogen, if it becomes wet, still remains. The original source of the material used to manufacture CBI is obviously of significance – if this can not be verified then the CBI should be treated in a similar manner to DRI, BC 015.

DRI FINES

These are the by-product of the DRI manufacturing process, pellets or briquettes, and are often 4mm in diameter or less. Although smaller than normal DRI pellets, this product is essentially DRI pellets and will behave in a similar manner, so it should be treated with the same caution: it should be kept dry at all times, the holds should be inerted and temperature and gas monitoring should be carried out. One added potential hazard with this product is that it may not have been stored under ideal dry conditions at the plant, as should be the case with normal DRI, and therefore there may be wet pockets of DRI fines within the cargo, which can subsequently cause problems during the voyage. Therefore, it should be treated as DRI, BC 015 and the storage history should be obtained.

HBI FINES

This is a term used by shippers to describe ordinary DRI fines possibly in an attempt to achieve a reduction in the carriage requirements as afforded to real HBI. The fines can be either simple DRI fines which have been completely misdescribed by the shipper, or fines produced during production of HBI. If the fines have been produced after the HBI briquetting process then it is possible that they may be in a relatively safe form and could be treated in a similar manner to HBI briquettes. However, if the fines have been produced prior to the HBI briquetting process, they may potentially be similar to a DRI pellet product. If the history of the fines is not known then they should be considered as DRI fines and treated in the same manner as DRI, BC 015.

REMET FINES

This is another term used by shippers to describe DRI fines. They are not "re-melted" fines, as the name could – and may be intended to – suggest, for the obvious reason that if the product

had been produced by a (re)melting process (which DRI is not) then it would not be in the form of fines. If a ship is offered a cargo of this description there is a very high chance of the product being DRI fines and it should therefore be treated as DRI, BC 015.

REMET FINES (HBI)

As with 'remet fines', remet fines (HBI) should be treated as DRI, BC 015.

METALLIC HBI FINES

As with 'HBI fines', metallic HBI fines should be treated as DRI, BC 015.

OTHER NAMES

Shippers have used other qualifications for DRI fines which exclude the abbreviation "DRI", such as "Orinoco iron remet fines" and "Orinoco remet fines in bulk". These should all be treated as DRI, BC 015.

CONCLUSION

It is a requirement of SOLAS Chapters VI and VII and of the IBC Code that the master must be provided with all relevant documentation related to the carriage of the intended cargo. Owners should be wary of any bulk cargo offered for shipment under trade names or abbreviated names and always insist on

a full product description, including technical and alternative names. Future versions of the BC Code are likely to maintain the current two categories of DRI but differentiate between the two types by referring to them as DRI "A" or "B".

In summary, if any iron bulk cargo is offered as "fines" and is described with terminology such as "HBI", "remet", or any other wording not found in the relevant section of the BC Code, it should be treated as a DRI product as detailed in the BC Code No. 015. The onus is on the shipper to show that the fines have not originated from DRI manufacture, and without that evidence the ship is entitled to insist on applying the more stringent requirements of BC Code 015 to the loading and carriage.

If the vessel has any doubts about any particular DRI loading it is recommended that independent advice be obtained from an expert. Gard is happy to assist in this regard, and in any other way it can.

This article was produced with the kind assistance of Dave Hughes, Consultant Metallurgist, Taylor Marine TR Little.

Footnote

1 See also the article "The dangers of carrying direct reduced iron (DRI)" in Gard News issue No. 173. ■

The new IMSBC Code and the carriage of direct reduced iron

Gard News 194, May/July 2009

New code introduces new carriage requirements for direct reduced iron.

The International Maritime Solid Bulk Cargoes Code (IMSBC Code) and amendments to SOLAS chapter VI to make the IMSBC Code mandatory were adopted at the 85th Session of the IMO Maritime Safety Committee at the end of 2008. The amendments are expected to enter into force on 1st January 2011.

The IMSBC Code will replace the Code of Safe Practice for Solid Bulk Cargoes (BC Code).

The IMSBC Code introduces new carriage requirements for direct reduced iron (DRI), which has been divided into the following three sub-categories, based on the increasing hazardous nature of each group:¹

- DRI (A), made of hot moulded briquettes, is the least dangerous, as the process reduces the reactivity of DRI and the carriage requirements remain essentially the same as the previous BC Code wording.
- DRI (B), made up of lumps, pellets or cold moulded briquettes, is considered to be highly reactive to moisture and the amendments allow carriage only under inert conditions with enhanced monitoring of atmosphere and changes in emergency procedures to reflect current best practices.

For DRI (B), the BC Code already makes carriage compulsory for the entire voyage in an inert atmosphere containing less than five per cent oxygen. The IMSBC Code repeats this requirement, but specifies how this is to be performed. It states that an adequate means of maintaining the inert atmosphere in the hold(s) for the entire duration of the voyage should be provided. An example of this is a vessel fitted with a nitrogen generating plant.

– DRI (C) comprises by-products, such as fines and small particles, which are not dealt with in the BC Code. DRI (C) has very similar properties to DRI (B), but finely divided DRI (C) is considered to be more reactive than DRI (B). This new schedule has been added to reflect the increase in carriage of fines and small particles, which are by-products of the manufacture of DRI (A) and (B). This new schedule closely reflects the increased carriage requirements for DRI (B).

In addition to DRI, the IMSBC Code introduces modified rules to the carriage of coal, brown coal briquettes and formed solid sulphur.

Footnotes

1 See also article "Understanding the different direct reduced iron products" in Gard News issue No. 178. ■

Carriage of Direct Reduced Iron (DRI) by Sea - Changes to the IMO Code of Safe Practice for Solid Bulk Cargoes

Member Circular No. 3/2010, 16 March 2010

Members will be aware of the general concerns that exist with regard to the carriage of Direct Reduced Iron (DRI) by sea. These concerns have increased significantly since the loss of life arising from the carriage of DRI on board the YTHAN (2004) and the deliberate sinking by the French Authorities of the ADAMANDAS (2003) with her cargo and bunkers on board.

The explosion and accompanying tragic loss of life on the Ythan resulted from the interaction between the vessel's cargo of "HBI Fines" and the fresh water (moisture) contained in the cargo at the time of loading. At the time of the incident the IMO Code of Safe Practice for Solid Bulk Cargo (the Code) categorised two types of DRI, namely hot moulded briquettes or hot briquetted iron (subsequently re-designated as DRI (A)), and pellets, lumps etc. (subsequently re-designated as DRI (B)). The DRI/HBI fines cargo could not in reality be categorised as either (A) or (B) under the Code and the expert advice was to treat it as the more dangerous and reactive type of DRI (B).

Following the above mentioned incidents and their subsequent investigation, the IMO Sub-Committee on Dangerous Goods, Solid Cargoes and Containers (DSC) considered amendments to the relevant Schedules of the Code as part of a review of the Code. The Marshall Islands, Intercargo and the IG proposed that DRI Fines should be individually classified and designated DRI (C) and both DRI (B) and (C) should be carried under an inert (nitrogen) atmosphere with a maximum allowable moisture content of 0.3 per cent in respect of DRI (C). It was recommended by the DSC at its 12th session held in September 2008 that these (and other minor) amendments be adopted by the IMO through the IMO Maritime Safety Committee (MSC). The MSC adopted the recommendations in November 2008 and the Code was renamed the International Maritime Solid Bulk Cargo Code (IMSBC Code).

The main changes to the Code in relation to the carriage of DRI (A), (B) and (C) can be summarised as follows:

DRI (A), BRIQUETTES, HOT-MOULDED

- a maximum limit on the moisture content of 1 per cent.
- cargo is to comprise essentially whole briquettes. Fines of less than 6.35mm and dust are limited to 5 per cent.
- concentration of hydrogen to be measured throughout the voyage. If it exceeds 25 per cent LEL appropriate precautions to be taken.
- surface ventilation only shall be conducted as necessary. When mechanical ventilation is used, the fans shall be certified as explosion-proof and shall prevent spark generation.
- wire mesh guards shall be fitted over inlet and outlet ventilation openings.

DRI (B), LUMPS, PELLETS, COLD-MOULDED BRIQUETTES

- average particle size is limited to 6.35mm to 25mm. Fines of less than 6.35mm and dust are limited to 5 per cent.
- loading conveyors are to be dry.

- prior to loading, an ultrasonic test or another equivalent method with a suitable instrument shall be conducted to ensure weather tightness of the hatch covers and closing arrangements.
- moisture content must be less than 0.3 per cent and must be monitored during loading.
- any cargo that has already been loaded into a cargo space and which subsequently becomes wetted, or in which reactions have started, shall be discharged without delay.
- carriage is only permitted under an inert gas blanket.
- the ship shall be provided with the means of reliably measuring the temperature at several points within the stow, and determining the concentrations of hydrogen and oxygen in the cargo space atmosphere on voyage whilst minimizing the loss of the inert atmosphere.
- the ship shall be provided with the means to ensure that the requirement to maintain the oxygen concentration below 5 per cent can be achieved throughout the voyage. The ship's fixed CO₂ fire-fighting system shall not be used for this purpose. Consideration should therefore be given to providing vessels with the means to top up the cargo spaces with additional supplies of inert gas having regard to the duration of the voyage.
- the ship shall not sail until the master and a competent person are satisfied that:
 - all loaded cargo spaces are correctly sealed and inerted,
 - the cargo temperatures have stabilised at all measuring points and are less than 65°C, and
 - concentration of hydrogen in the free space has stabilised and is less than 0.2 per cent by volume.
- Oxygen concentration shall be maintained at less than 5 per cent throughout duration of voyage.

DRI (C), BY-PRODUCTS, FINES

- average particle size is less than 6.35mm, and there are to be no particles greater than 12mm in size.
- the reactivity of this cargo is extremely difficult to assess due to the nature of the material that can be included in the category. A worst-case scenario should therefore be assumed at all times.
- carriage requirements are largely identical to those for DRI (B), including the 0.3 per cent limit on moisture and carriage under an inert gas blanket.

Attached for assistance is a more detailed summary of the carriage requirements for DRI under the IMSBC Code but it should be noted that it is necessary to comply with all of the relevant provisions of the Code.

In light of the above, members, when carrying DRI (B) or (C), should satisfy themselves that the nominated vessel is capable of maintaining oxygen levels at a concentration of below 5 per cent throughout the voyage.

The Code will remain recommendatory until January 2011 at which point it will become mandatory.

If Members have any questions or concerns relating to the carriage of DRI they should contact their Club.

All Clubs in the International Group have issued a similar circular.

Any questions with regard to the above may be addressed to Nick Platt or Adrian Hodgson in Gard (UK) Limited (+44 20 7444 7200) or Geir Kjebekk in Gard Arendal (+47 37 01 92 52).

Yours faithfully
Gard AS

Claes Isacson
Chief Executive Officer

ALL TYPES OF DRI

- Fines are now defined as particles up to 6.35mm (1/4") in size.
- Cargo spaces shall be clean, dry and free from salt and residues of previous cargoes. Wooden fixtures and combustible materials shall be removed.
- The carrier's representative is to have reasonable access to stockpiles and loading installations for inspection.
- Prior to loading, the shipper shall provide the Master with a certificate issued by a competent person stating the cargo is suitable for shipment and that it conforms with the requirements of the Code in terms of particle size, moisture content and temperature.
- A similar certificate shall be provided after loading relating to the whole consignment.
- The shipper shall provide comprehensive information on the cargo and safety procedures to be followed in the event of an emergency.
- No cargo shall be loaded or transferred during precipitation and non-working hatches shall be kept closed.
- The cargo shall not be accepted when its temperature is in excess of 65°C, or its moisture content exceeds the permitted value, or if the quantity of fines exceeds the permitted value, where appropriate.
- The cargo temperatures shall be monitored during loading and recorded in a log.
- The cargo shall be trimmed in accordance with the relevant provisions of the Code.
- Adjacent tanks other than double bottom tanks shall be kept empty during the voyage.
- Weather tightness shall be maintained throughout the voyage.
- The bilge wells shall be clean and dry and protected from ingress of cargo.
- Precautions shall be taken to protect personnel, equipment etc. from the dust of the cargo.
- During handling of the cargo, "NO SMOKING" signs shall be posted and no naked lights or other ignition sources permitted.
- Suitable precautions shall be taken before entering cargo spaces, which be depleted of oxygen and/or contain a flammable atmosphere.
- The ship shall be provided with a detector suitable for measuring hydrogen in an oxygen depleted atmosphere and for use in a flammable atmosphere.
- Cargo temperatures and hydrogen concentrations in hold atmospheres shall be measured at regular intervals during the voyage.
- If the hydrogen concentration exceeds 1 per cent or the cargo temperature exceeds 65°C, appropriate safety precautions shall be taken. If in doubt, expert advice shall be sought.
- Bilge wells shall be checked regularly for the presence of water.
- All records of temperature, hydrogen and oxygen measurements, where appropriate, are to be retained on board for 2 years.
- The hydrogen concentration shall be measured in the holds prior to opening the hatch covers.

DRI (A), BRIQUETTES, HOT-MOULDED

- The moisture content shall be less than 1 per cent.
- The cargo shall comprise essentially whole briquettes and the addition of fines shall be prohibited.
- Fines shall comprise no more than 5 per cent by weight.
- Weather deck closures and hatch covers shall be inspected and tested to ensure integrity and weather tightness.
- Surface ventilation only shall be conducted as necessary and air shall not be directed into the body of the cargo. When mechanical ventilation is used, the fans shall be certified as explosion-proof and shall prevent spark generation. Wire mesh guards shall be fitted over inlet and outlet ventilation openings, and the escaping gases shall be unable to enter living quarters.
- During discharge, the application of a fine spray of fresh water is permitted only when the cargo is to be stored in an open area.

DRI (B), LUMPS, PELLETS, COLD-MOULDED BRIQUETTES

- The average particle size shall be from 6.35mm to 25mm, with fines no more than 5 per cent by weight.
- The shippers' certificate shall state the date of manufacture for each lot of cargo.
- The certificate issued after loading shall confirm that the moisture content has not exceeded the permitted value.
- The cargo shall be certified as having been aged for at least 3 days, or treated so as to achieve the same reduction in activity.
- The cargo shall be kept dry at all times. Any cargo that has been wetted, or known to have been wetted, shall not be loaded.
- Loading conveyors shall be dry.
- Prior to loading, an ultrasonic test or another equivalent method with a suitable instrument shall be conducted to ensure weather tightness of the hatch covers and closing arrangements.
- The moisture content shall be less than 0.3 per cent by weight and shall be monitored during loading.
- Any cargo that has already been loaded into a cargo space and which subsequently becomes wetted, or in which reactions have started, shall be discharged without delay.
- The breakage of briquettes and lumps shall be minimised and the addition of fines shall be prohibited.
- Carriage is only permitted under an inert gas blanket.
- Prior to loading, provision shall be made to introduce a dry inert gas at tank top level. Nitrogen is preferred. All vents and openings shall be sealed to prevent the loss of the inert atmosphere.
- On completion of loading of a cargo space it shall be immediately closed and sufficient inert gas introduced to achieve an oxygen concentration of less than 5 per cent throughout the cargo space.
- The ship shall be provided with the means of reliably measuring the temperatures at several points within the stow, and determining the concentrations of hydrogen and oxygen in the cargo space atmosphere on voyage whilst minimizing the loss of the inert atmosphere.
- The oxygen concentration shall be maintained at less than 5 per cent throughout duration of voyage. The ship shall be provided with the means to ensure that this requirement can be achieved throughout the voyage. Consideration shall be given to topping up with additional supplies of inert gas: the ship's fixed CO₂ fire-fighting system shall not be used for this purpose.
- The ship shall not sail until the master and a competent person recognised by the national administration of the port of loading are satisfied that:
 - All loaded cargo spaces are correctly sealed and inerted;
 - The cargo temperatures have stabilised at all measuring points and are less than 65°C; and
 - The concentration of hydrogen in the free space has stabilised and is less than 0.2 per cent by volume (i.e. 5 per cent LEL).
- The cargo spaces shall remain tightly sealed and the inert condition maintained throughout the voyage.
- The ship shall be provided with a detector suitable for measuring oxygen in a flammable atmosphere.
- Oxygen concentrations shall be measured at regular intervals during the voyage.
- During precipitation, all cargo discharge operations shall be suspended and holds containing cargo shall be closed.

DRI (C), BY PRODUCTS, FINES

- The average particle size shall be less than 6.35mm, and there shall be no particles greater than 12mm in size.
- "The reactivity of this cargo is extremely difficult to assess due to the nature of the material that can be included in the category. A worst-case scenario should therefore be assumed at all times."
- The cargo shall be kept within the permissible moisture content at all times.
- The carriage requirements are identical to those for DRI (B), including the 0.3 per cent limit on moisture, with the following exceptions:
 - The shippers' certificate does not need to state the date of manufacture of each lot of cargo;
 - The cargo shall be certified as having been aged for 30 days.
 - Any cargo that has already been loaded and which subsequently is exposed to additional fresh water or seawater over its natural moisture content and becomes wetted, or in which reactions have started and its temperature has exceeded 120°C, shall be discharged without delay. ■

The dangers of carrying Direct Reduced Iron (DRI)

Loss Prevention Circular No. 07-03

Since the International Group of P&T Clubs' Circular on Direct Reduced Iron published in 1982, the dangers of DRI have somewhat disappeared from the limelight. Gard P&T has recently been involved in several cases, which have served as a stark reminder of the dangers involved in carrying this hazardous bulk cargo.

TYPES OF DRI

DRI is the raw material used in the production of steel in electric arc furnaces, which form the majority of the steel production facilities worldwide. DRI can be split into two distinct sub-groups; cold moulded pellets or hot moulded briquettes. The IMO Bulk Cargo (BC) Code deal with these two types separately. Hot moulded DRI briquettes are a more refined product, formed by the further processing of cold moulded pellets. Both forms of DRI are considered hazardous when carried in bulk and specific carriage requirements are listed in the BC Code.

DRI PROPERTIES AND DANGERS

DRI in either form is similar to other steel structures in its susceptibility to rust (re-oxidise) in the presence of oxygen. The rate of oxidation is dependant, to a greater or lesser degree, on the moisture content of the DRI and the atmosphere in which the DRI is carried. The oxidation process generates heat, which in bulk cargoes of DRI can be significant. The process of oxidation is accelerated in the presence of moisture and is substantially increased if the water contains dissolved chlorides, as is the case with seawater. The sponge-like structure of DRI also inhibits the dissipation of heat and DRI in bulk can therefore heat rapidly in isolated pockets.

Hot iron when in contact with water can cause a chemical reaction resulting in the production of hydrogen, which is highly explosive in the correct quantities. The generation of hydrogen is the most dangerous property of DRI and has led to several fatal explosions. In some manufacturing processes, the DRI undergoes one of two processes called either 'passivation', whereby the briquettes are coated with sodium silicate or 'ageing' in which the briquettes are allowed to form an iron oxide coating. These processes are intended to reduce or inhibit the oxidation process during transit. This additional process is dealt with specifically in the BC Code.

CARRIAGE REQUIREMENTS

Carriage requirements are set out in the IMO BC Code. Reference should also be made to the latest published advice and carriage requirements approved by the local Competent Authority and issued by the shipper. The BC Code recommends that the shippers should provide specific instructions for the carriage of DRI, and these should either be:

1. That the cargo spaces be maintained in an inert condition, with the atmosphere containing less than 5 per cent oxygen. The hydrogen content of the cargo spaces should be maintained at less than 1 per cent by volume, OR
2. That the DRI is manufactured or treated with an oxidation inhibiting process to the satisfaction of the Competent Authority.

If the atmosphere is inerted, the inerting agent must be nitrogen. Carbon dioxide should not be used, primarily because it can produce carbon monoxide, which is both toxic and flammable. Even on short sea voyages it is recommended that the cargo be fully inerted. Passivation has been shown to effectively reduce oxidation, from fresh water contamination, in the short term, but, over time, the effective protection is reduced. It should be noted that there is little protection from the rapid reactions caused by the ingress of salt water into the cargo spaces. It is therefore recommended that the carriage of DRI should always be undertaken under a nitrogen blanket. The ship's crew should carry out effective monitoring of the atmosphere in the cargo spaces. Records should be kept of the levels of hydrogen and oxygen in each cargo space.

The condition of the cargo should be monitored during loading. Cargo that is hot or damp should not be loaded. It is also recommended that the temperature of the cargo during loading should be monitored. If the cargo temperature is above the ambient temperature, advice should be obtained from the local Competent Authority. However, cargo with a temperature in excess of 65°C should never be loaded. It is usual for temperature thermocouples to be placed within the cargo holds during loading for the monitoring of cargo temperatures during carriage. It is important that these thermocouples are tested prior to being positioned within the cargo and their location within the cargo recorded.

It is also recommended that the cargo should be properly trimmed in order to reduce the amount of surface area exposed to the atmosphere. Trimming also helps reduce the "funnel" effect by reducing the amount of void spaces in the cargo where hot gases can move upwards while drawing in fresh air.

If the vessel has any doubts about any particular DRI loading it is recommended that independent advice be obtained from an expert. The Association is only too happy to assist in this regard, and in any other way it can.

For more information regarding Gard loss prevention products, please contact Terje Paulsen, at phone number +47 55 17 40 85 or email terje.paulsen@gard.no. ■

Carriage of dangerous cargo – Questions to ask before you say yes

Gard News 197, February/April 2010

The shipment of dangerous cargo is now commonplace in many trades. This article is aimed at those operating in trades where the carriage of dangerous cargo is not an ordinary occurrence.

Whilst cargoes can be legally dangerous as well as physically dangerous, this article is written in the context of the latter. Unfortunately, there has been a number of cases in which crews and their ships have been lost because of dangerous cargoes (e.g., due to liquefaction) or have suffered harm from fires/explosions caused by dangerous cargoes.¹ The sad truth is that there are some ship operators who probably do not know they are carrying a dangerous cargo because shippers misdeclare them, in some cases deliberately. The commentary below summarises some of the main questions to be asked before agreeing to carry dangerous cargoes, perhaps starting with the most important question: who is shipping? It is in the industry's interest, and particularly the ships' crews', to avoid doing business with so-called "rogue shippers".

WHO IS SHIPPING?

If the request to ship dangerous cargo (or cargo which, given its description, may be dangerous but not declared as such) is made by a party with whom the carrier has had no previous dealings or experience, investigations ought to be undertaken as to that party's experience in shipping such cargo, and whether they have previously been connected with any accidents or rogue shipments. Of course, rogue shippers can be expected to change names, so be aware of newly-formed companies. If the request or order is from time charterers, it is still important to identify and research the underlying shipper. In summary: is the party asking to ship/shipping dangerous cargo reliable and trustworthy? What can you refuse to carry?

Under a time charterparty, the charterer has relative freedom to employ the ship on lawful trades and to load lawful cargoes, but shipowners can exclude their right to load certain cargoes. Therefore, before entering any time charter, particularly a long one, shipowners should think carefully about which dangerous cargoes they wish to exclude. Standard form time charterparties usually contain a cargo exclusion clause, but not all require the shipowners' prior written consent. It is up to the owner to name cargoes he wishes to exclude from carriage and it is worth doing some research (and maybe obtaining expert advice) before doing so. It may be easier to expressly state which cargoes are allowed under the charterparty, to the exclusion of all others without prior written consent. Regulations may require certain fire-fighting arrangements or ships of special construction/strengthening for the carriage of dangerous cargoes and for a document of compliance to be issued before dangerous cargoes can be carried. Also, there may be limitations on the quantity of dangerous cargo that the ship can carry, e.g., for structural/stability reasons and/or because of restrictions under the IMDG Code. On smaller ships, the simple ability to safely segregate certain goods may be an issue.

WHAT ARE YOU ASKED TO CARRY?

It is all too common for dangerous goods to be misdeclared. It also happens that they get incorrectly or incompletely named. Different companies, countries and trades may also use different names for specific dangerous cargoes.² It is important to establish the exact cargo you are dealing with by obtaining details on its physical and chemical properties, its hazards and origin. It is then a case of referring to the relevant codes/regulations, such as SOLAS, BC Code and IMDG Code, to establish the relevant carriage guidance. It is important to note, however, that the cargo lists in the IMDG and IMSBC Codes are not exhaustive, which is why details from shippers on cargo properties and hazards are important. Care should be taken to refer to any amendments to the relevant codes/regulations and/or their very latest version (only recently has a new BC Code been introduced – now named the IMSBC Code). Guidance can be sought from the P&I Club or other industry bodies and if necessary advice can be obtained from experts. With reference to the IMSBC Code, it should be noted that a number of specific cargoes may be grouped together under a general entry, e.g., mineral concentrates and metal sulphide concentrates.

WHAT ARE THE DANGERS/HAZARDS POSED BY THE CARGO?

Once the cargo has been correctly identified, the carrier should seek to fully understand the dangers posed by that cargo to the ship and crew. Beyond what is provided in relevant codes/regulations, research can be undertaken with relevant industry bodies, the P&I Club,³ flag state⁴ and port state. It is important to be aware that codes such as the IMDG Code and IMSBC Code may not be completely comprehensive. For example, some ores, fines and concentrates that may liquefy may not be identified as cargoes possessing that hazard in the IMSBC Code. If necessary, expert advice can be sought. The cargo may be dangerous by its very nature (for instance, it poses chemical hazards), but others may only become dangerous in certain circumstances. The carrier should have a basic understanding of how and why the cargo can become dangerous – it may depend on the rate at which it is loaded, its mass/density within a given cargo space, its moisture content, temperature or contact with certain solids/liquids/gases. It is worth remembering that seemingly safe cargoes can create dangerous situations; for example wood can cause oxygen depletion with the obvious risk that poses to those that may seek to enter the cargo space.

WHAT DOES THE SHIP/CREW NEED TO SAFELY CARRY DANGEROUS CARGO?

The ship may need to be of a certain construction or strengthening for the carriage of dangerous cargo. It may also need special equipment, such as fire-fighting apparatus, a nitrogen generator for inerting, temperature monitoring, gas detection devices, protective clothing for the crew. The crew will need to be provided with the relevant codes/regulations containing guidance material on safe carriage and on responding to accidents involving dangerous cargo (e.g., the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods). Of

course, and most importantly, the crew will need to know exactly what dangerous cargo they are carrying (and, indeed, the answers to many of the questions posed in this article – and more).

WHAT SHOULD THE SHIPPERS PROVIDE?

The shippers should provide the exact cargo that the carrier has agreed to carry. The cargo actually presented for shipment may well differ from that first declared/notified and the carrier should check this before any cargo is loaded. Obviously, this will be difficult with packaged/containerised cargo, but at least external labels should be checked. Documentation should also match the cargo presented for shipment and that which the carrier has agreed to carry. Full and proper documentation is a key aspect in the carriage of dangerous cargo and, again, no cargo should be loaded in absence of this. Unfortunately, there have been many instances in which shippers have simply failed to provide the required documentation.⁵

Documentary requirements are set out in the relevant regulations/codes and, essentially, form the basis of the information on the dangerous cargo which the carrier needs as evidence that the goods/cargo is safe for carriage, to alert the carrier and his crew to the relevant hazards, and to guide the carrier/his crew on safe carriage and how to react in the case of emergency. The information should be provided sufficiently in advance to enable precautions to be put into effect by the carrier. The shipper's documentation should include analysis certificates for key safety parameters, such as the moisture content, flow moisture point and transportable moisture limit for a bulk cargo that may liquefy. The shipper should provide the relevant declarations that the information provided is accurate. The information provided should be truly representative of the cargo actually loaded. Key safety parameters stated in generic material safety data sheets may not be specific to the cargo to be loaded and should be treated with caution in the absence of analysis certificates that are specific to the cargo to be loaded. Sadly, there have been instances in which shippers' certificates have been found not to be truly representative of the cargo's key safety parameters, which is why it is extremely important for the carrier not to place full reliance on them. If the carrier is in any doubt, he should consider arranging his own tests (see below). In addition to documentation, dangerous cargo in a packaged form should be properly packaged and labelled by the shipper.

WHAT DOES YOUR CONTRACT SAY?

Cargo exclusions in time charterparties have already been mentioned, but what else does the charterparty say about the carriage of dangerous cargo? Is the master entitled to refuse to load, or, if already loaded, to unload and dispose of dangerous cargo that is unsafe for carriage at charterers' time, risk and expense? If the contract incorporates or will be compulsorily subject to the Hague/Hague-Visby/Hamburg Rules, it should be noted that all these Rules contain provisions with regard to dangerous cargoes. For example, the Hague-Visby Rules provide (in Article IV Rule 6):

"Goods of an inflammable, explosive or dangerous nature to the shipment whereof the carrier, master or agent of the carrier has not consented with knowledge of their nature and character, may at any time before discharge be landed at any place, or destroyed or rendered innocuous by the carrier without compensation and the shipper of such goods shall be liable for all damages and expenses directly or indirectly arising out of or resulting from such shipment. If any such goods shipped with such knowledge and consent shall become a danger to the ship or cargo, they may in like manner be landed at any place, or destroyed or rendered innocuous by the carrier without liability on the part of the carrier except to general average, if any."

The applicable law and jurisdiction under the contract are also worth considering. Will these result in ready access to justice in the event of a dispute or casualty involving dangerous cargo? It should be kept in mind that the law covering liability for loss/damage arising out of the shipment of dangerous goods varies from country to country. Under English common law charterers/shippers would risk being in breach of an implied and absolute undertaking if they were to load cargo without notice of its peculiar characteristics which endanger the ship, unless the owners or their crew knew or ought reasonably to have known of them. In the context of cargo which is known to be dangerous, English case law suggests that owners should be regarded as having contracted to bear risks which can be avoided by appropriate methods of carriage for the goods of the relevant type (the owners being expected to keep up to date with the correct carriage methods but not to have the knowledge of an expert chemist), but not the risks produced by a particular cargo, which are of a totally different kind (whether in nature or degree) from those attached to the carriage of the described cargo, and which should fall on the shippers/charterers. In a recent case⁶ the English courts decided that a carrier's right of indemnity against a shipper was not limited to a situation where the dangerous nature was the sole or dominant cause of the loss, but where in any event the damage would not have occurred except for the peculiar characteristics of the actual cargo shipped.⁷ The position under English law can be contrasted with that under US law, which appears to be more onerous for the shipowner.⁸

If the Hague/Hague-Visby Rules apply, a claim by the carrier against the shipper under Article IV Rule 6 would, under English law, be defeated if the carrier breached his duty to exercise due diligence to make ship seaworthy and that was a contributing cause of damage resulting from shipment of dangerous cargo. This is very relevant, as shown in the case of the EURASIAN DREAM.⁹ In that case the English courts decided that a pure car carrier was rendered unseaworthy as a result of the operators' failure to provide the vessel with specific documentation dealing with the peculiar danger of fire on car carriers and the precautions to be taken to avoid such fires.

The stowage of dangerous goods is often an important factor in their safe carriage and it is worth considering who would be

responsible for stowage under the contract. In a recent English court case (involving the negligent stowage of dangerous cargo next to a ship's bunker tanks),¹⁰ it was found that where a charterparty allocated responsibility for the stowage to the charterers, the shipowners had no responsibility to the charterers for damages consequent on improper stowage, even if it rendered the vessel unseaworthy. The outcome of the case would almost certainly have been different had the words "and responsibility" been added to clause 8 of New York Produce Exchange form charter.

It should not be forgotten that, when negotiating contract terms, the shipowner has an opportunity to stipulate what the shippers/charterers are obliged to provide in advance of loading dangerous cargo and what the carrier is entitled to do if the shipper/charterer does not comply. This can be particularly relevant if the place of loading has a history of problem or rogue shipments. Consideration can also be given to making contractual provision for full co-operation from cargo interests, full access to the cargo ashore for possible inspection/sampling and for analysis at specific laboratories which can be relied upon to give accurate results (preferably being at owner's option to invoke such provisions, whilst not relieving charterers and cargo interests of the primary obligation to provide full and accurate documentation). Such provisions would need to be carefully considered on a case by case basis as the ultimate effect could be to make it more difficult for an owner to refuse to carry a cargo in respect of which doubts still remain.

WHAT IS YOUR INSURANCE COVER?

It is important to be aware that the carriage of dangerous cargo can, in certain circumstances, prejudice the carrier's insurance cover. There may be a warranty in the insurance contract that no dangerous cargoes will be carried, or that they will only be carried in accordance with relevant regulations. In the absence of any warranty, a general duty of disclosure applies at the inception of an insurance contract (see for example Rule 6 of Gard's Rules for P&I cover). If a vessel's trade in dangerous cargo is not made known to the insurer and the insurer could not be reasonably expected to know of such trade, insurance cover could be prejudiced. Similarly, a radical change in the trade of the ship from one which has, for example, involved the carriage of steel to one involving the carriage of dangerous cargo in bulk could well be deemed to be an alteration of the risk requiring disclosure to the insurer. Rule 7 of Gard's Rules for P&I cover (Alteration of Risk) sets out the consequences of an alteration of risk not disclosed to the Club: one being that the member has no cover for liability, loss, cost or expense caused or increased by the alteration of the risk.

Gard's P&I Rule 74 (Unlawful Trades etc.) provides that: "The Association shall not cover liabilities, losses, costs or expenses arising out of or consequent upon the Ship carrying contraband, blockade running or being employed in or on an unlawful, unsafe or unduly hazardous trade or voyage".

The words "unsafe or unduly hazardous trade or voyage" may be of particular relevance in the context of carriage of dangerous cargo, and some guidance may be derived from the legal principles which govern contracts of carriage. Other Club Rules, such as Rule 8 (Classification and Certification of the Ship), requiring compliance with statutory requirements of the ship's flag state, and Rule 73 (Nuclear Perils), which sets out certain exclusions with regard to the carriage of nuclear material, may also be relevant.

WHERE/WHEN IS THE CARRIAGE TO/FROM?

Another important consideration when asked to carry dangerous cargo is the place/country of shipment. Sadly, a number of countries have a poor reputation for the shipment of dangerous cargoes, probably due to a lack of internal controls and/or sanctions on shippers. P&I Club circulars and articles can be referred to for guidance in this regard. The nature of the voyage and the ship's remoteness from assistance should also be considered. A long voyage through predictably heavy weather may, for example, raise additional concern. Having considered these factors, decisions can be taken on how best to safeguard the crew and the ship.

HOW TO MANAGE THE PECULIAR RISKS?

If the decision is that the ship can carry dangerous cargo, it is worth spending time considering how the risks peculiar to the dangerous cargo in question can be best managed and minimised. The most important phase is pre-carriage and, as already mentioned, the carrier should put in place his own checks to ensure that the cargo presented for shipment is safe for carriage.¹¹ Finding out how and where a dangerous bulk cargo susceptible to liquefaction has been stored and for how long is useful to know when moisture content of the cargo is the key safety parameter. Performing the carrier's own tests on the cargo can be as simple as the crew performing a "can test"¹² but if in any doubt proper representative sampling and reliable analysis will need to be considered. It goes without saying that the crew will need to be properly briefed before loading, and all crew members should be aware of the location and dangers of the cargo. It may be necessary to display signs prohibiting entry into spaces containing dangerous cargo and/or properly notify third parties involved in the carriage, such as stevedores and terminal personnel, about the dangerous cargo.

Perhaps most importantly, the crew will need to know the warning signs that something is going wrong with the cargo and how they should respond. If an accident does occur, it will have been prudent to have drilled the crew in the emergency procedures as the speed and thoroughness of the response can often make the difference. The lessons learnt from previous incidents are extremely valuable: they demonstrate the importance of proper risk assessment¹³ and quick access to accurate information and expert advice/assistance.¹⁴

WHY SHOULD YOU TAKE THE RISK?

After reading this article you may ask yourself: "why should I take the risk of carrying dangerous cargo"? No doubt the vast majority of dangerous cargo is carried successfully and without problem. On the occasions when problems do occur, the consequences can be severe. A cautious approach is always to be recommended. As always, prevention is better than cure.

Footnotes

- 1 See article "Liquefaction of unprocessed mineral ores - Iron ore fines and nickel ore" elsewhere in this issue of Gard News.
- 2 See for example the article "Understanding the different direct reduced iron products" in Gard News issue No. 178.
- 3 See Gard's for example Loss Prevention Circular No. 07-03, "The dangers of carrying Direct Reduced Iron (DRI)".
- 4 See for example the UK MCA Marine Guidance Note MGN 107 (M) in reference to The Merchant Shipping (Carriage of Cargoes) Regulations 1999.
- 5 See the article "Shipowners stand firm against lack of proper BC Code documentation" in Gard News issue No.193.

6 CSAV v. Sinochem Tianjin Import and Export Corp. (The ACONCAGUA) [2009] EWHC 1880 (Comm).

7 See article "Has justice finally been done in the calcium hypochlorite cases?" in Gard News issue No. 196.

8 See article "The DG HARMONY on appeal" in Gard News issue No. 191.

9 See article "An insight into the interpretation and implementation of the ISM Code" in Gard News issue No. 169.

10 CSAV v. MS ER Hamburg Schiffahrtsgesellschaft mbH & Co KG (The ER HAMBURG) [2006] EWHC 483 (Comm).

11 See for example Loss Prevention Circular No. 15-08 "Loading of hot coal at Maputo, Mozambique".

12 See the article "Shipowners stand firm against lack of proper BC Code documentation" in Gard News issue No.193.

13 See for example the article "P&I incident - dangerous goods container overboard" in Gard News issue No. 179.

14 See for example the article "Facing the challenge of fire at sea" in Gard News issue No. 175. ■



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