BRITANNIA LOSS PREVENTION

B GUIDANCE

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CARRIAGE OF COAL

COAL IS AN IMPORTANT, WIDELY-USED SOURCE OF ENERGY AND A CHEMICAL RAW MATERIAL, WHICH IS TRANSPORTED GLOBALLY IN LARGE QUANTITIES; MORE THAN A BILLION TONNES OF COAL PER YEAR ARE TRANSPORTED BY SEA (IEA – INTERNATIONAL ENERGY AGENCY, 2020).

However, its carriage as a cargo is associated with a number of hazards and coal must be carried in accordance with the relevant regulatory requirements, as outlined in this guidance.

FIGURE 1 Bulk carrier

PROPERTIES AND HAZARDS

GIVEN ITS ORIGINS AS A CARBONACEOUS SEDIMENTARY ROCK FORMED BY GEOLOGICAL PROCESSES APPLYING PRESSURE TO THE REMAINS OF PLANT MATERIAL OVER TIME (ISO 11760:2018 (EN)), COAL COMES IN MANY DIFFERENT FORMS AND THE TERM COVERS A RELATIVELY WIDE RANGE OF CARGOES.

Consequently, its properties and the associated hazards also vary significantly depending on the specific form of coal being carried as cargo. Coal "Rank" is a basic classification which refers to the degree of geological "coalification", which changes the original plant matter into an ever denser, drier, harder and more carbon rich material, and therefore changes the properties accordingly (U.S. Geological Survey). For example, high-rank coals, such as anthracite, are generally more likely to emit methane, while low-rank coals, such as brown coal, are more likely to have self-heating properties.

However, what is consistent is that all coal cargoes require certain precautions upon loading, and monitoring during voyage. The following characteristics of coal are most significant with regards to its carriage at sea and need to be considered. Some coals may:

- Emit methane (CH_4), which in turn may potentially create a flammable or explosive atmosphere susceptible to ignition by a spark or flame. CH_4 will accumulate in the upper layer of a space and can also leak into adjacent areas if the cargo space is not gas tight
- Deplete oxygen (O_2) in cargo holds and adjacent spaces, leading to an increase in carbon dioxide (CO_2) in the cargo space
- be prone to self-heating and potentially spontaneous combustion resulting in the release of carbon monoxide (CO) – an odourless, but toxic gas if inhaled, and with flammable limits in air of 12% to 75% by volume
- Liquefy, if carried with excessive moisture content (as detailed further below)
- React with water, producing corrosion-inducing acids, as well as toxic gases and hydrogen (H), which is lighter than air and odourless with flammable limits in air of 4% to 75% by volume.

REGULATORY REQUIREMENTS

AS A POTENTIALLY HAZARDOUS BULK CARGO, IT IS ESSENTIAL THAT COAL IS ALWAYS LOADED, CARRIED AND DISCHARGED IN ACCORDANCE WITH THE REQUIREMENTS OF THE INTERNATIONAL MARITIME SOLID BULK CARGOES (IMSBC) CODE.

The IMSBC Code contains a detailed schedule for the carriage of coal and provides information on the associated hazards, such as asphyxiation and exposure of crew members to toxic gases, as well as the precautions which need to be taken when carrying coal. These requirements should be understood and closely followed by both ship and shore management. If shipowners are in any doubt, they are encouraged to seek expert advice or clarification from the relevant Flag State.

IMSBC CLASSIFICATION

By default, coal is classed as IMSBC Group A and B, which are defined as follows:

GROUP A: Cargo which may liquefy if shipped at a moisture content in excess of the transportable moisture limit (TML)

GROUP B: Cargo which possesses chemical hazards

Coal can be classed as **GROUP B** (only) in one of the following cases:

- By a test determined by the competent authority in the country of origin, or
- When the particle size distribution fulfils specific criteria defined in the IMSBC Code

It should be noted that blended coals should be considered as both Group A and B, unless all the original coals are Group B only.

In the latest edition of the IMSBC Code (amendment 05-19 in force from 1 January 2021), coal is also categorised as a solid that can be combustible (CB), self-heating (SH), evolving flammable gas when wet (WF) and/or corrosive (CR).

IMSBC GROUP A HAZARDS: LIQUEFACTION

WITH THE EXCEPTION OF COAL CARGOES CLASSED AS GROUP B ONLY, THE CARGO DECLARATION SHOULD BE ACCOMPANIED BY DOCUMENTATION RELEVANT TO THE MOISTURE CONTENT (MC) OF CARGO AND ITS TML, ISSUED BY AN ENTITY THAT IS RECOGNISED BY THE COMPETENT AUTHORITY OF THE PORT OF LOADING.

The IMSBC Code section 4 should be consulted for specific requirements in this regard but these include:

- The TML certificate should contain or be accompanied by the testing done for determination of TML. The shipper is responsible for ensuring that a test to determine the TML is conducted within six months of the date of commencement of cargo loading.
- The shipper is also responsible for ensuring that sampling and testing for the MC is conducted as near as practicable to the date of commencement of loading. The interval between sampling/testing and the date of commencement of loading should never be more than seven days.
- The MC certificate should be accompanied by a statement by the shipper that the MC is, to the best of their knowledge and belief, the average moisture content of the cargo at the time of declaration.
- The ship's master should be provided with a document issued by the competent authority at the port of loading stating that the shipper's procedures established for sampling, testing and controlling the MC of cargo on board ship (to ensure that the MC is less than its TML) are approved and the implementation checked as per section 4.3.3 of the IMSBC Code.

The IMSBC Code stipulates that if a Group A cargo has been exposed to significant rain or snow between the time of testing and the date of completion of loading, the shipper shall be responsible for ensuring that the MC of the cargo is still less than its TML, and that evidence of this is provided to the ship's master as soon as practicable.

If the cargo is loaded onto the ship from barges, in developing the procedures under 4.3.3 (mentioned above), the shipper shall include procedures to protect the cargo on the barges from any precipitation and water ingress.

CARGO DECLARATION

SHIPOWNERS SHOULD SATISFY THEMSELVES THAT THE SHIPPER'S CARGO DECLARATION HAS BEEN PROVIDED IN ACCORDANCE WITH THE REQUIREMENTS OF THE IMSBC CODE, IN PARTICULAR WITH REGARD TO THE CARGO PROPERTIES AND THE ASSOCIATED HAZARDS.

The declaration shall include a section clearly stating whether the cargo of coal is liable to emit methane, or self-heat. In such instances, the Special Precautions in the IMSBC Code for "coals emitting methane" and "self-heating coals," respectively, must be taken.

The IMSBC Code also stipulates that the shipper shall provide the master with the characteristics and the recommended safe handling procedures for the loading and transport of the coal cargo. As a minimum, this information should include the cargo's contract specifications for moisture content, sulphur content and size.

The cargo declaration must be examined in detail, bearing in mind that it may be inaccurate. It is recommended to treat all coal cargoes as potentially hazardous (in particular, as being liable to self-heating) until confirmed otherwise.

The appropriate Bulk Cargo Shipping Name (BCSN) is Coal, although trade names may differ. In general, if the cargo declaration does not contain a BCSN specifically matching the relevant IMSBC Code schedule, the requirements of the IMSBC Code section 1.3 must be followed and the competent authority for the port of loading should assess the suitability of the cargo for shipment.

CARGO TEMPERATURE UPON LOADING

THE IMSBC CODE STATES THAT IF THE CARGO IS DECLARED AS LIABLE TO SELF-HEATING , THE TEMPERATURE OF THE CARGO MUST BE MEASURED BEFORE AND DURING LOADING.

However, as the cargo declaration might be incorrect, it is recommended that the temperature of coal should be measured before loading in all instances. Depending on local logistics and the location of the stockpile, surveyors may need to be appointed in order to obtain adequate measurements before the cargo is transferred to the vessel. The measurements should be recorded with care, as they may be required as evidence in the event of the loading being stopped or cargo rejected.

Coal cargoes with temperatures above 55°C shall not be accepted for loading. The reason for imposing a limit is that, at a certain temperature, the rate of the self-heating reaction once in the cargo hold is likely to reach a temperature point of self-ignition before the reaction can be slowed down by restricted oxygen levels.

Self-heating can be localised and obtaining adequate temperature measurements may require gaining multiple access points to the cargo parcel. It is also advisable not to accept average temperature values measured in the cargo prior to loading, as the IMSBC Code has no provision in this regard.

Particular caution is advised where hot coal is presented for loading and the cargo has not been declared as liable to self-heating. The Club has experienced several cases where inadequate monitoring of coal before loading gave rise to safety concerns **Risks of loading coal from barges in Indonesia Dec/15**.

LOADING – OTHER CONSIDERATIONS

- Cargo spaces and bilge wells should be clean and dry, with the latter covered as appropriate (eg. with burlap) to prevent the cargo from entering into the bilge well.
- Unless expressly provided otherwise, the boundaries of cargo spaces for the stowage of coal shall be resistant to fire and liquids.
- Gas levels in working spaces, store rooms, passage ways other areas adjacent to cargo holds should be monitored and the spaces adequately ventilated, as required.
- Electrical cables and components within cargo holds and adjacent spaces should be free from defects and either safe for use in explosive atmosphere, or positively isolated (this does not apply to engine rooms separated from cargo space by a gas-tight bulkhead with no direct access).
- Coal cargo should not be stowed adjacent to hot areas, i.e. having a temperature consistently higher than 55°C during the carriage of the cargo, as defined in MSC.1/Circ.1351 Rev.1 (Interpretation of Stowage and Segregation Requirements for Brown Coal Briquettes and Coal Related to "Hot Areas" in The IMSBC Code). This includes, for example, the plating of heated fuel service or settling tanks.
- The Appendix to the IMSBC Code schedule outlines the segregation requirements for the carriage of coal with respect to various classes of dangerous goods cargoes.
- Coal cargo should be trimmed in accordance with the relevant provisions of the IMSBC sections 4 and 5. Insufficient trimming may result in opening vertical cracks into the mass of cargo, which in turn may permit oxygen circulation and possible self-heating.
- Smoking and the use of naked flames should not be permitted in the cargo areas and adjacent spaces, with appropriate notices posted advising such.
- Hot work or sources of ignition in the vicinity of cargo and adjacent spaces should only be considered after proper ventilation and satisfactory methane gas measurements. A thorough risk assessment is advisable.
- The IMSBC Code schedule also outlines the weather precautions to be taken during loading and discharge if there is the possibility that the coal cargo may liquefy during the voyage and the cargo is being carried in a ship other than a ship complying with the requirements in section 7.3.2 of the IMSBC Code for specially constructed or fitted cargo ships for confining cargo shift.

CARGO TEMPERATURE UPON LOADING

ALL COAL CARGOES REQUIRE MONITORING THROUGH REGULAR MEASUREMENTS OF TEMPERATURE AND GAS CONCENTRATION, AS WELL AS THE PH VALUE OF HOLD BILGE SAMPLES, WITHOUT THE NEED TO ENTER THE CARGO SPACES.

The measurements should be carefully recorded. The frequency of readings will depend on the information provided by the shipper and the analysis of gas concentration levels in the cargo hold

headspace. At a minimum, the readings should be taken daily. A record should be maintained of all such readings, which will help identify any changing trends in the measurements.

The master should advise the Owners and report to the shipper if the behaviour of the cargo during carriage differs from that described in the cargo declaration.

TEMPERATURE MEASUREMENTS

THE IMSBC CODE RECOMMENDS THAT INSTRUMENTS AVAILABLE ON BOARD ENABLE CARGO TEMPERATURE MEASUREMENTS IN THE RANGE FROM 0°C TO 100°C.

Self-heating is most likely to occur in localised spots within the cargo mass. Temperature sounding pipes or temperature sensors (if installed) are usually located in the vicinity of the bulkhead, i.e. they are peripheral to the stow. It should be borne in mind that the measurements obtained in these locations are only an indication of the temperature near the pipe. Due to the thermally insulating properties of coal, a localised increase of the temperature in the stow may not be detected this way. Therefore temperature measurements alone may not be a reliable indicator of self-heating.

However, as the self-heating of coal results in the emission of carbon monoxide (CO), measurements of gas concentrations are considered a more effective method of monitoring for self-heating, as detailed below.

GAS MEASUREMENTS

GAS CONCENTRATION MEASUREMENTS SHOULD PROVIDE AN INDICATION OF THE TWO MAJOR HAZARDS ASSOCIATED WITH THE CARRIAGE OF COAL, I.E. SELF-HEATING (REFLECTED BY CO CONCENTRATION) AND EXPLOSIVE ATMOSPHERE (REFLECTED BY METHANE (CH4) LEVELS).

All vessels engaging in the carriage of coal are required to have appropriate gas monitoring equipment for measuring gas concentrations of CH4, O2 and CO. Headspace in cargo holds is accessed via sampling points. If the holds are being ventilated, then ventilation should be stopped for an adequate time (at least four hours) prior to taking the measurements. The IMSBC Code provides full detailed guidance on sampling and measurement procedures. This includes the siting of sampling points and a measurement strategy for both unventilated and ventilated holds.

Care should be exercised in interpreting CH4 measurements made in low O2 levels. This is because the catalytic sensors generally used to detect CH4 rely on the presence of sufficient O2 for accurate measurement. However, this does not affect CO measurements, or the measurement of CH4 using an infrared sensor. Further guidance can be obtained from the instrument manufacturer.

Before loading, it is important to confirm that the gas (and temperature) monitoring equipment and sampling ports are in good working order, and all such equipment should be regularly serviced and calibrated. The personnel undertaking these checks should be appropriately trained and aware of equipment limitations e.g. methane measurements carried out in low oxygen concentrations will be less accurate.

VENTILATION

THE GENERAL RULE OF THUMB FOR VENTILATION MANAGEMENT IN COAL CARGOES IS THAT IN RELATION TO SELF-HEATING/COMBUSTION HAZARD, THE CARGO SHOULD NOT BE VENTILATED (TO LIMIT OXYGEN ACCESS), WHILE IN RELATION TO EXPLOSION HAZARD, THE CARGO SHOULD BE VENTILATED (TO PREVENT THE ACCUMULATION OF METHANE).

If there is no indication of self-heating or methane emission, or unless expressly provided otherwise, the holds should be surface ventilated for the first 24 hours after departure from the loading port according to the IMSBC Code. During this time, the gas in the headspace of cargo holds should be monitored once per sampling point per cargo space (which will require the ventilation to be stopped for an appropriate amount of time).

Unless specifically required because the methane (CH4) concentrations are not at an acceptably low enough level, coal cargoes should not be ventilated further following the above 24-hour period. Unnecessary ventilation may trigger or worsen a self-heating reaction by providing oxygen.

If the CH4 level is below 20% of the Lower Explosion Limit (LEL), ventilation should be closed and monitoring continued. Further ventilation should only be considered if the CH4 concentration levels have not reached an acceptably low level, for the minimum period of time required to remove the accumulated methane.

When significant concentrations of CH4 are subsequently observed in unventilated cargo spaces, the detailed Special Precautions for coals emitting methane in the IMSBC Code shall apply. In particular, if the CH4 level reaches 20% of the LEL or more after continuous ventilation for a period of 24 hours, ventilation should be continued. No air at all should be directed into the body of the coal as the introduction of air could promote self-heating. The master should ensure that, as far as practicable, any gases which may be emitted from the coal cargo do not accumulate in adjacent enclosed spaces.

Carbon monoxide (CO) levels above 50 ppm (or increasing steadily over three consecutive days), should be considered as an indication the cargo may be self-heating and the ventilation should be stopped and ventilation openings sealed. Prior to entering any spaces adjacent to cargo holds, the atmosphere must be checked. The detailed Special Precautions for self-heating coals in the IMSBC Code must be adhered to. This includes a list of information that should be provided to the shipper and the appropriate shipowners' shoreside office when a self-heating may be occurring.

In both of these cases, the shipowners and the Club should be advised and expert advice sought urgently. Section 5 of the Special Precautions for self-heating coals in the IMSBC Code outlines the minimum information that should be provided.

BILGE WATER MEASUREMENTS

HOLD BILGE PH TESTING SHOULD BE SYSTEMATICALLY CARRIED OUT DURING THE VOYAGE.

If pH monitoring indicates a presence of a corrosion risk, the bilges should be frequently pumped out during carriage in order to avoid possible accumulation of acids on tank tops and in the bilge system.

SUMMARY

The majority of ships carry coal cargoes without an incident, despite the potential hazards. The IMSBC Code provides detailed requirements and recommendations for the carriage of coal, addressing the risk of fire or explosion. The master, officers and all the personnel involved should be fully familiar with and adhere to these requirements. Where there is any risk of an incident, then the master should contact the Owners and the Club. Expert advice can be obtained, if necessary, to further minimize the risk of an incident or loss.

FOR FURTHER INFORMATION

For further information, please do not hesitate to email lossprevention@tindallriley.com.