

Carriage of Coal

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Introduction



Over a billion tonnes of coal are traded internationally each year, the vast majority of which is shipped by sea without incident. The hazards associated with the carriage of coal are well-known and it has a comprehensive entry in the IMSBC Code. Coal should always be carried in strict accordance with the requirements of the IMSBC Code.

Despite many carriers being experienced in the trade, and comprehensive advice being available from numerous sources, serious incidents involving coal cargoes still occur. Typically these problems stem from sub-standard handling procedures by shippers before loading. But all coals have a propensity to self-heat or produce methane to some extent and caution should always be exercised.

The purpose of this briefing is not to repeat the comprehensive advice given in the IMSBC Code and elsewhere, but rather to provide some general practical information for seafarers and shipowners. This guidance focuses on the hazards associated with coal and stresses the need for preparedness and vigilance by vessel operators and crews.

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Exporters

Quality shippers in well-established markets are likely to have comprehensive and satisfactory handling procedures for coal before it is shipped and as such, problems during the voyage should be fewer. However, where the market has grown rapidly, such as in Indonesia over the last decade, shippers with less knowledge and experience of handling coal may enter the market. This can lead to problems during the voyage due to sub-standard handling of the coal before loading and there may be a higher risk of coal cargo problems, which requires higher levels of vigilance.

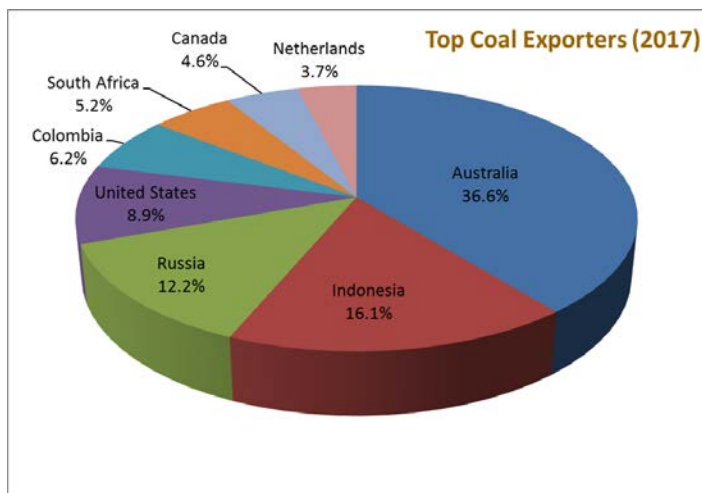


Figure 1: World's Top Exports November 2017

<http://www.worldstopexports.com/coal-exports-country/3265>

Six top coal exporters increased their international sales from 2013 to 2017: Mongolia (up 99.3%), Philippines (up 51.8%), Russia (up 14.5%), Colombia (up 9%), Australia (up 6.1%) and China (up 4.1%).

Decliners were led by North Korea (down 71.7%), Czech Republic (down 43.8%) and Poland (down 34.1%).

The Main Hazards

There are five main hazards associated with coal:

- Flammable atmospheres
- Liquefaction
- Asphyxiation
- Self-heating
- Corrosion

Of these hazards, self-heating and the creation of a flammable atmosphere create the most problems during the voyage.

The coal schedule in the IMSBC code states that coal is a Group A and B cargo - unless classified as Group B only upon the successful outcome from a modified Proctor/Fagerberg test procedure specifically for coal or if its particle size distribution meets the following:

1. not more than 10% by weight of particles less than 1 mm ($D_{10} > 1\text{mm}$); and
2. not more than 50% by weight of particles less than 10 mm ($D_{50} > 10\text{mm}$)

A blend of two or more coals shall be classified as Group A and B unless all original coals in the blend are Group B only.

The IMSBC Code contains advice that deals with each of these hazards in turn and coal should always be carried in strict accordance with the IMSBC Code.

*Tip: use the mnemonic **FLASC** to help you recall the hazards associated with coal.*

Flammable Atmospheres

Coal can emit methane gas which in mixture with air can lead to fire/explosion where a source of ignition is present. Shippers are required to declare whether or not the coal they are exporting is liable to emit methane. However, owners and masters should be aware that some shippers do not declare their cargoes as liable to emit methane even where there have been previous incidents involving the emission of methane.

The Code requires monitoring for methane in all circumstances and anticipates a situation where methane concentrations remain high. Guidance is provided in the IMSBC Code in relation to the monitoring and ventilation procedures to be followed and on the avoidance of creating sparks where methane is being produced.

It is vitally important that vessels have on board gas detectors suitable for use in oxygen-depleted atmospheres.

There have been cases where catalytic-type gas detectors have been used to test the atmosphere in an oxygen-depleted hold. This type of instrument relies on the presence of oxygen to test for methane and if used in an oxygen-depleted atmosphere it will not give accurate readings.

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The gas detector should be maintained and operated in accordance with the manufacturer's instructions which will include regular calibration.



Figure 2: Sampling point in hatch coaming

Liquefaction

A cargo which contains a certain proportion of small particles (particles less than 7mm) and a certain amount of moisture may liquefy, that is, reach a flow state under the influence of external forces such as vibration, impaction or ship's motions.

Prior to loading, the master should sight the cargo and ensure that the cargo presented matches the description on the shipper's declaration. There have been occasions when coal cargoes have been incorrectly declared as Group B when in fact the cargo is Group A and B.

A simple method of testing the cargo for the presence of fine particles is to use a sieve constructed of 7mm x 7mm wire mesh to separate a sample of the cargo.



Figure 3: Separating fine particles and lumps of coal



Figure 4: Coal sample after separation approximately 60% fine particles and 40% lumps.

Once the sample has been separated the approximate proportion of fine particles and lumps can be estimated as shown in Figure 4.

The master can then perform a 'can test' of the fine particles to check for the possibility of liquefaction.

The Can Test

Section 8 of the IMSBC code gives details of the can test procedure which should be carried out by the crew. Can tests should be performed with samples from different areas of the cargo stockpile, particularly any groups of fine particles and during the loading sequence. This is critical as even a layer of cargo containing a high proportion of fine particles has the ability to partially liquefy and destabilise the entire cargo in that hold.

The results of can tests should be supported with photographic evidence showing the outcome of the test. If the can test results raise concerns, the master should request the attendance of a cargo surveyor.

The master should not delegate testing for liquefaction to any attending surveyor. They should perform the test themselves with the assistance of a surveyor if necessary. There have been cases where all the tests were performed solely by the surveyor.

North's can test training package can be downloaded [here](#).

Visual Inspection

The master must be satisfied that the cargo is safe to load and this can only be done by physically inspecting the cargo.

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Inspection is important as a coal cargo may appear to be dry as seen in Figures 5 and 6.



Figure 5: Dry crust of coal cargo



Figure 6: Damp coal underneath a dry crust

An initial inspection might suggest this cargo is dry. But a closer inspection could prove that only the surface of the coal is dry. There are clear signs of moisture underneath this crust. It is very possible that the moisture content of this cargo is above its TML.

The crew must continue to monitor the cargo during loading operations. Watch out for muddy splattering in the cargo holds as this could be another indication that the cargo has a combination of fine particles and high moisture content.

Asphyxiation

It is extremely dangerous to enter cargo holds or adjacent spaces when carrying coal. The atmosphere may be dangerous. Coal can produce methane, carbon dioxide

and carbon monoxide; all of which may lead to a depletion of oxygen in the hold and result in asphyxiation.

Persons should not enter holds or adjacent spaces unless absolutely necessary and not until they have been properly ventilated and the atmosphere tested.

The IMSBC Code contains details on hold entry precautions to be followed. North's guidance on safe enclosed space entry can be read here:

<http://www.nepia.com/media/868999/Enclosed-Spaces-April-2016-LP-Briefing.PDF>

Self-heating

There may be many different types and grades of coal cargo, some of which may be more liable to self-heating than others.

Shippers must declare whether or not the coal they are exporting is liable to self-heat. Ship owners and masters should be aware that some shippers do not declare their cargoes as liable to self-heating or to produce methane even where there have been previous incidents involving these problems from the same source.



Figure 7: Steam rising from heating coal

An indicator of self-heating is the level of carbon monoxide produced in the hold. The IMSBC Code contains advice on the monitoring of the carbon monoxide levels and the action to be taken by the master if self-heating is suspected.

Another consideration is that coal emits methane, an odourless, flammable gas, presenting a fire and explosion risk.

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Monitoring coal cargoes for self-heating and emissions of methane is vital. Careful monitoring allows for early action by the vessel and can avoid serious problems.

The IMSBC Code contains advice on the monitoring that should be done and the necessary equipment.

Firefighting, life-saving and smoke detection equipment must be well maintained and tested at all times.



Figure 8: Coal on fire in a ship's hold



Figure 9: Smart AR882A IR Device for measuring temperature of the coal surface before loading or in the hold

Corrosion

Coal can react with water to produce corrosive acids. As well as the risk of corroding the vessel's steelwork, this process has the potential to produce hydrogen gas. Any accumulation of water in the holds needs to be monitored and any build up pumped away using the bilge system.

The IMSBC Code contains advice on bilge water testing for corrosion.

Precautions Prior to Loading

Ensure that the vessel receives the shipper's declaration with the information described in the IMSBC Code coal schedule.

The declaration must include a section on whether or not a cargo is liable to emit methane or self-heat. Unless the coal cargo has been classed as Group B only, it must be accompanied by certificates showing:

- Transportable Moisture Limit (TML); and
- Moisture Content (MC).

The interval between sampling/testing for moisture content and the commencement of loading should never be more than seven days. If the cargo has been exposed to significant precipitation between the time of testing and the commencement of loading the shipper must retest the cargo. The coal schedule in the IMSBC Code contains specific advice on weather precautions when loading Group A coal.

The schedule also contains details of the monitoring equipment that must be on-board and it is important that this equipment is fully operational and fitted in line with the requirements of the code.

Cargoes with a temperature above 55°C should never be accepted for loading. This is a key safety precaution. The Master can easily check the surface temperature of the cargo using an infrared thermometer as seen in Figure 9.

Masters should exercise extreme caution when presented with hot cargo even where the cargo has not been declared as liable to self-heating. This can be the case with Indonesian coal cargoes which, in general, are liable to self-heat but which are regularly declared as not liable to self-heating.

Burgoyne's, a firm of cargo experts with many years of experience dealing with problematic coal cargoes, have produced a useful briefing note on Indonesian coal cargoes which may be [read here](#).

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Coal Cargo Bilge Water

Accurate bilge pumping records should be maintained to avoid shortage claims at the discharge port.

This is because when moisture from coal collects in the bilges and is pumped overboard, the weight of the coal will effectively be reduced even though the actual quantity remains the same.

The bilges can only be pumped overboard if the cargo is not classed as Hazardous to the Marine Environment (HME) and in accordance with MARPOL Annex V.

The shipper's declaration should state whether or not the cargo is HME.

Summary

Coal has well-known hazards and the conditions for safe carriage are described at length in the IMSBC Code. As long as the provisions of the IMSBC Code are followed and the cargo is monitored closely throughout the voyage there is no reason why, even where problems start to develop, the vast majority of situations cannot be managed onboard.

Three Key Points – Think SMS!

- **S**top unsuitable cargo coming aboard. Cargo above 55°C should not be shipped.
- **M**onitor the cargo loaded for signs of self-heating or methane production throughout the voyage.
- **S**eek expert advice if carbon monoxide or methane levels are giving cause for concern.

Early intervention can prevent potentially dangerous situations from developing into serious incidents.

We are grateful for the assistance of Peter Cook of Burgoyne's in preparing this briefing.

For more information contact the loss prevention department at loss.prevention@nepia.com