

Coal Cargoes – Know the Dangers

Introduction

Coal is a potentially hazardous cargo and serious incidents continue to arise. In some instances it would appear that those on board were not entirely familiar with the risks, and on other occasions the coal was not carried in accordance with regulatory requirements or best practice.

One example involved a crew member who was using a rotary wire brush on deck to remove patches of rust from the hatch coaming of a closed hold containing coal, possibly creating a source of ignition. While operating the equipment an explosion took place inside an adjacent hold, blowing the hatch covers upwards and propelling the crew member over the ship's rail into the sea. He suffered serious injuries as a result.

In another case a vessel with a cargo of Indonesian coal on board saw smoke rising from one of the holds while anchored outside the discharge port. The vessel had been asked to ventilate the holds just prior to berthing. However, in the absence of firm orders the vessel's crew decided to ventilate the holds anyway in case they were instructed to berth at short notice. The vessel did not berth until several days later during which time the cargo in several holds began to self-heat.

On another occasion a deck rating on board a vessel carrying coal was asked to take samples from inside a cargo hold and collapsed at the base of a vertical ladder leading from the main deck. Another deck rating entered the hold to assist him but collapsed in the same location, as did two more crew members in succession. Although all four crew members were eventually rescued, one lost his life and the others required hospital treatment for respiratory injuries.



Photo Courtesy of Critus Marine Surveyor

IMSBC Code

The International Maritime Solid Bulk Cargoes (IMSBC) Code contains a detailed schedule regarding the carriage of coal, describing the particular hazards associated with this cargo and specifying the precautionary measures to be taken. The IMSBC Code classifies coal as Group B (ie cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship). Additionally, the IMSBC Code classifies coal as Group A (ie cargoes which may liquefy if shipped at a moisture content in excess of their transportable moisture limit) if 75% or more of the material consists of fine particles under 5mm in size.

The requirements of the IMSBC Code schedule for coal should be read, understood and closely followed.



Cargo Declaration

The shipper's cargo declaration should be scrutinised carefully to determine which hazards are associated with the coal to be loaded. However, in some parts of the world it should be borne in mind that the cargo declaration may not necessarily be accurate. For example, declarations regarding coal cargoes from Kalimantan province, Indonesia, often state incorrectly that there is no self-heating risk. All coal cargoes from Kalimantan should be treated as being liable to self-heat. In the event of doubt, Members may forward a copy of the cargo declaration to the Managers for comment.

Potential Hazards

Methane (CH₄)

Some coal cargoes produce methane, a non-toxic gas which is flammable at concentrations of between 5% and 16% in air. Ventilation should be carried out to ensure that the methane content of the atmosphere inside the cargo holds is always less than 20% of the Lower Explosive Limit (LEL) for methane. If coal with a methane hazard is to be loaded, all sources of ignition (eg smoking, hot work, naked flames, activities that may produce sparks) should be prohibited on deck, within the cargo spaces and inside enclosed spaces adjacent to the cargo holds. Since methane is lighter than air, it should also be remembered that methane gas may build up inside deck houses and other compartments if they contain access hatches or other cargo hold openings which are not gas tight.

Self-Heating, Oxygen Depletion and Carbon Monoxide (CO)

Some coal cargoes may self-heat due to oxidation. This process produces carbon monoxide, an extremely toxic, odourless and colourless gas which also depletes the amount of oxygen in the atmosphere. Since introducing fresh air into the cargo spaces will increase the risk of combustion, self-heating coal should be ventilated only if it becomes necessary to dissipate the accumulation of methane gas. Any ventilation carried out in such circumstances should therefore be kept to a minimum.

If self-heating coal reaches a temperature of 55°C or over it may spontaneously combust. Temperature probes (thermocouples) may be placed within the body of the cargo to aid the early detection of self-heating but their limitations need to be understood. Self-heating is often localised and a temperature probe may not detect cargo nearby which has begun to self-heat as coal is thermally insulating. The Club



occasionally encounters situations where crew members are over-reliant on temperature probes and assume that all is well if the readings are less than 55°C which may not necessarily be the case. Monitoring the level of carbon monoxide as required by the IMSBC Code is a far more accurate means of detecting self-heating at an early stage.

Coal should only be accepted for shipment if the temperature of the cargo is less than 55°C. Additional information can be found in the Club's Loss Prevention Bulletin on the [Monitoring of Self-Heating Coal Cargoes Prior to Loading](#). Once a cargo hold has been loaded and the hatch covers have been closed, the amount of carbon monoxide inside the compartment should be monitored closely to determine whether or not self-heating is taking place. If the level of carbon monoxide in any cargo space reaches 50 ppm or exhibits a steady rise over three consecutive days, a self-heating condition may be developing. Should such a situation arise the IMSBC Code lists the action to be taken thereafter.

Breathing air with an oxygen content of less than 12% can lead to unconsciousness. Less than 6% may result in death. The speed with which personnel may be overcome by oxygen depletion can be rapid, to the extent that they may collapse before they realise what is happening. Although exposure to carbon monoxide gas can be fatal even at low concentrations, it is often the lack of oxygen that is the main cause of such incidents.

As with methane, carbon monoxide is lighter than air and may accumulate inside enclosed spaces such as deck houses with cargo hold access arrangements inside which are not gas tight. No one should be permitted to enter the cargo holds or adjacent compartments until the atmosphere has been tested and found to be safe. Enclosed space entry procedures should always be followed.

Given the importance of monitoring gas levels in cargo holds and adjacent enclosed spaces, it is essential that the vessel's gas detectors are in full working order, calibrated correctly and not overdue for servicing. Any crew member responsible for operating such equipment should be fully trained and familiar with its use.

In the event of potential hazards such as the presence of toxic or flammable gas or reduced oxygen levels, the entrances to cargo holds and adjacent enclosed spaces should be locked shut and warning notices prohibiting access should be posted.

Liquefaction

If the shipper's cargo declaration states that the coal is Group A in addition to Group B, the accompanying certification and test reports providing the moisture content and transportable moisture limit (TML) of the cargo should be checked carefully to verify that the moisture content is less than the TML. The IMSBC Code requires the shippers to arrange for the moisture content to be determined not more than seven days prior to loading, repeating the test if significant precipitation is experienced between the time of testing and loading. The shippers are also required to ascertain the TML not more than six months prior to loading, or earlier if the composition or characteristics of the cargo change in the interim.

The vessel should also carry out regular "can" tests throughout loading in accordance with the guidance set out in Section 8.4 of the IMSBC Code. As an additional precaution it may also be prudent to carry out "can" tests even if the coal has not been declared as Group A, particularly if it appears to be wet or damp or if the proportion of fine particles seems to be high. If a "can" test results in the appearance of free moisture or fluid conditions, the Managers should be contacted immediately as further laboratory tests and expert advice may be required.

Sulphur

Coal from certain locations may have a high sulphur content. If the coal or the cargo holds are wet, the sulphur and water may react to produce sulphurous acid which is corrosive and may damage hold steelwork, particularly if the coatings are not in good condition. The reaction also produces toxic gas and hydrogen. The IMSBC Code requires the shippers to declare



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the sulphur content of the cargo, therefore they should be asked to provide such information if they fail to do so. In order to monitor the possible corrosive effects of carrying high sulphur coal, the vessel should be provided with a means of measuring the pH value of cargo hold bilge water from outside the cargo spaces.

Conclusions

If coal is to be loaded, the shipper's cargo declaration should be examined in detail to identify the properties of the cargo and the associated hazards. It should also be remembered that some cargo declarations may not be entirely accurate.

All crew members should be informed about the possible risks before loading, perhaps during a shipboard safety meeting prior to arrival. The hazards and precautions may also be discussed when carrying out risk assessments or holding toolbox talks.

Members requiring further guidance are advised to contact the [Loss Prevention department](#).