



## Prevention of accident damage to cargo loaded on Bulk Carriers

### Case 2) Heat Damage caused by heat transfer from the Fuel Oil Tanks

In Case 1 we explained about seawater damage, and now we discuss heat damage caused by heat transfer from bunker tanks. This occurs quite frequently. These days, vessels use high viscosity low quality heavy fuel oil which is unpumpable at low temperatures. So heating of the oil in these tanks is necessary to enable it to be pumped from the double bottom or deep tanks to the settling tank in the engine room.

Due to the increasing use of high viscosity low quality oil, cargo damage caused by the heating of fuel oil beneath the cargo holds happens more frequently.

#### 1 Grain in Bulk is easily affected by heat

Most easily damaged by heat transfer from fuel oil tanks are Soybeans and Maize but Wheat, Rapeseed, and other bulk grains are also occasionally heat damaged as is Soybean Meal.

Soybeans are especially sensitive to heat, and if the temperature of the beans reaches about 40°C the beans will become withered and lose their ability to sprout, and oxidisation is increased.

#### 2. Fuel oil tanks

Generally, fuel oil tanks causing heat damage are as follows :-

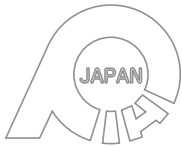
- Fuel Oil Tanks in double bottoms
- Deep Tanks located forward of No.1 hold
- Fuel Oil Settling and Service Tanks located at the fore end of engine rooms

Cargo loaded in the aftermost hold is occasionally damaged by heat transfer from the engine room.

#### 3 Type and pattern of damage to cargo caused by heat transfer from each tank

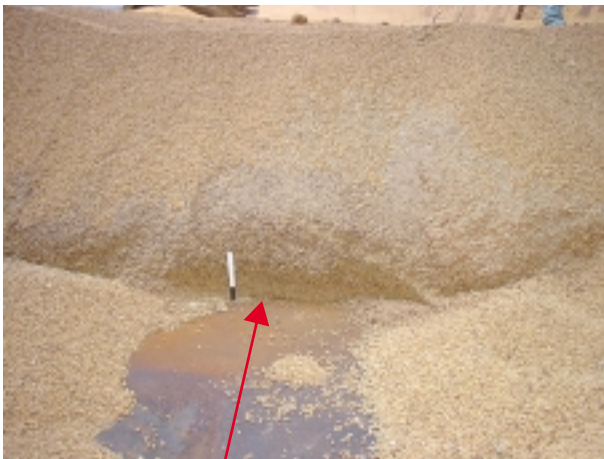
##### • Double Bottom Fuel Oil Tanks

The number of tanks varies depending on the type of vessel, but generally, vessels of Panamax type have seven holds, and the fuel oil tanks are located only underneath Nos. 5, 6 and 7 holds.



**3** Sequel.....

When the fuel oil in those tanks is over heated, the plating above the tanks may become warm, and as a result, the cargo may become discoloured, caked and mouldy, and sometimes the cargo may be carbonised. Although the type and the extent of the damage will vary in proportion to the moisture content of the cargo and the degree of heating of the fuel oil, typically the cargo may be damaged up to a height of some 2 to 3 meters above the tanktop, and the temperature of the beans may rise to some 80°C. Moreover, in rare cases, the whole cargo in a hold may have to be treated as damaged. From experience, the degree of damage to cargo in No.7 hold is often worse than in No. 5 and 6 holds, and this is usually due to the fuel oil heating lines for the oil in the tanks under the No. 5 and 6 holds or in the deep tank located at forward of No.1 hold, passing through the tank under No.7 hold, and so, the duration of heating of the tank under No. 7 hold is longer than for the other tanks. (Damaged conditions and pattern are shown in the photos below)



Showing heavily caked and discoloured cargo of 1m thick



Showing beans heated to 87.0°C



Heavily discolored and caked cargo



Showing gathering of the damaged cargo

**3** Sequel.....

• **Deep Tank located in front of No.1 Hold**

Not all vessels are equipped with a Deep Tank, but some have a Deep Tank between the Chain Locker and No.1 hold. When the fuel oil in this tank is overheated, the cargo in the fore part of No.1 hold adjacent to the aft bulkhead of the deep tank may be damaged similarly to the cargo on the double bottom tanks, described previously. The damage may extend some 1 to 2 meters from the forward bulkhead of No.1 hold, and may reach the level of the tanktop. (same depth as the deep tank)

(Damaged conditions and pattern are shown in the photos below)



Damaged cargo along the fore bulkhead in No.1 hold cargo



Showing heavily caked and discoloured

• **Fuel Oil Settling and Service Tanks located at the fore end of the engine room**

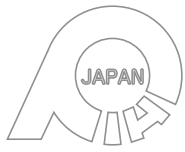
A few vessels have the Fuel Oil Settling and Service Tanks along the sides in the middle of the engine room or at the aft end, but in most vessels, they are located some 30cm away from the forward bulkhead near the vessel's centerline. These tanks are joined to the forward bulkhead by the bottom plates of the tanks and by brackets, etc., at the top of the tanks. Therefore, if the fuel oil in these tanks is heated too much (Generally, it is heated to 80°C for the settling tank, and 90°C for the Service tank), the cargo along the aft bulkhead in the hold adjacent to these tanks may sustain heat damage in the same manner as the cargo along the forward bulkhead of No. 1 hold.



Showing heavily caked and discoloured cargo along bulkhead plates between the engine room and the aftermost hold



Mouldy cargo in the top surface along the aft bulkhead of the aftermost hold

**4 Damage prevention plan**

Of course, in order to prevent heat damage to the cargo by heat transfer from the tanks, the fuel oil in the tanks should not be over heated or heated longer than necessary.

In addition, the following precautions should be taken.

**a** Most of the serious heat damage occurs because the Engine Department often do not fully understand the character of the cargo, and so the fuel oil in each tank is heated too much. So, when a cargo of Bulk Grain is loaded, it is important to have good communications between the Engine and Deck Departments.

**b** Usually, the heating lines in the double bottom tanks are installed at a height of about 10cm from the tank bottom. From past experience, when the heating lines are exposed above the surface of the oil or are at the same level, the amount of heat transferred to the tanktop plates is greater than when the tanks are full or have a lot of oil in them.

Therefore, sufficient oil should be left in each tank when shifting consumption to the next tank. In this connection, it is also important to take into consideration the order of consumption. Experience shows that heat damage has frequently occurred to the cargo in the after hold, because of oil consumption starting from the after tank to the fore. It is recommended that the order of consumption of the oil should be from the bow to the stern.

**c** Heavy fuel oil of 180 or 380 centi-stokes (unit of kinematic viscosity) is now generally used. Although there will be a cost factor, in order to prevent damage to Grain Cargo, the use of heavy fuel oil having a viscosity of 180 centi-stokes is recommendable as this can easily be transferred without heating to high temperature.

**d** To heat the oil in the double bottoms or deep tanks, the steam valves are only cracked open (1/16 to 1/4 rotation), and the valves are operated manually. Since the vibration of the vessel may cause the valves to open further, a stopper should be applied to prevent this happening. Sometimes, it is thought that fuel oil heating steam lines are completely closed, but actually they are not due to incorrect operation or a defect in the valve so steam continues to flow through the heating lines. This is a common cause of heat damage.

The valves must be correctly operated, frequently checked and properly maintained.

**e** During the voyage, the steam generated by the exhaust gas economiser may exceed the amount required by the vessel and sometimes the surplus steam is circulated in the fuel oil tanks' heating lines to dispose of it. When this is done, the fuel oil in each tank will be continuously heated, and serious heat damage will occur.

Therefore, when surplus steam is produced, other methods of dealing with it should be used.

— End—

<With collaboration from Nippon Kaiji Kentei Kyokai( NKKK )>

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