

Oil contamination of marine boilers

Introduction

The malfunction and breakdown of marine boilers are not new issues although it is well known that only a very thin layer of oil on the surface of the boiler tubes can cause local overheating and possible damage to the boiler. Gard has recently seen a number of claims involving boiler damage caused by the presence of oil in the boiler feedwater system. In several cases, where a minor oil leakage has been discovered by the crew, the boiler has been blown down from the bottom instead of surface blowing resulting in a boiler totally covered with oil. During cleaning after repairs, the oil has not been properly removed from the boiler or from the feedwater piping system which again has led to cracks and an associated loss of integrity in high heat transfer areas.



Many of the reported incidents have led to expensive and time consuming repairs including cleaning of the feed water system and renewal of the boiler tubes. The purpose of this circular is therefore to remind shipowners and operators of the importance of proper boiler operation and maintenance, and to highlight the relevant control measures for preventing, and where necessary handling, oil leakages into the feedwater system.

Recent cases

The most common sources of oil contamination are leaking heating coils in fuel tanks and fuel heaters or lube oil heaters. In one recent case it was alleged that fuel oil had been detected in the hotwell which had come from a leak in the fuel oil purifier heater a few weeks earlier. The defective heater was replaced with a new spare and the hotwell was cleaned. The boilers were then put back in operation. A few weeks later the crew noticed a low-level-alarm in the hotwell tank and further investigation revealed water leaking inside the furnace. Opening of the boiler revealed several cracks in way of the fire tubes.

In another case an excessive amount of HFO was discovered in the hotwell. No oil detection alarm sounded since the alarm had been disconnected due to problems with the detection system in the observation tank. During the inspection it was discovered that the feedwater system was completely polluted by oil, and as the common circulating pump was running, this also included the exhaust boiler. The investigations also revealed a feedwater leak into the flame chamber, due to a crack in the wall panel in the auxiliary boiler, and some broken pin tubes due to local overheating. The cause of the feedwater contamination was found to be a broken heating coil in one of the HFO tanks. The heating coil had been renewed during the previous dry-docking, and further inspections revealed that the coil had been mounted with some pipe clamps missing and as a result, vibration had caused the breakdown of the heating coil. The shipowner decided to take the vessel off-hire for a complete cleaning of the feedwater system and retubing of the defective pipes in the auxiliary boiler.

Consequences

Issues such as disconnection of the oil detection alarm for the hotwell may lead to major damage. The breakdown may have been avoided if the alarm had been working and the situation would no doubt have been discovered at an earlier stage. The most dangerous type of water contamination is heavy fuel entering the steam or condensate from a leaking heating coil or heat exchanger. If the problem is not discovered in time, the boiler can be completely destroyed by overheating due to reduced water flow and minimised heat transfer/cooling of the boiler tubes. The immediate effects range from foaming and carry over in oil fired boilers to the malfunction of boiler water level controls and even protective shutdown devices. More severe oil contamination may lead to a collapse of the heat transfer rate through the boiler steel, which contributes to a higher metal temperature than the design value¹.

¹ According to DNV, even a thin film of oil or a deposit as thin as 0.5 mm on the water side can easily increase the metal temperature on the furnace side from a design value of 250° C to well above 600° C under normal operating conditions on an auxiliary boiler rated at 7 bar (DNV Technical eNewsletter, 2 October 2012, «Oil Contamination of Marine Boilers»).

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Preventive action

The following practices and preventive measures should be considered in order to avoid extensive damage due to oil contamination:

1. Alarms, monitoring systems and automatic safety shutdown functions should be tested regularly to ensure that they function properly. Safety alarms and automatic shutdown functions must never be bypassed.
2. If the boiler plant is, nevertheless, operated with bypassed faulty safety shutdown functions, a continuous visual watch should be kept on the water level and any potential oil contamination in the hotwell tanks.
3. Filters installed in the hotwell tank must be replaced regularly or as required. As small amounts of oil cling to the filter material, it is important that the filtering material is carefully monitored and replaced as necessary.
4. Ensure that the oil detecting device in the hotwell tank (if fitted) is working properly.

Corrective actions

If there is a suspected oil leakage into the feedwater system, carefully examine and hydro test all relevant heating coils, heat exchangers and other potential leak sources in the steam/condensate system in order to identify the origin of the leakage. Be aware that there could be more than one leakage. The following practices and corrective actions should be considered when oil is discovered;

1. If oil is observed in the hotwell it is recommended to check whether a dark oily film contaminates the boiler water level glasses inside. If so, do not blow down the boiler from the bottom; just surface blow several times. If the boiler is bottom blown, it will become totally covered in oil.
2. After repairs, the piping system, heating coils, pumps, hotwell and heaters have to be cleaned of all the remaining oil. Manufacturers' recommendations and procedures for cleaning should be followed.
3. The boiler must not be started up again until an oil-free feedwater supply is guaranteed.

Recommendations

To prevent boiler damage caused by the presence of oil in the boiler feedwater system, Members and clients should follow manufacturers' recommendations and highlight the above preventive and corrective actions in their procedures. Furthermore, it is recommended to:

- Encourage the crew to report any accidental damage so that it can be inspected and/or repaired as necessary and as soon as possible.
- If repairs on the steam and heating system have been carried out during yard stay, proper inspections should be conducted to ensure that heating coils are properly mounted according to class requirements.

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