Engineering Circular No. 55

ENG/OPP/MARPOL-38(5)/04	Date : 26.07.2005
Subject: - Complex Fuel Contamination Case Study	

Sir,

Enclosed please find a copy of the Bunker Bulletin issued by DNV Petroleum Services, Rotterdam in connection with complex fuel contamination case study for information and circulation.

This issues with the approval of Chief Surveyor with the Government of India.

Sd/-

(D.Mehrotra)

Dy. Chief Surveyor cum Sr.DDG(Tech)

COMPLEX FUEL CONTAMINATION CASE STUDY

Dt : 12-May-2005

This DNVPS Bunker Bulletin is based on a recent case of complex bunker fuel contamination, which had severe safety consequences for both ship and crew. The vessel in question (name withheld for reasons of confidentiality) bunkered 80' of marine diesel fuel (MDO) on March 10, 2005 at a port in India. The fuel oil was delivered by the supplier using trucks. Although an unusual odor was observed by ship staff during bunkering, no alarm was raised. That by itself is noteworthy.

Two hours after the ship's auxiliary engines [B&W] started consuming the said MDO, RPM indicated a continuous decline and was subsequently unable to carry the electric load. Similar declining trend was observed on the other two auxiliary engines onboard, which led to a complete power was restored on emergency basis only after fresh fuel was supplied by a tug offshore. The fresh fuel had to be picked up by the ship crew manually in drums since the ship was drifting without any power. Emergency repairs and parts replacement were carried out on the failed fuel pumps.

Those who handled the fuel pump parts during the repairs subsequently developed skin irritation. Unfortunately, no fuel oil sample was collected during bunkering. But after the power black out and emergency repairs, samples from the bunker tank and settling tank were collected and forwarded to DNVPS for advanced testing and fuel pump failure investigations. Upon receipt, the samples were classified as 'unusual odor' samples and standard handling precautions were taken.

The samples were processed through standard tests plus the advanced analytical techniques of Gas Chromatography-Mass Spectrometry (GC-MS) to identify the contaminants. The damaged plunger and barrel along with a new set were forwarded to the DNV material lab for metallurgical investigations.

Detailed analysis using GC-MS showed that the distillate fraction of the samples was contaminated with Dimethyl Sulfide, 3-Chloropropanenitrile and 2-propanol (traces). Dimethyl Sulfide is used as a solvent for wide range of organic and inorganic materials. It is known to be used as a pre-sulfiding agent for catalysts in the refinery and petrochemical manufacturing processes. Dimethyl Sulfide is also a chemical intermediate for a wide range of organic synthesis.

The 3-Chloropropanenitrile is used in pharmaceutical and polymer synthesis. Based on information published by the US Environmental Protection Agency (EPA), when 3-Chloropropanenitrile is heated to above 130'C, it releases hydrogen chloride. When heated to decomposition, it emits highly toxic fumes of chlorine containing compounds and nitrogen oxide.

Dimethyl Sulfide, 3-Chloropropanenitrile and 2-propanol (trances) is regarded as chemical contaminants in fuels as they are not naturally occurring in crude oil. If found in fuels as delivered, these contaminants are in violation of marine fuel standards ISO 8217:1996(E) Clause 4.1 Note 3, which states that: "The fuel should not include any added substance or chemical waste which jeopardizes the safety of ships or adversely affects the performance of the machinery". Therefore, this fuel did not conform to the ISO 8217:1996(E) specification.

A parallel material failure investigation revealed that excessive clearance was observed on the failed fuel pumps as indicated from the plunger and barrel diameter measurements compared to the measurement of the new fuel pump. Visual examination showed discoloration on the plungers and indication of excessive metal wastage on the barrel internal. Scanning Electron Microscopy (SEM) analysis on the plunger revealed that the plunger suffered severe surface attack by corrosive substances. Although the source of the chemical contamination is unknown, this case study reinforces the significance of proper fuel sampling and regular fuel testing as part of an operational routine to safeguard safety of life and ship, and the use of specialized services in the detection of complex contaminants in failure investigations.

Best Regards,
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Regional Manager

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