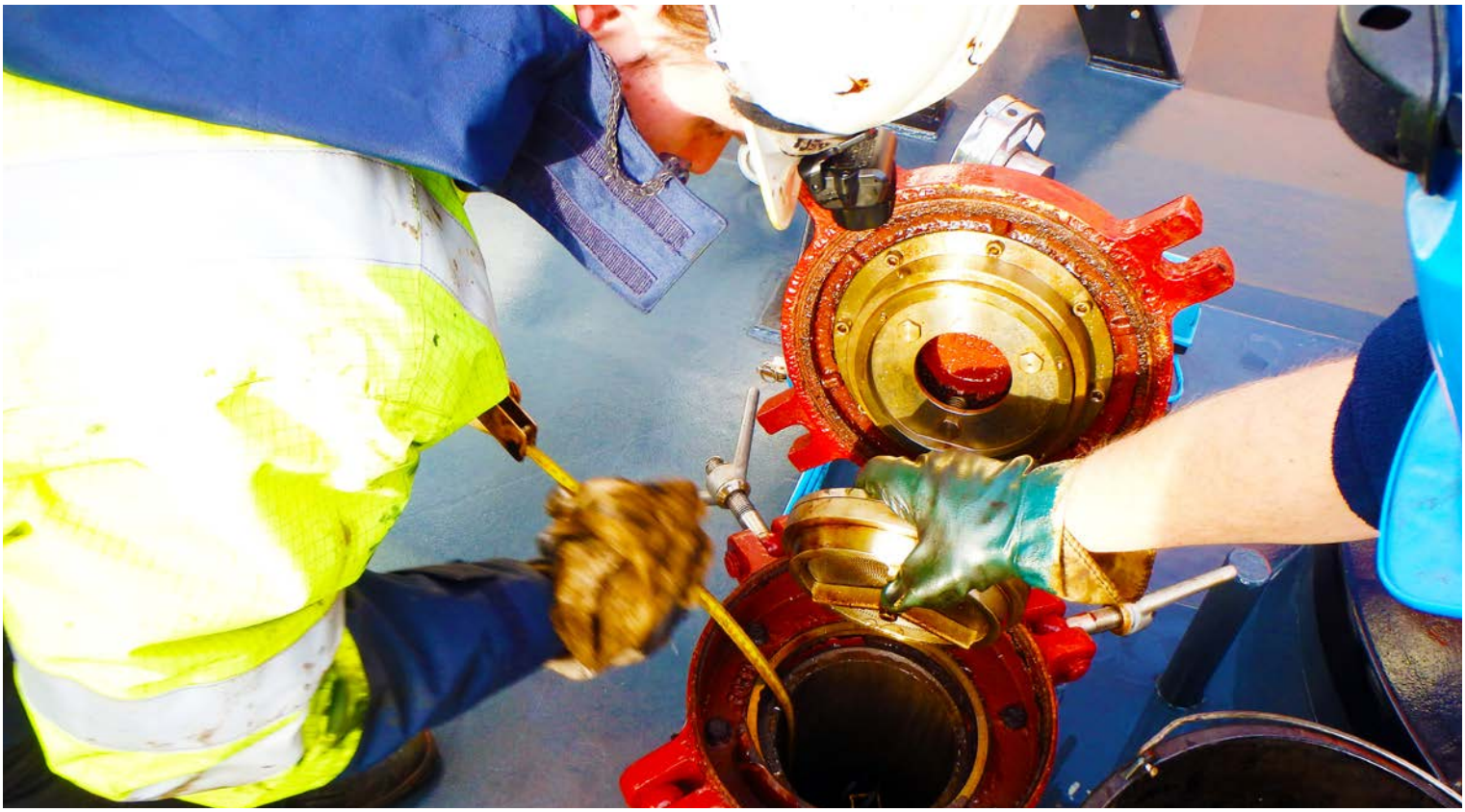

VERIFUEL CASE STUDY

CORROSIVE FUELS IN EAST RUSSIA

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Understanding Marine Fuel

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Marine Fuel Services **Case Study**

CORROSIVE FUELS IN EAST RUSSIA

VeriFuel, first in the industry, establishes a new proprietary test method to identify that the problematic fuels have unusual oxidation behaviour.

SYNOPSIS

A series of vessels have experienced corrosion in the fuel system consuming fuels bunkered from the Slavyanka area. As testing to specification, as well as applying the commonly used investigative testing procedure, has been non-conclusive, VeriFuel has taken a different approach in order to show that these fuels exhibit different behavior to normal, non-corrosive marine fuels.

The VeriFuel team was the first to identify this problem. Working together with the experts from our Antwerp laboratory, VeriFuel was also the first establish a new proprietary test method which proved very useful in showing that the problematic fuels have unusual oxidation behavior.

BACKGROUND

As of July 2015, a number of vessels have experienced heavy corrosive attack in the fuel treatment system, as well as on the engine fuel pumps. The only common parameter for these fuels is that they are bunkered in East Russia, more specifically in the Slavyanka area.

Routine ISO 8217 analysis did not reveal anything unusual for these fuels. Even the acid number (AN) was on the low side – approximately 0.20 mg KOH/g.

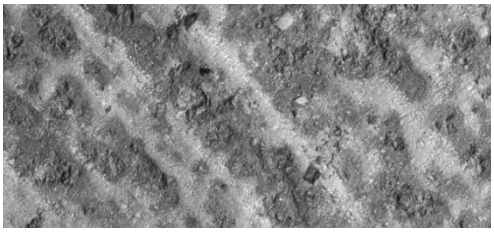


Figure 1: The cut-off shaft, the oxidation/ corrosion pattern can be seen as dark grey areas. *Courtesy of MAN Diesel & Turbo*

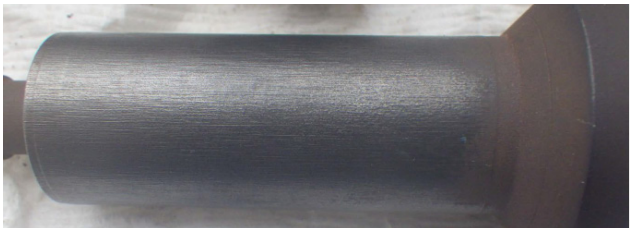
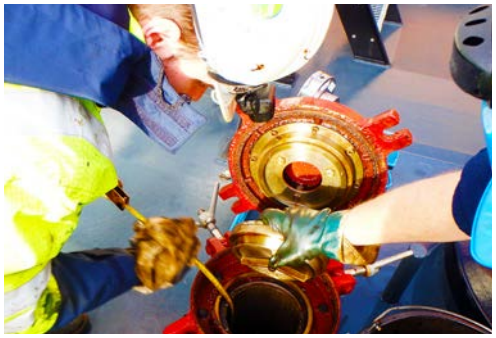


Figure 2: Cut-off shaft in fuel valve – after 3 weeks in service. *Courtesy of MAN Diesel & Turbo*

As more similar incidents were reported, it became clear that the situation is endemic as a number of vessels have experienced the same problems (corroded filter elements, corroded centrifuge bowl parts, corroded engine fuel pumps). To further complicate the situation, not all fuels being supplied in the area led to corrosion.

Figure 3: Corroded bowl parts


CASE STUDY

'Normal' investigative testing, such as GCMS, had proven unsuccessful in finding the culprit of these specific fuels. Therefore, Bureau Veritas, VeriFuel, took on the approach to simulate the conditions to which the fuel is exposed during normal operation in order to evaluate if the fuel 'changes' under these conditions.

It is known that the presence of chloride can initiate pitting corrosion for which reason the chloride and fluoride content were analyzed on one of the samples representing the problematic fuel. Test results showed the presence of low levels of chloride and fluoride (7 mg/kg and 4 mg/kg, respectively). It is uncertain whether these levels can initiate or contribute to formation of pitting corrosion.

A special in-house method was designed to evaluate the oxidative stability of residual fuels, the "Oxidation Stress Test". During the test, the fuel is heated to on-board, operational levels and exposed to air over a 48-hour period. If formed during the test, the volatile organic acids are collected in a separate container. The acid number of the fuel sample is measured at 0, 8 and 48 hour intervals – same for the acid number in the collected volatile organic acid fraction (called the VAN).

In order to get an indication of the overall impact of the "oxidation stress test", a combined factor is calculated taking into account the relative increase in acid number for both the fuel and the volatile organic acid fractions.

'Normal', unharmful fuels were tested in parallel for reference. Table 1 below shows some results as of March 2016.

Experience	AN 0 hrs mgKOH/g	AN 8 hrs mgKOH/g	AN 48 hrs mgKOH/g	VAN 8 hrs mgKOH/g	VAN 48 hrs mgKOH/g	Combined Factor AN8	Combined Factor AN48
Corrosive	0.20	0.74	3.70	0.14	0.67	4.40	18.00
Corrosive	0.33	0.40	2.55	0.06	0.77	1.40	14.10
Corrosive	0.38	0.85	3.40	0.09	0.68	2.50	10.70
Corrosive	0.38	0.88	3.43	0.14	0.74	2.70	11.00
Non-corrosive	0.45	0.67	1.12	0.49	1.49	1.40	2.70
Non-corrosive	2.06	2.49	3.99	0.16	0.39	1.80	3.40

Table 1: Some "Oxidation Stress Test" results, March 2016

CONCLUSION

Fuels can occasionally cause operational damage despite meeting the ISO 8217 specification on all parameters. When this happens, experience - combined with special test technologies - has to be applied in order to either find the 'culprit' of the fuel, or to prove that the specific fuel has an unusual behavior compared to normal fuels.

In the case of the corrosive Russian fuels, VeriFuel, is the first and only Marine Fuel Testing organization to develop a test method that can successfully prove that these specific residual fuels perform poorly under oxidation stress. As a result, organic acids form in the fuel and are likely to have caused the corrosion experienced in the fuel systems.

A very important part of fuel testing is awareness. Only awareness will make it possible to take the necessary precautions to avoid damage. The newly developed method is a useful tool to provide warning about corrosive fuels, especially for operators bunkering in an area where such fuels can be encountered. Only by knowing that the bunkered fuel can become highly corrosive, can costly and potentially dangerous situations be prevented where fuel filters are corroded, separators break down and fuel pumps are damaged.

Please do not hesitate to contact the VeriFuel team for further information about this case, or our Marine Fuel Services.

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