



**By January 1, 2020 MARPOL regulations** will have forced virtually the entire global marine industry to have made a tough choice: stick with HFO and install expensive sulfur scrubbers and become floating chemical processing plants, or switch to more costly low sulfur distillate blends.

Yet simply switching to distillate blends such as LS-MGO is not without problems. The property of a fuel to keep asphaltenes dispersed is known as aromatic or stability reserve. When aromatic based fuels with high asphaltenes are mixed with paraffinic-based fuels or cutter stocks, the fuel's stability reserve can be disturbed. Asphaltenes begin to flocculate, eventually leading to precipitation and the formation of sludge. High molecular weight paraffins or waxes may also precipitate and more fuel is lost to sludge. The presence of oxygen and saltwater contribute to a highly corrosive sludge, further destabilizing the fuel.

*Excessive sludge often forms in fuel tanks when different fuel types are mixed. When combined with saltwater, the sludge becomes a corrosive brew leading to higher fuel system maintenance and combustion problems, as well as increased rates of metal loss.*



The XBEE  
Enzyme Fuel  
Technology has  
been awarded  
the Lean & Green  
Tools Certificate.





## Clean fuel tanks save money

The M/V *Paivi* first started using XBEE in 2012 to resolve a sludge problem caused by incompatible IFO 180 bunkers. In 2016 she was brought into dock to have her fuel tank cleaned in preparation for switching from HFO to MGO. According Mr. Laufer of **Interscan Schiffahrt**, after inspection, it turned out the M/V *Paivi*'s fuel tank did not need cleaning.

Reducing sludge will save time and money, especially for those vessels requiring mechanical tank cleaning prior to switching over to distillate fuels.

*"The tank of the MV Paivi, then filled with HFO 180, was opened to check its condition. Because of the new environmental regulations in the current sailing area, the ship could no longer operate efficiently with heavy fuel oil. Therefore, it was necessary to change the fuel system from HFO to MGO. To fill the tanks with the new gas oil, they had to be cleaned. However, in the end this cleaning was not necessary, because of the natural enzymes in Xbee. They had already done the cleaning process."*

## Enzymes are fuel stabilizers and purifiers

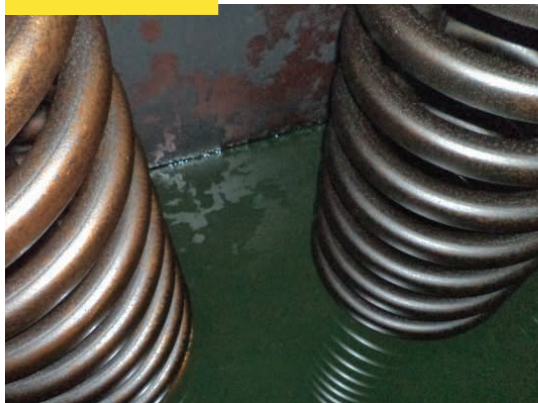
After more than two years of running the M/V *Paivi* on IFO 180 treated with XBEE, **Interscan Schiffahrt** inspected her fuel tank, and made a comparison to her sister ship, the M/V *Tim*, which had run untreated IFO. The M/V *Paivi*'s fuel tank was exceptionally clean, with virtually no visible sludge or water.

The untreated fuel tank of the M/V *Tim* had extensive sludge and emulsified water, as well as excessive corrosion.

*"The cleansing performance by Xbee has exceeded our expectations. Have a look at the attached photos."*

-- Mr. Laufer, **Interscan Schiffahrtsgesellschaft GmbH**

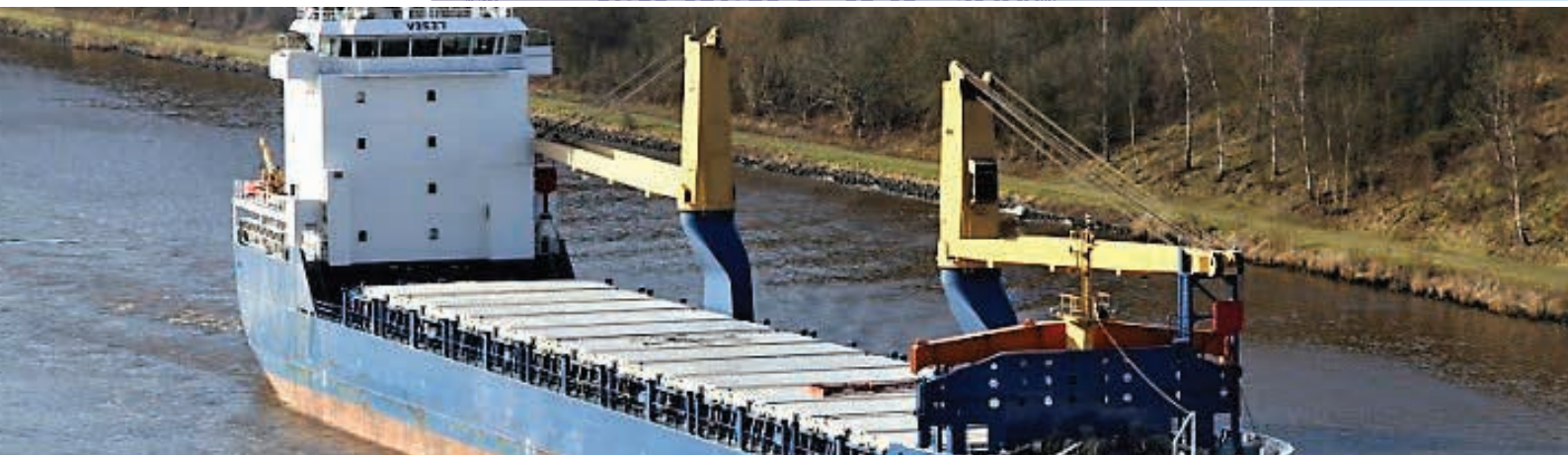
M/V Paivi · With XBEE



M/V Tim · Without XBEE







## Mixing Incompatible Heavy Fuel Oils can cause heavy sludge

The M/S Antje, owned by **Concord Shipping**, had problems with high paraffinic HFO 380 when working in Australia. Large amounts of fuel were being lost with sludge in the fuel separator.

XBEE was used to eliminate the sludge and to improve the fuel's quality, as well as improve the efficiency of the fuel separator.

Fuel instability often occurs when the aromatic solvency of the fuel is disturbed, typically by paraffinic solvents used as cutter stocks, or fuels based on paraffinic crudes. Bunkers from different fuel sources may separately pass ISO 8217 certification tests, yet when blended and subjected to age and heat on board the vessel, the bunkers become incompatible. Heavy sludge affects the fuel system, causing increased maintenance costs and operational problems.

ASTM D 4740 measures fuel compatibility and resistance of mixed fuels to form sludge under a ship's high-temperature fuel handling conditions. Demonstrated in this test by **Intertek Caleb Brett** Laboratories, a mixture of 3.5% sulfur HFO 380 bunker samples that were initially ISO 8217 compliant, but when aged and mixed, became highly unstable, XBEE enzymes improved the compatibility rating from an unusable "5" to a usable "3".

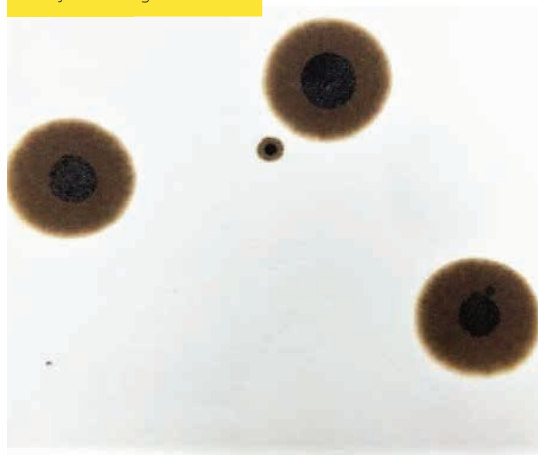
## Incompatible HFO bunkers from mixed fuel sources cause high sludge precipitation and operational problems. XBEE successfully reduced the sludge precipitation, stabilizing the mixed fuels.

### The ASTM D 4740 Standard Reference Spot Description

- 1 · Homogeneous spot (no inner ring)
- 2 · Faint or poorly defined inner ring
- 3 · Well-defined thin inner ring, only slightly darker than the background
- 4 · Well-defined inner ring, thicker than the ring in reference spot No. 3 and somewhat darker than the background
- 5 · Very dark solid or nearly solid area in the center. The central area is much darker than the background.

### ASTM D 4740 Spot Tests, Results of XBEE treatment compared to neat fuel

Neat fuel · Rating '5'



XBEE treated fuel · Rating '3'



XBEE is unique in the fuel industry. Using naturally occurring plant enzymes instead of solvents, emulsifying detergents, or organo-metallic compounds, XBEE has been laboratory-documented to improve compatibility in an unstable blend of HFO at a dose

rate of just 1:4,000. Independent laboratory studies on combustion also demonstrate that XBEE improves combustion, reducing fuel consumption and CO<sub>2</sub>.

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