"Diesel pest" – a new disease?

FUEL TREATMENT **The term "diesel pest" is used to describe an phenomenon, which is often only recognized once it is too late, when blocked filters have interrupted the flow of fuel and the engine has come to a standstill. A clean filter will enable the engine to start running again, but it has not eliminated the root cause; it is only a matter of time until the damage manifests into a more serious and more expensive problem.**

Every time a ship refuels, the ship's operators run a certain risk of contracting diesel pest, which is a microbial contamination of oil and fuel. This contamination can occur because any type of fuel (diesel, gas, fuel oil, and also petrol, kerosene, naphtha and other middle distillates) can contain the micro-organisms depicted in Figure 1 (bacteria, yeasts and fungi).

As early as 1971, the Navy Research Laboratory in Washington identified micro-organisms as a key source of contamination and subsequent service disruption. Quality testing on diesel fuel samples was standardised by the IP Code of Practice for testing the microbial content in light distilled fuels (IP 386/88). A working group set up by the Institute of Petroleum published a standard guide entitled "Guidelines for the investigation of microbial content of distillate fuels" (5.1.94). The SGS limits can be viewed as threshold values for microbial contamination. The total number of micro-organisms is limited to < $3x10^3$/l, which is a value lower than that applied to drinking water. But in practice, even contamination this low can lead to serious problems. To this day, microbial purity is not a quality criterion in petroleum delivery standards.

Microbiological tests must be established as routine procedures when filters are blocked or there are unexplained sludge deposits and signs of unusual wear. This also applies to petroleum storage facilities along the entire retail chain: from oil refinery storage tanks to tankers.

Fig. 2: Surface corrosion of a ship's tank

Consequences and possible damage

While blocked filters are an annoyance, and expensive and time-consuming to clear, they are the mildest form of damage. Microbial corrosion can cause much more severe damage, potentially even putting the ship and its crew at risk. The corrosion is not caused by the direct interaction between bacteria and metal; the real culprits are the by-products of bacterial metabolism. The corrosive attack caused by fungi follows the same general pattern: the fungi excrete organic and inorganic acids along with other metabolism by-products, and these trigger the corrosion process. Figure 2 shows the damage to the surface of a ship's tank caused by microbial contamination. In this particular case, by the time the contamination was detected, the tanks were severely corroded to the point of perforation.

A comprehensive study lists the most commonly occurring damage, in order of frequency:

- Filter and separation problems
- Engine corrosion
- Damage to bearings
- Damaged injection pumps and nozzles
- Burst engine parts
- Corroded turbine blades
- General symptoms of corrosion

Solutions

To determine which solutions are effective, and which are ineffective, we need to take a closer look at the micro-organisms and the environments in which they thrive. To reproduce and multiply, micro-organisms need two key

Fig. 1: Micro-organisms

parameters: water and a substrate. Because they are organic substances, fuels and mineral oils act as substrates for micro-organisms. Once you have this substrate, the only factor limiting microbial growth is water or the water concentration in fuel or mineral oil.

Older research put the limit for microbial growth at < 100ppm free, i.e. unbound water; however, more recent tests have shown that microbial growth only stops at a content of < 60ppm water in diesel and other types of fuel. At this level, the remaining water is dissolved (solubility 70ppm) and the aw value is lower than that necessary for microbial growth (unbound water).

A very effective solution is thus to keep unbound water to a lesser degree than 60ppm. Because distillation produces a fuel that is practically sterile, the simplest solution is to keep it that way by avoiding exposing the product to water (including condensate) and air. But because this is quite simply not feasible, NFV technology offers solutions to tackle this problem effectively.

Water forms in the storage tanks and when spot deliveries are added, as well along the entire supply chain, thus creating the environment micro-organisms need to grow. This chain continues into the bunker tanks and right through to the service and feed tanks.

To avoid recontamination, it is necessary to start with the fundamental design when building and reconditioning tank systems. Easy, fast and regular dewatering must be a key feature in these plans. MAHLE Industrial Filtration supplies fully automatic tank dewatering systems which not only remove the pure water phase at the bottom of the tank, but also separate the water in the intermediate phase (product/water). Tank systems, including storage tanks, bunker and feed tanks, must be designed to provide optimum separation conditions. Drainage pipes, which also act as sampling points for NFV maintenance systems as well as dewatering outlets of fuel pipelines, must be installed at the very lowest point (Figure 3).

Every effort must be made to maintain microbial quality standards when designing tank systems and transport systems for fuel; dewatering systems such as NFV fuel treatment systems which ensure with guaranteed residual water contents of between < 20 – 50ppm play an important part in achieving and maintaining these quality standards.

Biocides can further be used to prevent microbial growth in fuel storage tanks; these substances can also be used to clean up contaminated fuels. A suitable biocide should contain an active agent which immediately kills off all micro-organisms. The biocide is effective against a wide spectrum of bacteria (including sulphate-reducing bacteria) and is also effective against yeasts and fungi.

The alkalinity of the biocide neutralises the acids produced by microbial growth, thus providing effective and lasting protection against corrosion. No corrosive combustion products are formed; the substance is sulphur-free, contains no organic chlorine compounds so that there is no hazard of the waste water being contaminated by AOX. It contains no halogens and complies with international emission standards.

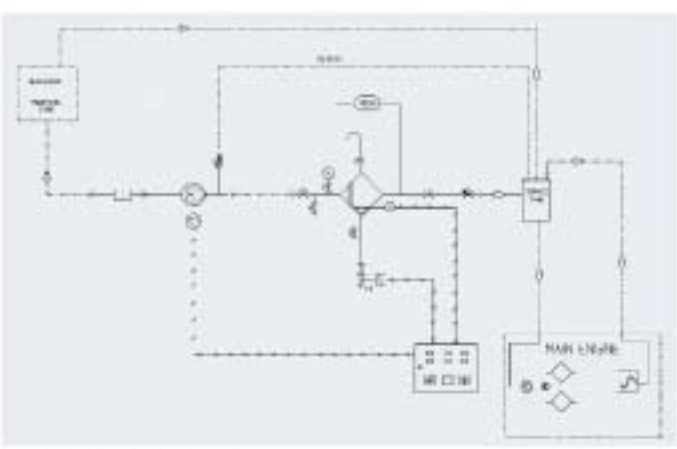

Fig. 3: Tank dewatering system

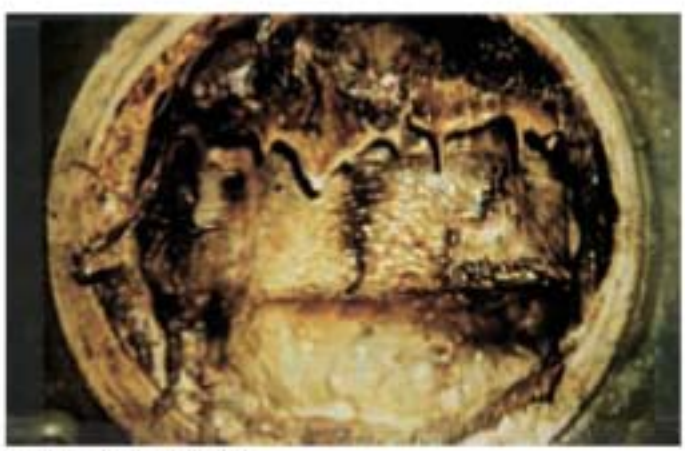

Fig. 4: Blocked fuel line