Microbial Contamination and Associated Corrosion in Fuels, During Storage, Distribution and Use.

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Many microbes (bacteria, yeasts and moulds) can feed on hydrocarbons and proliferate in water, fresh or saline, dirty or clean, associated with any fuel, but particularly diesel fuels and gas turbine fuels. The more nutrients in the water and fuel, the faster they grow. Other factors influencing growth are warmth, oxygen, pH and oxidation-reduction potential. Microbial growth is slimy or mat like and it adheres to surfaces or interfaces, from where it is able to spread throughout the fuel phase, causing fouling and malfunction of filters, injectors, fuel gauge probes and coalescer units. It can also be very corrosive due to microbial products, such as acids, and sulphide (from Sulphate Reducing Bacteria - SRB). These are direct corrosive mechanisms and are local and intense. There are also indirect corrosive mechanisms, due to microbial degradation of protective coatings and corrosion inhibitors. These mechanisms are referred to as Microbially Influenced Corrosion (MIC). For significant corrosion to occur, conditions must not only favour microbial growth but also the corrosive process. Risk assessment strategies have been developed.

Microbial growth can occur during fuel distribution, storage and use, but the type of growth and its consequences will differ in different locations. In steel fuel storage tanks, slow turnover encourages the growth of SRB. These cause corrosion pits and produce sulphide which dissolves in the fuel. In aircraft fuel tanks, high fuel turnover encourages aerobic (oxygen using) microbes and the MIC of the aluminium alloys is due to microbial acids, and to electron flow caused by oxygen gradients. Wing planks may pit or perforate.

Early detection is the key to successfully controlling microbial growth with chemicals (biocides), or with physical, anti-microbial methods. Reliable on-site tests for microbes have been developed. Since 2002, IATA has published a Guidance Handbook for airlines and maintenance bases, specifically for turbine fuel samples taken from aircraft. This guide lists approved on-site tests, limit values and remedial procedures. In-house fuel monitoring and associated limit values and remedial actions, have also been developed by fuel suppliers and by major users, such as the Royal Navy, UK. The tests and supporting services used by RN are NATO codified.
No shipboard problem can develop unless there is some microbial contamination in the bunkered fuel and it is a challenge to extend this philosophy of early detection and remediation to all bunkering facilities. Biocides must be selected according to their activity and regulatory compliance; some are NATO codified.

The microbial corrosion problems common in fuel can also be found in hydraulic and protective oils, cooling water and particularly in oily bilges.

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