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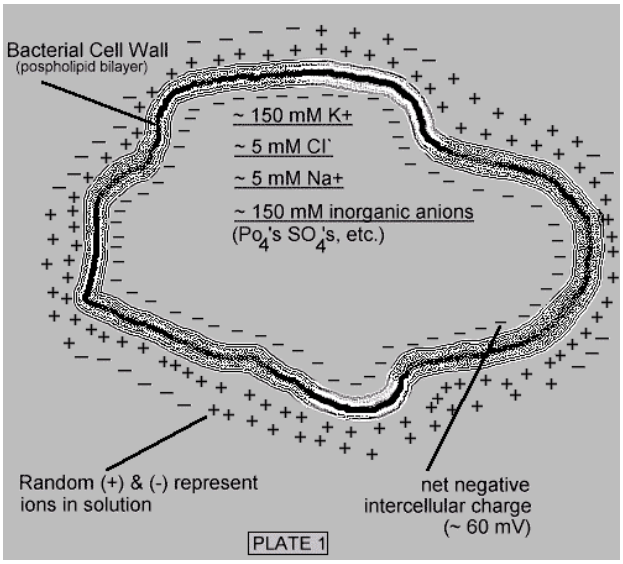
Controlling Microorganisms in Diesel Fuel ... A New Solution to an Old Problem

By Mr. F. X. McGeechan

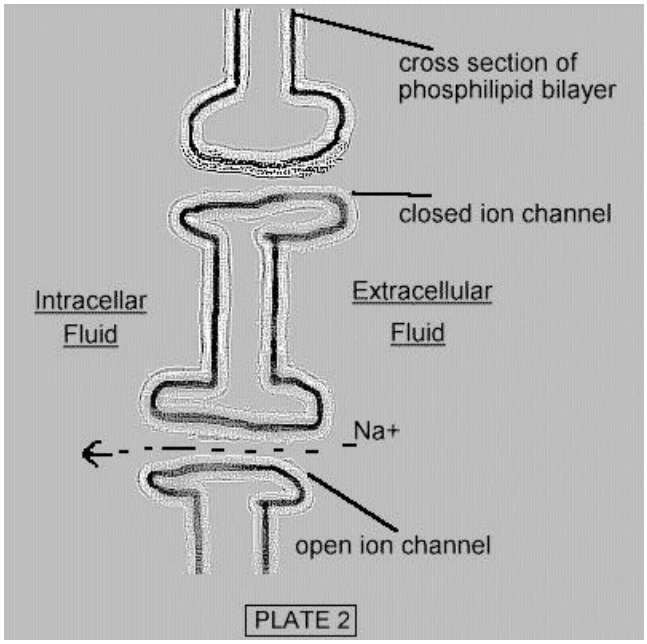
The Marine industry has long been plagued with the problem of "bugs", the microorganisms that live and grow in fuel, fuel tanks, cargo and ballast tanks and lube oil systems. This contamination problem has grown to such proportions that it is considered almost epidemic. New technology is now available for permanently eliminating microbial contamination problems in a clean, safe and environmentally friendly manner. The basis for growth of microbes is water. All fuel oil contains some water and, therefore, microbes in varying quantities. These "bugs" flourish at the oil/water interface, using the oil as their food source. Temperatures normally experienced in engine room environments (60 to 95 degrees F) provide ideal breeding conditions. Most affected are light oils, e.g., MDO (marine diesel oil), GO (gas oil), some lubricants, and generally any oil with a boiling point below 700 degrees F. Although less common, heavier fuel grades are sometimes affected but fuel heating often resolves the problem.



"Bugs" present many problems to ships' engineers. These include filter plugging, clogged fuel lines and high rates of corrosion in fuel tanks, ballast water tanks and bilges. It has become so prolific that the IMarE has appointed a special subcommittee comprised of authorities including IMO and shipping industry representatives to study the problem and recommend solutions. Some aerobic microorganisms, commonly referred to as "algae", if left unchecked will grow into colonies, forming mats or long strings of seaweed like structures. Other bugs, anaerobic ones, known as SRBs (sulfate reducing bacteria) are referred to as "metal-eating bacteria". They combine with moisture to produce sulfurous acid that is responsible for corrosion in fuel components, injectors, and tanks. Quoting from Marine Engineers Review, January 1996, "Heavily infected fuel will, within just a few hours, result in filter plugging, fuel starvation, injector fouling and purifier malfunction. Non-uniform fuel flow and variations in combustion may accelerate piston ring and liner wear rates and affect camshaft torque."

ADVANCEDTECHNOLOGY

Although relatively unknown in the US, within the last ten years, a new technology using magnetic flux fields to combat the "bugs" and their associated problems has been developed in New Zealand. The theory that magnetic flux fields inhibit microorganism growth and survival has long been noticed. There is an old story about a Scottish marine engineer who observed that the fuel oil supply line and filters to his port generator had fewer clogging problems than to his starboard generator. He determined that the difference between the two fuel supply systems was that the port fuel line passed passed through a magnetic flux field. The engineer concluded that somehow this controlled the material that caused the fuel line and filter clogging.



Some ten years ago, Lindsay Forrest, a New Zealand marine engineer, after observing a similar phenomenon, put together a team to prove this theory and then developed a practical device to control microorganisms in marine diesel fuel. After many years of scientific research and development to produce the proper "flux field environment", they introduced the De-Bug TM Model L-1000 Fuel Decontamination Unit. The success of this unit is based on a specific flow rate through a patented stack of three ceramic-coated permanent magnets (Tri-mag TM) which achieves a microorganism kill rate efficiency of nearly 100% (97.6%) in one pass.

WHY MICROORGANISMS HATE MAGNETS

Microorganisms are single-celled organisms surrounded by a phospholipid membrane. The purpose of the membrane is two-fold. First, it physically contains the cell's organelles and the other cellular machinery (proteins) needed for survival. Second, it maintains a separation between the intracellular and extracellular salt solutions in which the cell exists (Plate No. 1). This separation of the ions across the bacterial cell wall and the maintenance of the impermeable phospholipid membrane is essential for cell life. The bacteria cell membrane contains protein channels that transport different ions across the membrane to control both electrical and chemical potential that exists across it (Plate No. 2). When microorganisms are subjected to a strong magnetic flux field, the ability of the protein channels to maintain the electrical and chemical potential across the cell's membrane is greatly affected. In brief, the membrane is drastically torn apart and the microorganism is destroyed. The question arises "What remains after the microorganism is ripped apart?" Since we are dealing with microbe sized organisms, the resulting debris after destruction are sub-micron in size. These debris remain suspended in solution and are small enough to pass through primary and secondary filters, delivery pumps, diesel pressure pumps and injector tips. They are then burned with the fuel, leaving no hazardous material with which to contend.

WHAT ABOUT BIOCIDES?

A common method for killing "bugs" is to dose fuel with biocides. However, typical biocides are so highly concentrated that even a small spill can be potentially devastating. These toxic chemicals which kill the fuel "bugs" are also poisonous to all other animal and plant life. Further, tank bottoms containing biocides become more dangerous to handle and fall within regulated controls for hazardous material disposal. Recently, a study that focused on the effects of biocides in fuel combustion revealed an increase of NOx between 0.002-0.004% above the normal NOx emissions. Although this appears to be negligible, it cannot be ignored as the EPA regulates the sale of additives that contribute to air pollution. As a result, Biocides are beginning to cause concern as they are dangerous to handle and damaging to the environment. Some countries may prohibit their future use.

Biocide dosing of fuel can cause other problems. "Fallout" of dead cells to the tank bottoms forms sludge that could still find its way through the fuel system, clogging fuel lines and filters, potentially leading to performance problems and engine damage. Further, over time, biocides do not assure control of microbes, as typically the microbes build a resistance to the product through the evolution process.

DE-BUG'S IN USE

De-Bug TM units have been used successfully in a wide range of sizes and in various applications. De-Bug TM users include: military forces of several nations; marine interests; other transportation sectors; police and fire services; and commercial/industrial sector clients. The largest unit in use to date is a Model L-50,000 (with a design flow rate of 13,225 gallons per hour) installed, with ABS approval, on the 267 meter M/V Cossack Pioneer.

CONCLUSION

Regardless of the problem; complete fuel line plugging, corroded injectors, reduced filter life, or just minor symptoms, microbial contamination exists and cannot be ignored. The long term effects on vessel operation and maintenance costs are critical. Aside from the fact that Biocides have some health and environmental risks, they also require continual application with the associated ongoing costs, and have questionable long term effectiveness.De-Bug TM units are an environmentally safe solution for killing and protecting against the "bugs". As a permanent installation, with no moving parts and little maintenance (occasional check of the bowl for water), De-Bug TM units pay for themselves many times over. Further, the liability of crew members handling toxic biocide materials is eliminated.

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