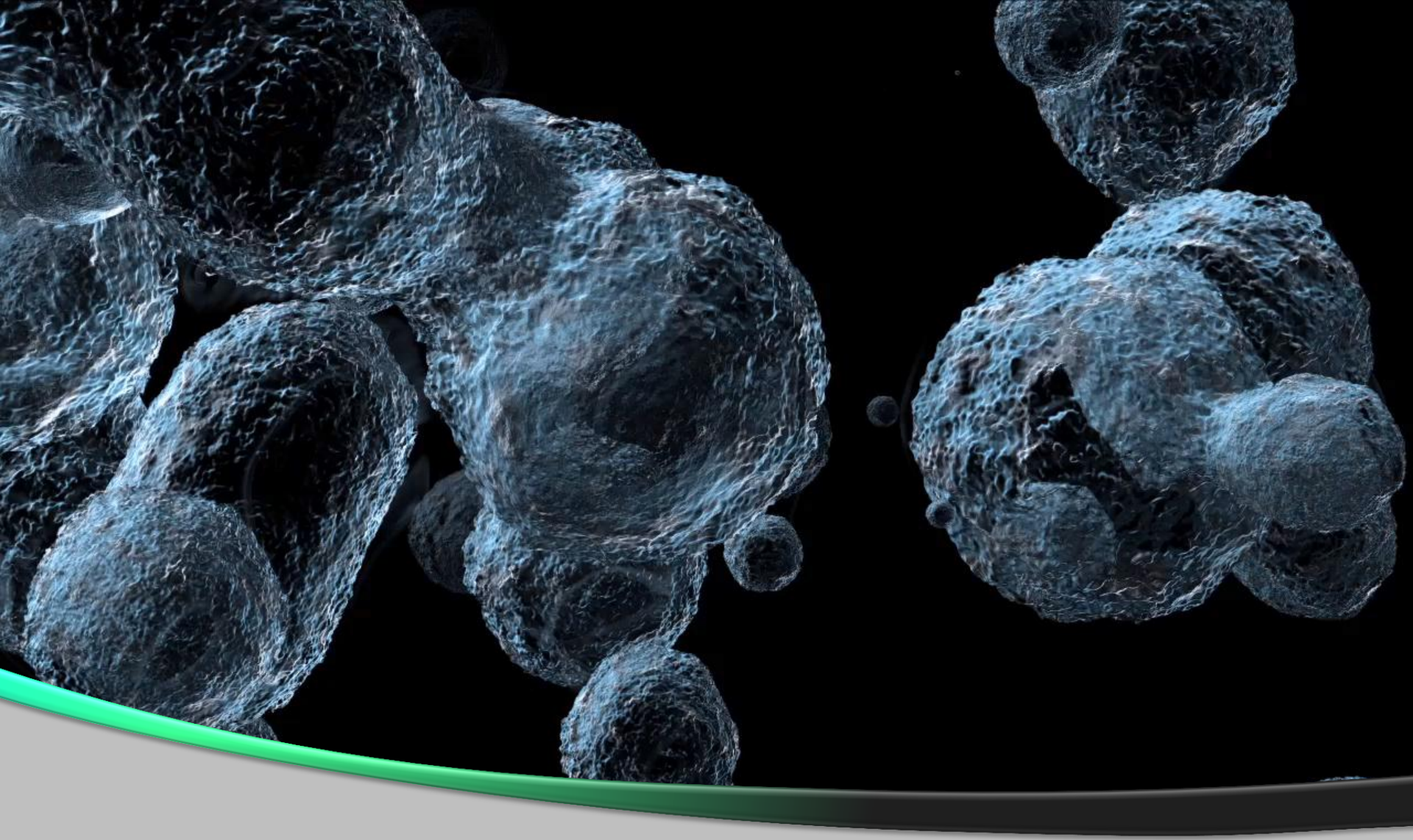
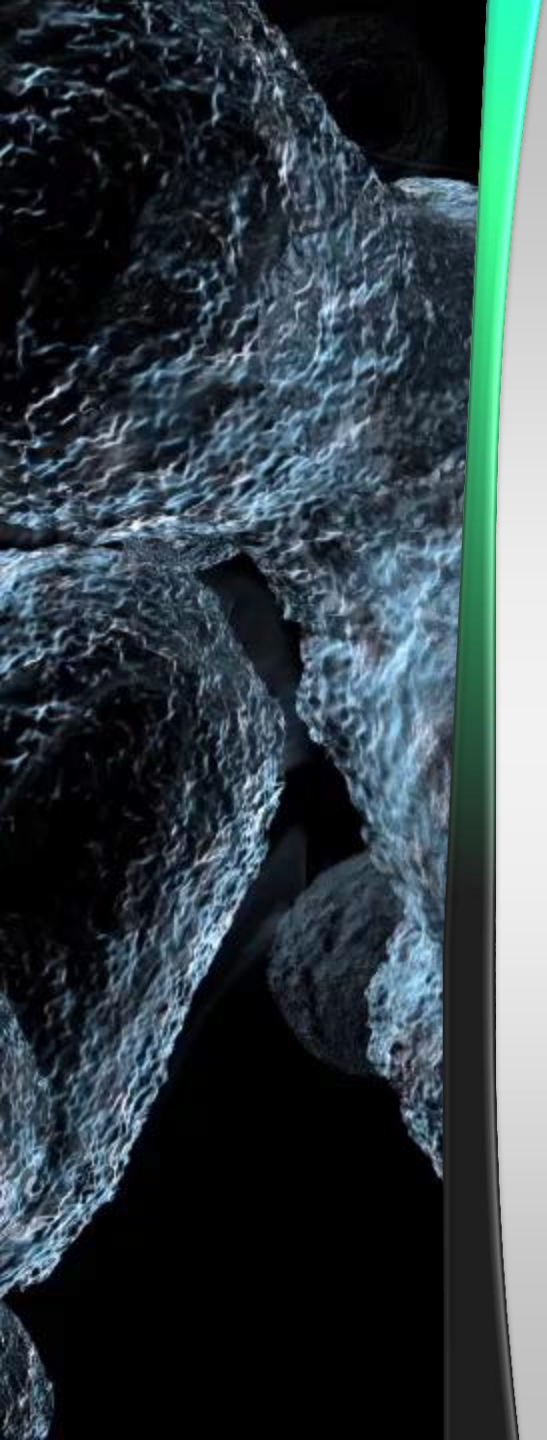


Biofuel contamination

An explanation of Kleenoils ability to remove ‘diesel bug’



Content Page

- Introduction to diesel bacterial contamination
  - How it gets in
  - Engine problems
    - characteristics
      - Speed of contamination
- solution to diesel bacteria contamination
  - Biocides
    - Magnets
      - How magnets work against bacteria
- Kleenoil
  - Implementation
  - The DFC
    - Maintenance
    - Summary

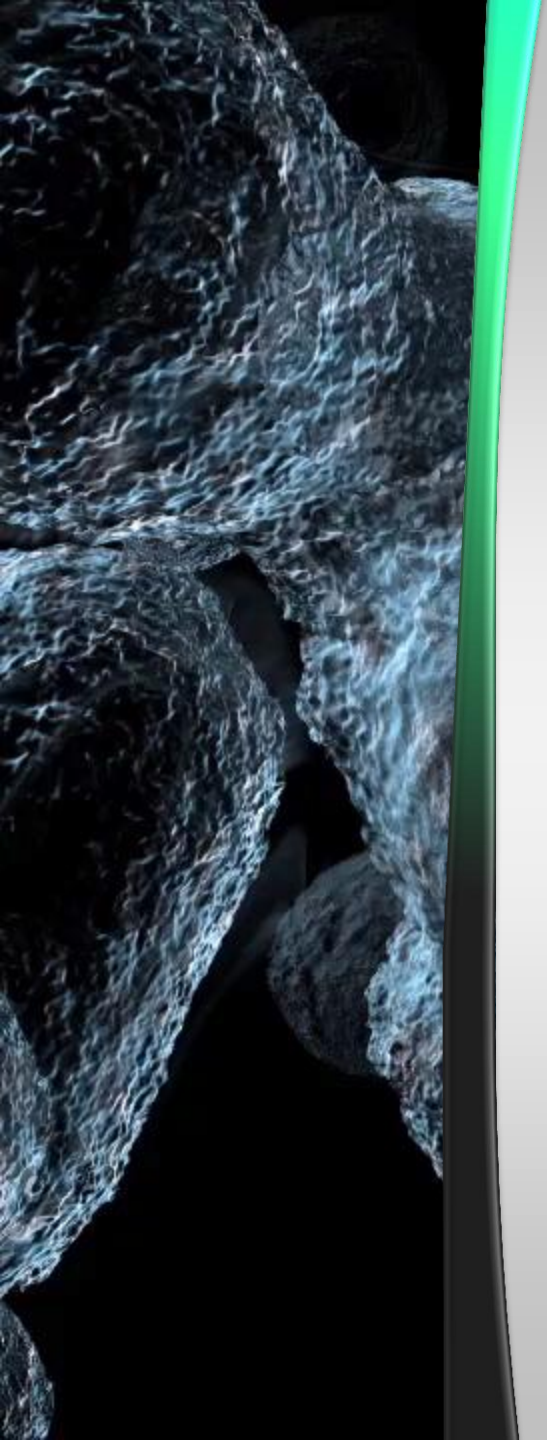
Where has diesel bug come from ?

Diesel bug has always been a problem in the marine and agricultural sector, but with the implementation of **blended diesel with biodiesel** the problem has spread in to the common market.

The Government's Road Transport Fuel Obligation (RTFO) requires that the UK has 5% blend biofuels and will evolve to have even stricter controls and lead to higher blends across the nation.

You will note mostly B6 is supplied from stations - but many commercials are trialing blends up to 100% (B100) depending on areas and times of year.

Introducing higher blends will make the occurrence of diesel bug more prolific and fuel hygiene will become an important factor to all users.



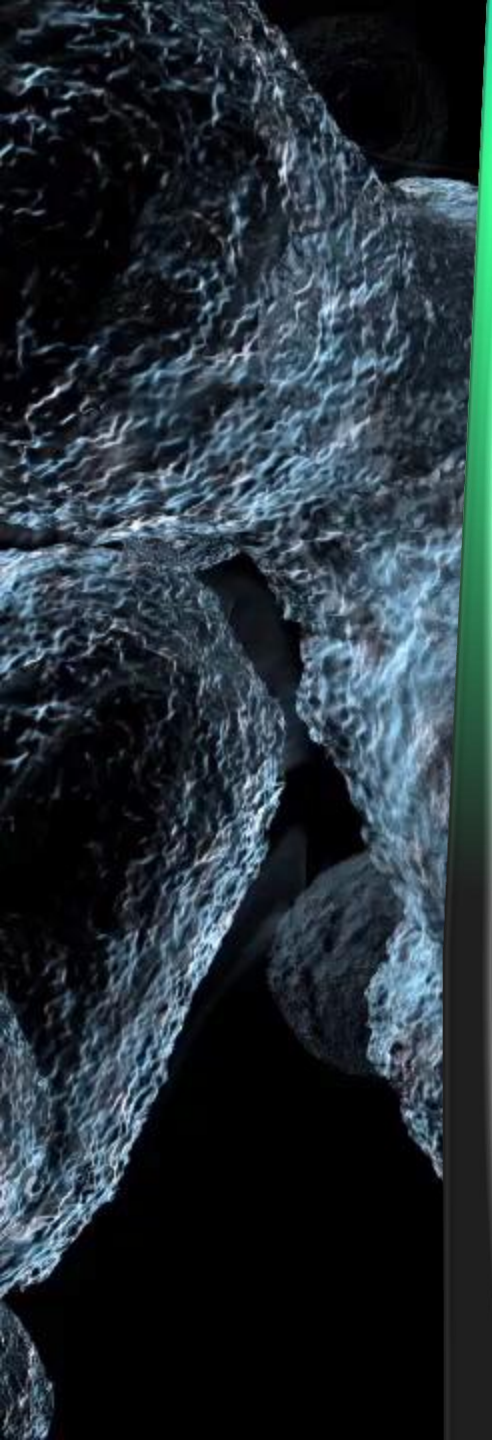
Bacterial Contamination of Diesel

Bacteria in diesel is a well known problem to anyone who works with diesel engines, so what is this bug and why does it contaminate diesel?

Diesel is an organic fuel so it provides an ideal environment for microscopic fungi, yeast and bacteria to feed and grow.

This environment provides:

- dissolved water for germination
- carbon for food
- oxygen and sulphur for respiration
- trace elements for growth and propagation

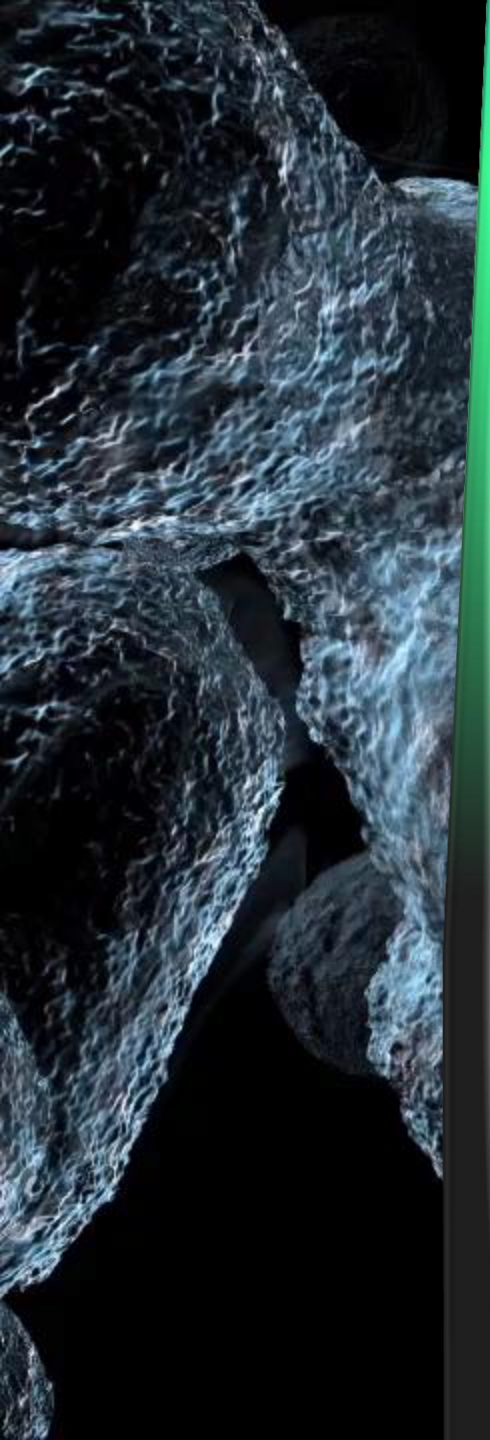


Inherent Problems of biodiesel in the engine

Biodiesel may contain small but problematic quantities of water. Although it is not miscible with water, it is hydroscopic (absorbs water at a molecular level) In addition, there may be water that is residual to processing or resulting from storage tank condensation.

The presence of water is a problem because:

- Water reduces the heat of fuel combustion, causing smoke, harder starting, and reduced power.
- Water causes corrosion of fuel system components (pumps, fuel lines, etc.)
- Water freezes to form ice crystals that provide sites for nucleation, accelerating gelling of the fuel.
- Water causes pitting in pistons.
- Microbic bacteria in water cause the paper-element filters in the system to rot and fail, causing failure of the fuel pump due to ingestion of large particles.



twenty seven (27) varieties of bacteria…

… are responsible for the majority of problems with diesel engines and their performance. There are many differing types of bacteria which can infect systems and form bio-films on steel surfaces. Accelerated corrosion can also occur wherever the bio-film settles, usually in pits or crevices. Unlike general corrosion, it is an attack on a very specific area.

It is very difficult to determine when a system is first contaminated, but once contaminated diesel enters the fuel system, it is very difficult to eradicate.

.

Each species has its own characteristics:

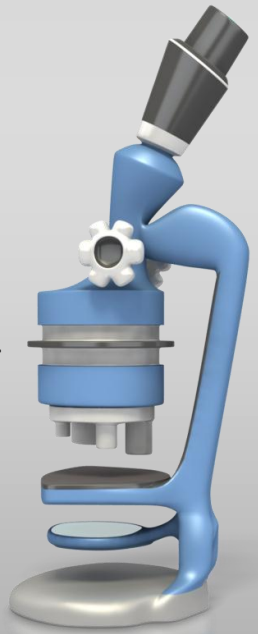
BACTERIA

Bacteria utilise hydrocarbons and reproduce asexually by binary fission; swelling in size as they feed, they then separate into two cells. In this way, microbes double their numbers every 20 minutes, one spore converting to 262,144 in 6 hours.

SULPHATE REDUCING BACTERIA (SRB)

SRB's are a specific group of bacteria utilising simple carbon, not hydrocarbons, and require the activity of other microbes in a consortium. Aerobic (in the presence of oxygen) or anaerobic (without oxygen) bacteria have a combined effect. The aerobic bacteria (sulphate oxidising) create a film to consume the oxygen first. This allows the anaerobic (sulphate reducing) bacteria to thrive.

SRB's reduce sulphates and produce hydrogen sulphide (a lethal gas). They are directly involved with many microbial corrosion reactions and can cause sulphide souring of stored distillate products. Their action changes the Ph creating an acidic environment, conducive to accelerated corrosion. They attach themselves to the steel as a film and go to work. They derive their nutrition from the surrounding environment and multiply. They are particularly difficult to deal with and produce a sludgy by-product with a strong sulphur odour similar to rotten eggs (hydrogen sulphide).



IRON REDUCING BACTERIA

These also contribute to corrosion, eating steel and reducing ferrite to an oxide through a chemical reaction.

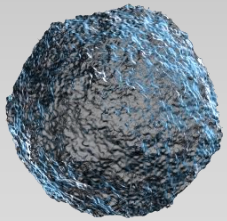
YEASTS

Yeasts prefer acidic environments, such as produced by SRB's. They bud on the parent cell, eventually separating. Reproduction takes several hours.

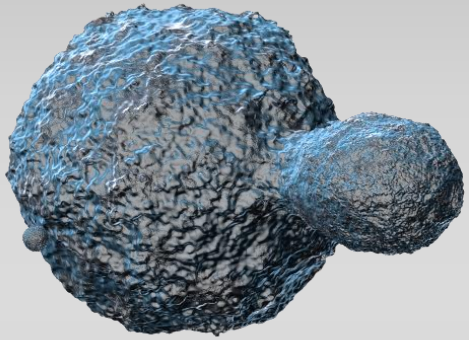
FUNGUS

Fungi grow in the form of branched hyphae, a few microns in diameter, forming thick, tough, intertwined mycelia mats at fuel/water interfaces.

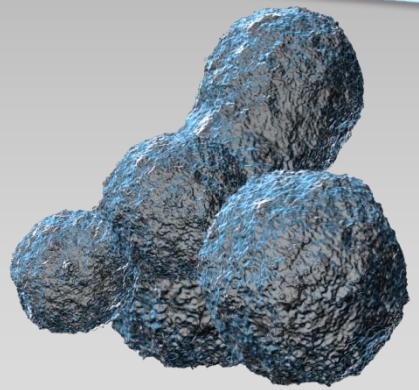
Speed of contamination .....



Diesel bug originates from the air or moisture, or during tank filling and/or expansion and contraction of storage tanks, the bacteria cover themselves in a protective film (slime) to protect against biocides and can lie dormant in the minute crevices of the metal, rubber and polyurethane coatings of the fuel tanks and fuel system.



Then, when water is present (a droplet is a lake to a microbe) and the environment hits the right temperature range, they begin reproduction in the area of fuel/water interface.



Microscopic in size, they can develop into a mat easily visible to the naked eye very rapidly. A single cell, weighing only one millionth of a gram can grow to a biomass of 10 kilograms in just 12 hours, resulting in a biomass several centimetres thick across the fuel/water interface.

Diesel Bug Removal

There is a huge market of ‘debugging’ offering a variety of solutions – mainly various additives called biocides.

Adding biocides to the fuel system may actually cause more problems as dead cells collecting on the bottom of the tank can still find their way into the fuel system, potentially leading to blocked filters and further engine damage.

Over time microbes may build up immunity to the biocides.

Occasional dosing can actually accelerate growth.

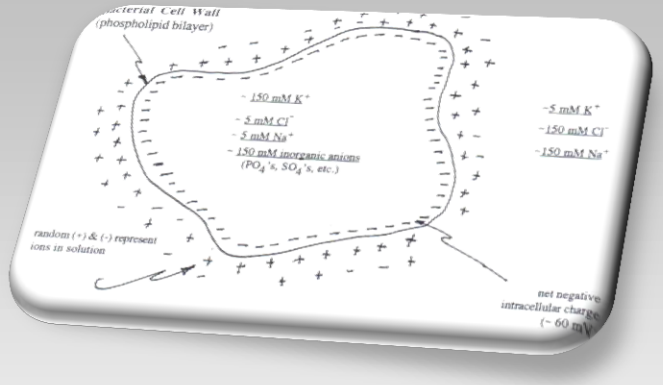
Removal - Magnets

Then there are the magnets –

Effective - Micro-organisms are very vulnerable to magnetic waves. The organisms are single-celled, with a membrane surrounding each cell, and electrically charged ions that travel across this membrane are essential for the organism's life. Exposing the microbes to a strong, changing magnetic field, will ensure maximum destruction of the cells, but you still need to remove the debris effectively.

There are an array of magnetic solutions on the market – whether as fluids, clamps or 'drop ins' These are all simple to integrate, but still leave the problem of removing the debris.

Magnets



So Magnets can destroy bacteria

– but how ?

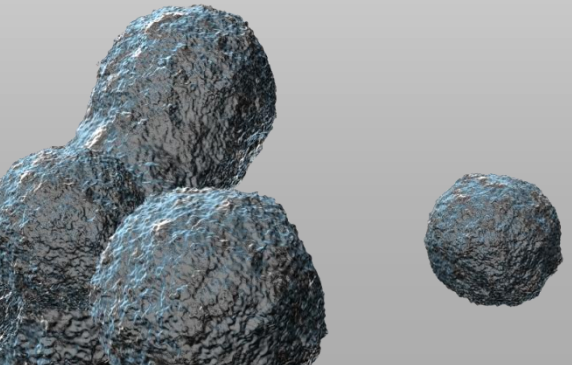
Bacteria are single cell organisms with a phospholipid membrane. The membrane contains the cell and its protein but it maintains a separation between internal and external salt solutions – this membrane has a higher negative charge internally to a positive charge externally so holding it stable. There allowing a flow of protons through ion channels in the membrane to control the bacteria's PH level which is crucial to survival of all cells.

PH levels are related to the concentration of protons – which are positively charged atoms.

Presence of a magnetic field upsets the balance of these charged atoms – overwhelming the cells ability to balance its P.H level and so either temporarily stunning or killing each cell .

The Solution

KLEENOIL BY PASS FILTRATION SYSTEMS FOR THE ULTIMATE IN FLUID FILTRATION . .....
A by-pass filter system primarily using depth filtration to ensure oil cleanliness to ISO4407 14/11/9 or better, and remove all water.



Kleenoil have implemented an 8000 gauss magnetic core into the filter system to enable all fluid to pass within 5mm of the charge – so destroying bacterial growth, but then, more importantly – removing the debris along with all other contaminant and water.

Using Kleenoil either continually, or within a proactive maintenance programme is the most effective system.

DFC Diesel Fuel Cleaner

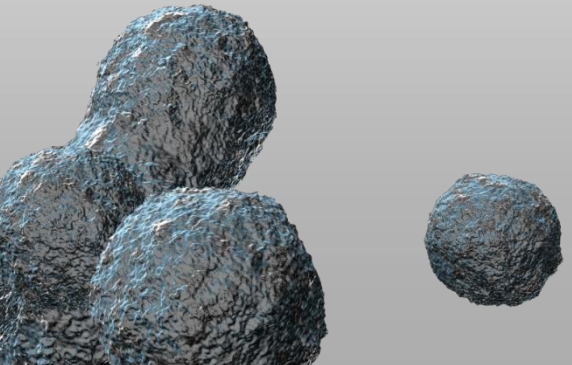
A self contained unit designed for continuous cleansing of fuel tanks.

STANDARD CONFIGURATION

- 110 VOLT MOTOR & MODIFIED PUMP
- QUAD SDFU9788KU85 UNITS
- FLOW RATE APPROXIMATELY 1200 QUARTS PER HOUR.
- RECOMMENDED FOR CONTINUOUS RUNNING
- CUSTOM BUILT CABINET
- BUND AND FLOAT SWITCH
- BIO-FUEL COMPATIBLE
- VITON SEALS
- 4 X 8000 GAUSS MAGNETIC CORE
- SAFETY BY-PASS VALVES
- SAMPLING POINT
- 12 MONTH WARRANTY ON ALL PARTS.
- INSTRUCTION MANUAL INCLUDED.
- BUILT TO ORDER FOR BESPOKE

diesel fuel

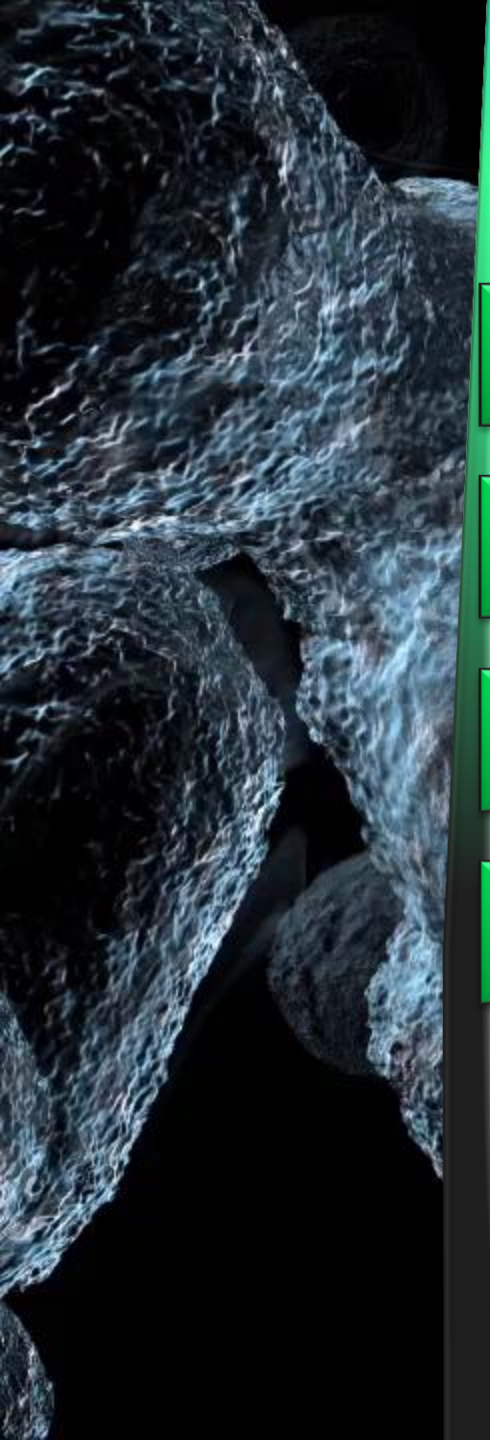
KLEENOIL have designed a cleaning unit to suit Diesel fuel – developed with all parts suited to the corrosive nature of biodiesel, using an 8000 gauss magnetic module and effective depth filtration cleaning.



Simple operation

The unit is an enclosed, powered tank, enabling the operator to simply drop the inlet and outlet pipes into the tank and begin immediate cleansing.
The system allows for transfer too.

Economical cartridge changes are simple and clean



DFC to summarise the solution .....

8000 gauss magnet	All fluid travels within 5mm of an 8000 gauss rare earth magnet
Depth filtration	All fluid is finely filtered through dense media removing all water and contaminant to <3 micron absolute
Complete removal	Bacteria, contaminant, water is retained in the filtration media to be changed at recommended intervals
safe disposal	Replacement cartridges are easily changed and disposed within companies usual waste regulations

KLEENOIL

Questions?

More Information?

Kleenoil filtration ltd

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www.kleenoil.co.uk