

## *FCP Solutions*

### *Microbial Contamination: Growth in Fuels and Oils*

■ A single cell weighing one millionth of a gram can grow to a biomass weighing 10 kilograms within 24 hours.

#### *The Bug in a Bottle*

■ Contaminating microbes grow at the interface between diesel fuel and water which is ever present.

■ Introduces the De-Bug Diesel Fuel De-Contamination Unit.

■ Severe infestations generate their own water as a by-product.

#### *The Effects of Microbial Contamination*

■ The physical effects of microbiological contamination are the formation of biological sludges, biofilms (slimes) and surface or interfacial scums.

■ These mainly occur in the fuel tanks and also manifest themselves as material which block filters.

#### *The Effects of Microbial Contamination*

■ A number of microbial and chemical processes produce corrosive by-products including strong organic acids and sulphides.

■ These can degrade protective coatings such as paints, rubber, some plastics and metal oxide films as well as destroy or inactivate chemical corrosion inhibitors and cause hydrogen embrittlement of metals.

#### *The Effects of Microbial Contamination*

■ Black deposits on copper or copper containing alloys in pipe work and bearings as well as pitting are evidence of microbial induced corrosion.

■ Engines rely on high quality fuel that has been properly filtered and separated (from water), with no flow restrictions, to achieve proper atomisation, combustion, engine performance and fuel efficiency.

#### *The Effects of Microbial Contamination*

■ Fuel that is infected with bacteria is not reliable and there are many and varied consequences of using contaminated fuel in marine diesel engines.

■ These include:

- 1. encouraging growth of further contamination**
- 2. fuel filter clogging and blockage**
- 3. coalescer malfunctions**
- 4. engine wear due to variations in fuel flow**
- 5. corrosion of the fuel system**
- 6. corrosion of engine fuel injectors**
- 7. damage to in-line instruments**

#### *The Effects of Microbial Contamination*

■ Engine fuel injection equipment is most susceptible to the effects of microbial contamination, resulting in corrosive damage to needles.

■ Fuel pump elements also suffer from wear damage and are also prone to seizure.

■ Ultimately, performance suffers and fuel consumption and maintenance costs increase, but perhaps the most critical concern is the real potential for blockages in the fuel system

which cause engine failure while underway - with potentially devastating consequences.

### ***The Effects of Microbial Contamination***

- Filter blockage is only the obvious sign of fuel bug contamination.
- The real problem is from the corrosion caused by the sulphide by-products of the bug.
- In effect you have sulphuric acid in your fuel.
- Repairs to injector pumps, fuel lines and injectors invariably cost far more than the price of a De-Bug Unit.

Severely Blocked Fuel Filter

### ***Using Biocides***

- Biocides are frequently used to treat severe contamination, however many of them are hazardous chemicals and require careful handling.
- Although some are marketed as being "environmentally friendly", many are harmful to the environment and waste disposal contractors may need to be called in if waste containing dead microbes and biocide are to be offloaded from an infected vessel or machine.

### ***Using Biocides***

- Adding biocides to the fuel system can actually cause more problems.
- The fallout of dead cells collecting on the bottom of the tank forms a sludge material that can still find its way into the fuel system, clogging fuel lines and filters, potentially leading to performance problems and possibly engine damage.
- This can be especially true in marine applications in rough weather when the contents of the tank are effectively shaken into suspension.

### ***Using Biocides***

- Furthermore, over time biocides lose their effectiveness as microbes build up immunity to the chemicals.
- Occasional dosing can actually accelerate this action and some owners have reported bio-mass growth in systems despite regular treatments with biocides.
- Thus biocides can actually contribute to the problems of microbial contamination; not only by causing a large amount of sludge to build up but by also giving the user a false sense of security.

### ***Using Biocides***

- Biocides should normally only ever be used after a fuel tank has been physically cleaned.
- Biocides should only be used in a single shock dose to prevent immune strains developing.

### ***De-Bug Fuel Treatment Units - the Benefits Are Immediate.***

#### **■ Less Downtime:**

Installation of a De-Bug Fuel Treatment Unit can greatly reduce the inactivity of diesel engines due to breakdowns.

#### **■ Value For Money:**

The cost of a De-bug unit can be quickly absorbed by the proven fuel savings.

### ***De-Bug Fuel Treatment Units - the Benefits Are Immediate***

#### **■ Greater Profits:**

With less downtime, less engine repairs and less fuel consumption.

**■Environmental Issues:**

When a De-bug Treatment Unit is operating, the potentially damaging sludge does not collect and requires no off-loading: Reduced use of biocides.

***De-Bug Fuel Treatment Units - the Benefits Are Immediate***

**■Installation:**

Simple and easy to install inline.

**■Safety:**

Reduced chances of breakdown at sea.

**■Longevity of Operation:**

De-Bug Fuel Treatment Units have no moving parts, nothing to wear out or breakdown through continued use.

***De-Bug Fuel Treatment Units - the Benefits Are Immediate***

**■Improved Fuel Quality:**

Fuel burns cleaner and more efficiently.

**■Improved Engine Performance:**

Decrease in engine wear resulting in more power and engine efficiency.

***How De-Bug Works:***

**■Micro-organisms**

Once bacteria, moulds and yeasts in fuel have grown to be visible their colonies consist of millions of individual cells.

■Remember a single cell weighing one millionth of a gram can grow to a biomass weighing 10 kilograms within 24 hours.

***How De-Bug Works:***

■Very simply stated, all micro-organisms are single-celled with a membrane surrounding them.

■The unit membrane physically contains the cell and the proteins needed for survival while maintaining separation between the internal cell and the external environment.

***How De-Bug Works:***

■Ions, which are electrically charged, travel across this membrane and their movement is essential for the organism's life.

■When micro-organisms are placed under the influence a changing magnetic field, the ability of the cell to maintain the electrical and chemical potential across the cell's membrane is greatly affected, resulting in the cells death.

***How De-Bug Works:***

■Both "Tri-Mag" and "Multi-Mag " are unique paths of fluid motion produced inside a De-Bug that produce the relative changing field necessary to kill single-celled organisms.

***How De-Bug Works:***

**■What De-Bug Does:**

The De-Bug Fuel Treatment Units are not a filter nor do they supply any chemicals to destroy micro-organisms.

■Instead, De-Bug Units are a static magnetic inline device that create an optimum magnetic flux field density directly responsible for destruction of the cell membrane.

***How De-Bug Works:***

- Exposing the microbes to a strong, changing magnetic field will ensure maximum destruction of the cells.
- This patented design of multiple ceramic coated permanent magnets located within the unit, when properly sized and strategically placed, have been shown to have a 97.5% efficiency in destroying the damaging micro-organisms within a single pass in some models, and significant, although slightly less effective kill rates in others

***How De-Bug Works:***

- De-Bug is a cost effective, one time, permanent installation, with no moving parts, no electrical hook-up, and maintenance that may require only an occasional cleaning.
- And unlike chemical biocides, micro-organisms which have been destroyed by the De-Bug unit do not collect at the bottom of fuel tanks.

***How De-Bug Works:***

- Instead, the debris stays randomly suspended in the fuel and due to their sub-micron size easily pass through engine components.
- They are then burned with the fuel and leave no build-up in tanks to be cleaned.
- Remember, if you have to clean the fuel tanks once, you will most likely pay more than putting on the De-Bug. Think about that the next time you consider using an expensive biocide!

***Specifications:***

- The **De-Bug** is manufactured to exacting standards in New Zealand.
- The De-Bug Worldwide Ltd facility produces **De-Bug** models for engines from less than 100 hp to those in excess of 8000 Hp.

***Specifications:***

- Most production models have Bureau Veritas approval.
- One larger model (50,000 L/Hr) has been approved by the American Board of Shipping, and several models are carried on the NATO military database.

***Specifications:***

- LM6 or LM25 Marine grade anti-corrosive aluminium is used for production models, whereas larger (greater than 50,000 L/hr) are built in stainless steel.
- All are built to utilize our proven, patented flow.
- **If you have a specific application, we can have a unit built to suit.**

***Specifications:***

- The picture shows the installation of an L4000 model, which has a maximum rated flow of 4000 L/Hr. Every time the fuel passes through the De-Bug unit it is treated, thus providing systematic control of microbial contaminants. **The De-Bug unit is not a filter; it is a static fuel treatment unit.**

***Specifications:***

- The De-Bug unit requires little maintenance, and provided the unit is properly fitted, and used, **the De-Bug unit is guaranteed to significantly reduce microbial contamination.**

### ***L140***

- Up to 100 h.p.
- 140 litres/hr
- 40 p.s.i.
- 60mm dia
- 105mm high
- 84mm wide
- 0.31LM6 marine grade anti-corrosive aluminium alloy
- ¼" NPT ports
- Dis-assembly of Tri-Mag voids warranty

### ***L500***

- 100 to 500 h.p.
- 500 litres/hr
- 50 p.s.i.
- 115mm deep
- 160mm high
- 127mm wide
- 1.75 LM6 marine grade anti-corrosive aluminium alloy
- ½" NPT ports
- Drain plug and air bleed screw

### ***L1000***

- 100 to 600 h.p.
- 1,000 litres/hr
- 50 p.s.i.
- 110mm deep
- 194mm high
- 114mm wide
- 1.98LM6 marine grade anti-corrosive aluminium alloy
- ½" NPT ports
- Drain plug and air bleed screw

### ***L4000***

- 600 to 4000 h.p.
- 4,000 litres/hr
- 50 p.s.I
- 386mm deep
- 260mm high
- 375mm wide
- 17.4LM24 marine grade anti-corrosive aluminium alloy or stainless steel
- 1½" NPT ports
- Drain plug on base.

### ***L5000***

- 1000 to 8000 h.p.
- 5,000 litres/hr
- 50 p.s.i.
- 386mm deep
- 333mm high
- 375mm wide
- 21.5LM24 marine grade anti-corrosive aluminium alloy or stainless steel
- 1½" NPT ports
- Drain plug on base

### ***Typical Installation***

#### ***International Tests***

■ Performance and operational benefits of installing De-Bug fuel treatment units in fuel systems has been proven under laboratory conditions as well as in ship and shore installations worldwide.

#### ***Proven Performance***

■ The **Biodeterioration Service of the Corporate Research Laboratory of ICI New Zealand** has demonstrated the effectiveness of De-Bug Tri-Mag™ units.

#### ***Proven Performance***

■ Two test rigs were built to simulate fuel systems with De-Bug units fitted. One of the De-Bug units was modified with non-magnetic spacers in place of the Tri-Mag™ bug killer pack to allow comparative testing.

#### ***Proven Performance***

■ Diesel fuel with known contamination levels was then circulated through both rigs and samples were removed from the rigs at regular intervals and tested for fungal counts.

#### ***Proven Performance***

■ The functioning De-Bug unit caused a rapid and dramatic decline in the bacterial and fungal counts and fuel from the test rig remained effectively clear of fuel degrading fungi for the duration of the trial.

■ The non-magnetic unit had no effect on reducing the bacterial and fungal count.

#### ***Proven Performance***

■ ICI New Zealand also published a report entitled "Testing of Diesel Samples for Microbiological Contamination from a truck with the 'De-Bug' unit". The report confirmed the overall effectiveness of the De-Bug unit in an 'in situ' situation of treating contaminated fuel on a working fuel system.

#### ***Proven Performance***

■It was determined that, regardless of the contamination level in the tank fuel, the De-Bug unit successfully cleaned up the fuel system. During the in situ truck test – on average, over 90% of the fungi and yeast cells were either destroyed or killed.

#### *Proven Performance*

■The **Dutch Institute for Fishery Investigations (RIVO)** undertook a trial of De-Bug units fitted with Tri-Mag™ stacks over a period of four months in 1990.

■The trial confirmed the operational and economic benefits of fitting De-Bug units to maritime vessels.

#### *Proven Performance*

■**Shell Oil (New Zealand) Ltd.** undertook a comparative trial to ascertain the effectiveness of De-Bug Multi-Mag™ units.

■Although the trial was undertaken to determine the effectiveness of the units when fitted to Kerbside Pump Units used in filling stations, it was also able to demonstrate the effectiveness of Multi-Mag™ units in other applications such as quayside fuelling facilities and re-fuelling barges.

#### *Proven Performance*

■The trial, which was conducted at the premises of Shell Oil New Zealand, confirmed that the fuel had a significantly lower fungal and bacterial count when treated with De-Bug Multi-Mag™ units.

■This trial demonstrated the effectiveness of the Multi-Mag™ unit which can be incorporated in a number of high flow rate systems and can be used on an intermittent or continuous basis if required.

#### *Proven Performance*

■The rigorous and successful evaluation of the Tri-Mag™ units by ICI New Zealand, Shell Oil New Zealand and RIVO means that prospective users of the units can install them with confidence.

■In all three cases, microbial contamination was reduced between 90% and 100%. It was then successfully controlled.

#### *De-Bug Versus Biocide*

■**Biocide does not destroy bacteria, but it does kill most of them.**

■**The carcass can still block filters if the infestation is very high.**

■**The De-Bug destroys them and they pass right through the filters!**

#### *Cost Effective*

■De-Bug units offer significant value for the money when the consequences and potential costs of not fitting them is taken into account.

■As a general rule, it is more cost effective to fit the De-Bug than it is to clean the system.

#### *Warranties*

### **A 12 month warranty is provided**

■All De-Bug units supplied will be of merchandisable quality and will comply with the specification agreed for them. A full one year replacement warranty on parts and materials is given provided that failure of such parts and materials has not resulted from negligence or wilful act by the end user.

### ***Guarantees***

#### **Guaranteed to reduce microbial contamination**

- De-Bug units are unconditionally guaranteed against manufacturing defects for one year.
- De-Bug units are guaranteed to significantly reduce microbial contamination subject to correct installation in the fuel system.

### ***Exclusions***

- Disassembly of L140 units voids all Warranties and Guarantees

### ***Summary***

- De-Bug units are the simplest long term cost effective way of controlling microbial infestation in diesel fuel
- Control is attained without the use of potentially harmful biocide chemicals
- The simple one off installation will provide years of trouble free low maintenance service.