

# Microbial Contamination of Fuels

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Contact:

**Andrew Clarke**

E&S Environmental Services Ltd.,  
Unit 10,  
Viscount Court Industrial Estate  
Brize Norton, Oxon OX18 3QQ  
Tel: 01993 852419  
Fax: 01993 852152

Email:

[Andrew@eandspumps.co.uk](mailto:Andrew@eandspumps.co.uk)

[www.eandsgroup.co.uk](http://www.eandsgroup.co.uk)



Environmental Services

# MICROBIAL CONTAMINATION OF FUELS

## Causes, effects and solutions

Article by Andrew Clarke

### The problem:

Microbial contamination of petroleum fuels is a growing and commercially sensitive problem faced by retailers and distribution companies. The constant need to clean clogged filters, pumps, purge fuel lines and de-contaminate tank bottoms is operationally disruptive and financially draining.

All fuel systems have the potential for contamination, and unprotected systems will continue to provide life support to the microorganisms once they are introduced. Such organisms need water and food to survive. For biological contamination, the slimy rancid organisms only need a minute amount of water for survival and live and multiply at the fuel/water interface in the tank, using the hydrocarbons in the fuel as their food. As they grow, they form mats that are dark in colour and appear gel-like. Their waste produces water, sludge, acids and other harmful by-products.

These organisms are either air or waterborne and contaminate fuel systems by entering through vents, standing water in sump bottoms, dissolved 'free water', sludges in tanks, or incurred during transport or delivery. They grow at incredible rates with some varieties having the ability to double in size every 20 minutes!

### Unseen harmful effects

Micro organisms will consume rubber gaskets, O-rings, hoses or tank linings and coatings for their mineral contents. Microbes that produce slime therefore influence the onset of corrosion. Biological slimes are called biofilms. They have been shown to provide sanctuary for a variety of types of microbes that appear to work symbiotically, causing problems that no single microbe could achieve on its own. There is mounting evidence that demonstrates that microbes, growing within the slime layers inside tanks, are responsible for a considerable amount of tank and pipeline damage. This is true for both steel and fibre-reinforced polymers (FRP).

Bacteria are so small that you can't see a group of them (a colony) until there are over a billion individual cells. Approximately ten million cells will make a fluid slightly cloudy. Bacteria are one of



the two groups of microbes that degrade fuels and fuel systems.

Fuels, especially diesel, are organic compounds made up of hydrogen and carbon, and are a good food source for these microscopic organisms.

Within a fuel tank they have all the elements for survival and growth - water for germination, carbon for food, dissolved oxygen and sulphur for respiration, and trace elements for growth.

### What is Biofilm?

Understanding what constitutes biofilm is important. Many microbes produce a sticky, slimy material, which serves several critical roles.

It helps microbes attach to surfaces. Once enough of this material is produced, it forms a film. This film may eventually grow to be more than 1/4 inch thick. Whole microbe communities, made up of many different types of bacteria and fungi, live within the biofilm. As communities, they can change their environment, and carry out chemical reactions that no single microbe could. This is why biofilms are so important in bio-deterioration. Biofilms can also protect the microbes that live within them from some biocides and other agents that might kill bacteria and fungi.

### Microbial growth – rapidly multiplies

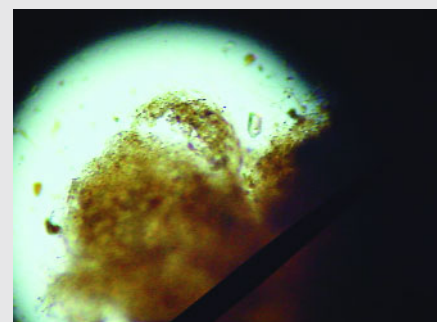
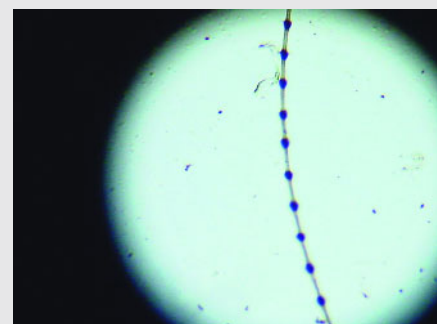
Virtually all fuel has some bacteria life, however, it may not be that apparent to the naked eye. These microbes start off as small microscopic single, separate living cells. At this point, they can pass through the smallest size filters installed in petrol stations, and injector nozzles. However, their growth can be rapid. Given the right conditions, a single cell weighing one millionth of a gram can grow into a biomass of slimy algae mats weighing 10

kilograms (22 pounds) within twenty-four hours. By the time you can visually see evidence of growth, the infestation problem is quite severe. Not all growth happens so suddenly. In some situations, growth occurs slowly, creating problems during development.

In hot, humid environments, 'bug' activity estimates show bacteria counts doubling every four to six hours. Hot days and cooler nights create the ideal conditions for condensation in the fuel systems. This can result in only one thing: Bacterial growths! Microbes, or micro organisms, in vents, fills and the fuel can create tremendous problems for the overall system in both petrols and diesels.

### Infections can be costly – for new tanks too!

Low-level microbial contamination can be every bit as costly as a major infection. Maybe even more. It can go unnoticed if it is not looked for. Over 90 percent of the nutrients the microbes consume become by-products, such as slime, sludge and acids, which corrode and rust tanks. The rest becomes new colonies. Many companies are replacing old storage tanks with the new so it makes sense to get as long a life out of these costly new installations as possible. It was thought that tanks lined with or made completely of resin materials, such as fibreglass or PVC, were immune from biodegradation. Recent studies in the USA have



found this not to be true, showing that microbes can attack the basic materials of the new tanks.

### Changes in fuels chemistry

Dramatic changes in the fuel industry are driving a need to revise the way we monitor and control microbial contamination. Ethoxylated gasoline additives, diesel additives, oxygenated petrols, which may include ethanol (which is hydroscopic i.e. attracting water), Bio diesel and 'cracked' diesel (which both hold more water than 'straight-run' diesel), are all providing new challenges for retailers to maintain fuel in pristine condition.

Further, new low sulphur diesels promote the growth of algae. Reducing the sulphur reduces the aromatic content of a fuel. The problem with this is that the microbes utilise the aromatics and are satisfied quickly, producing little waste. If however the aromatics are reduced, the microbes have to utilize the fuel itself constantly. They then become prolific and create excessive amount of byproducts.

In petrol the problem has surfaced in larger quantities and appears to be linked to the new types of oxygenated petrol. In the US, with many places mandating 'oxy-fuels', the problem is increasing as, for some reason, the makeup of these fuels appear to spur on the growth of microbes.

### Larger tanks – greater potential problems

It is often the impression that fuel at a large volume throughput station is cleaner than the fuel at a local small station. This could be an incorrect assumption. From data taken in the US, it was found that the high volume tanks tested were the ones with the most problems. Every time fuel is delivered, there is the potential to also get contaminants, (be it sand, dust, water etc.) which come with that load. The more fuel delivered, the greater the amount of contaminants.

Some stations also get fuel from a variety of sources making them more susceptible to problems.

### The motorist – your customer!

Retailers' customers can also be affected by microbial contaminants in fuel. If microorganisms reach engine fuel

systems, they will plug filters, foul pumps and cause fuel starvation. They may cause caking around the injection nozzles, resulting in inefficient combustion and dark exhaust smoke.

If problems occur with motorists, there is the potential for financial compensation to be paid to them. And the loss of customer confidence in your products also results in a severe setback to the supplying companies' reputation, with all the attendant unwelcome media attention.

### What can be done?

#### 1. Good housekeeping

Fuel life can be maximised through a well-managed water, sludge and microbial de-contamination programme. Keeping petroleum products dry and clean is essential to any well-maintained storage operation. The monitoring of water bottoms and removal of sludge and particulate matter is therefore vital. A monitoring and maintenance plan should be developed to avoid a critical problem, and now is a good time to start.

It is recommended that fuel be sampled every three months to monitor its condition and remedial action taken as necessary.

#### 2. Fuel polishing & tank cleaning

E&S have developed a highly effective mobile fuel polishing and filtration unit that is safe, reliable and highly efficient. Its primary function is to remove water and in-organic matter, and with the use of Fuel Treat<sup>®</sup>, to eliminate bacterial growth and remove the debris. This unit cleans the tank at the same time (whetted part) and is far more cost effective than the conventional, time consuming, and expensive 'man entry' method, with its attendant disruption to site operations and H&S considerations.

#### 3. Fuel Treat<sup>®</sup>

And with the addition of E&S's specially formulated Fuel Treat<sup>®</sup> additive – which combines a biocide with a detergent and water dispersant agent, microbes are killed (with the debris removed by the filtration unit) and the microscopic water particles held in suspension in the fuel and not allowed to settle out. This drastically reduces the conditions that allow microbes to grow, reduces corrosion and ensures customers receive clean fuel.

Fuel Treat<sup>®</sup> is a safe and environmentally harmless product. It does not affect either the quality of the fuel, the efficient performance of the engine or

catalytic converters. It is fully burnt in the combustion process and has no effect on exhaust emissions.

It mixes easily and quickly with any hydrocarbon fuel and it is used as the final part of E&S's fuel maintenance programme designed to ensure diesel, petrol and gas oil remain in pristine condition in storage, having first removed free water, sediments and sludge with the mobile fuel polishing unit.

### Recommendation: Fuel Management Programme:

The best solution to this problem is prevention, and that is where a good Fuel Management Programme comes in.

Having first deployed the mobile fuel polishing system, with Fuel Treat<sup>®</sup> additive, to restore the fuel to its original clean, water and microbe free condition, we recommend that storage tanks be dosed with Fuel Treat<sup>®</sup> on a regular three monthly basis. This will ensure that any water that may build up in the tank remains in suspension within the fuel, eliminating the primary cause of bacterial growth.

Preventing such bacterial build up in a fuel storage system is more operationally efficient and saves money on costly down time to constantly clean clogged filters and pumps.

### In summary:

#### Recommendations:

- Take regular samples, min. every three months
- Remove water & contaminants, min. every six months
- Continue to use Fuel Treat<sup>®</sup> – ensures no return of harmful bacterial growth
- Build a regular monitoring programme into site operations

#### Conclusion:

- Prevention is better than cure
- Short term (cheap) solutions are rarely effective
- Early diagnosis saves costly downtime
- Maintaining fuels pristine quality in storage requires a planned diagnosis & remedial programme

Many retailers now rely on E&S's management of their Fuel Maintenance Programme to ensure clean products are dispensed to their customers – every time, all the time.

