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# FUEL POLISHING SYSTEMS

## Effective Fuel Management

Storage of diesel is often an overlooked area – a popular misconception is that diesel fuel is “good for life”.

The reality is very different.

To fully understand the issues at play, it is worth taking into account several areas:

- The Diesel fuel quality standard
- The specification of supplied diesel
- Known issues
- Recommendations from the fuel supplier
- Discovering issues before they become problems
- Short and long term solutions

To look at these issues, we have been in conversation with BP and have utilised their available library of fuel data. This information can be found for separate research on BP’s own web site at:

<http://www.bp.com>



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Specific files for diesel fuel storage and known / acknowledged problems can be found at:

<http://www.bp.com/sectiongenericarticle.do?categoryId=9012404&contentId=7018003>

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Reference material: BP Docs ADF1402/0907/1006/1107/0509/1502/0607 © BP p.l.c

First let's consider what diesel actually is. According to BP, diesel is:

Complex mixture of middle distillate hydrocarbons, with carbon numbers in C10 to C28 range. Performance enhancing additives may be included. Hazardous Components Cracked components containing polycyclic aromatic hydrocarbon compounds may be present. Fuels, diesel. EINECS No: 269-822-7, CAS No: 68334-30-5

<b>Boiling Point</b>	180 - 380°C Test Method: ASTM D 86
<b>Vapour Pressure</b>	<0.1 kPa Test Method: ASTM D 323
<b>Physical State</b>	Liquid
<b>Colour</b>	Colourless -> brown
<b>Density</b>	830 - 855 kg/m <sup>3</sup> @ 15°C Test Method: ASTM D1298
<b>Flash Point</b>	>61.5°C (PMC) Test Method: ASTM D 93
<b>Flammable Limits LEL</b>	0.7%
<b>Flammable Limits UEL</b>	5.0%
<b>Kinematic Viscosity</b>	2.0 - 4.5 mm <sup>2</sup> /s @ 40°C Test Method: ASTM D 445
<b>Other Information</b>	Grades: Automotive Diesel Fuel



So this is the ideal state for diesel then, just after it is supplied it is a liquid, clear to brown in colour, density and other variables as above. However diesel is not as stable or as easy to store as many people think.

### **Diesel Fuel Quality - Possible adverse factors**

The modern diesel engines have a very complicated, sophisticated and precise set of components that rely on consistent and precisely defined fuel characteristics to perform efficiently. The UK Petroleum Regulations require fuels to comply with the European Standard EN590. This standard defines the main fuel properties, allowing for minor variations appropriate for the different climatic conditions within the EU.

Thus the density, viscosity, burning characteristics, lubricity, flash point, corrosivity, water content, ash formation, rate of oxidation, and several other chemical and physical properties are precisely specified. These are essential to ensure good engine operation. Any deviation can cause excess emissions, lack of power and poor starting.

Typical problems include:

- Low fuel density - lack of power
- High fuel density - black smoke
- High viscosity - black smoke
- Low viscosity - lack of power, poor starting
- Low cetane - poor combustion, rough running, emissions, noise
- Low volatility - poor starting, deposit formation
- High sulphur - increased emissions
- Low lubricity - injection equipment wear
- High wax content - freezing in cold weather
- High ash formation - engine deposits, poor running
- Poor stability - gum and deposit formation
- Water content - corrosion of injection equipment
- Low flash point - possible danger in handling
- High carbon residue - engine deposits, emissions increase
- High corrosivity - erosion of injection and fuel pump/tank surfaces
- High acidity - corrosion of fuel pump and tank
- High aromatics - increased emissions
- Low detergents - increased deposits, emissions.
- Low anti-foam - poor filling properties, fuel spillage

Many of these properties are inter-related, and a good fuel has a relatively narrow range of operation between conflicting requirements. UK diesel fuel ex-refinery is generally of a very high quality, but can be contaminated by mixing or poor storage conditions.

John Stubbs, Head of Technical Policy, The Automobile Association.

As can be seen, diesel is surprisingly fragile and difficult to keep within specification. After many years of offering it in Europe as a stable, usable vehicle fuel, the oil companies can now be confident of producing fuel within specification and guaranteeing it. However diesel is inherently unstable, meaning that whilst it is fine to use in cars and heavy machinery where the fuel is turned over/used relatively quickly, stored diesel soon starts to display issues.



### STORAGE LIFE

Under normal storage conditions diesel fuel can be expected to stay in a useable condition for:

- 12 months or longer at an ambient of 20°C.
- 6-12 months at an ambient temperature higher than 30°C.

As diesel gets older, a fine sediment and gum forms in the diesel brought about by the reaction of diesel components with oxygen from the air. The fine sediment and gum will block fuel filters, leading to fuel starvation and the engine stopping. Frequent filter changes are then required to keep the engine going. The gums and sediments do not burn in the engine very well and can lead to carbon and soot deposits on injectors and other combustion surfaces.

The expected life of a diesel fuel is indicated by the oxidation stability test ASTM D2276. The test measures how much gum and sediment will be deposited after keeping the fuel at 120°C in the presence of oxygen for 16 hours. It roughly corresponds to one year storage at 25°C. A result of less than 20mg/L of sediment and gum after the test is considered acceptable for normal diesel.

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That is the official BP line; however it is worth noting that in recent communications with the various oil companies, the general message tends to be it is only practical to store diesel for '6 months to be safe'.

**From: Careline [Careline@bp.com] Sent: Tue 21/06/2005**

As a guide, we would suggest that if held for any longer than a period of 6 months, the product could be expected to deteriorate in quality.

### Exxon Mobil / Esso

If you keep it clean, cool and dry, diesel fuel can be stored 6 months to 1 year without significant quality degradation.

Of course we do have to consider temperature variations and other atmospheric conditions (humidity etc) in these estimates, hence 6 months being a fairly standard duration. As the BP document mentions above, their tests correlate to a single year of storage at 25 degrees centigrade. Nowadays we are starting to see higher summer temps, meaning higher storage temperatures, after all not many companies think to air-condition their plant rooms.

### *So what does it mean if your diesel fuel is stored for longer than 6 months?*

As the diesel starts to degrade, several effects will be seen. As BP describe, a fine sediment and a type of gum forms within the fuel. This is the real 'age problem' as being thicker than the original liquid; it will cause the primary filter to block. Naturally, that just means the primary filter is doing its job – but what would happen if you needed the fuel to flow?

### Gums

These can be formed from chemical changes to the fuel, notably by exposure to oxygen, high temperature, acids, and metals during storage. Gums drop out of the fuel in the form of sediment which can block injectors and fuel filters. It normally takes more than 6 months for refined fuel to produce significant amounts of gum.

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## What does it mean if my diesel fuel is stored for less than 6 months?



Typically the fuel will be within specification, and so there is no need for any additional work/process to be carried out. However this makes one big assumption – the fuel is stored correctly. What if the fuel is contaminated, what if it is not stored the correct way?

### ACCELERATED AGEING

The ageing process (of diesel) can be accelerated by the following conditions:-

- Contact with zinc, copper or metal alloys containing them. These metals will quickly react with diesel fuel to form unstable compounds.
- The presence of water. Water allows the growth of fungus and bacteria, these produce natural by-products such as organic acids which make the fuel unstable.
- Exposure to high temperatures.
- Exposure to dust and dirt which contain trace elements that can destabilise the fuel, such as copper and zinc.
- Fuel composition. Some components in diesel fuel naturally age quickly.

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Here we can see the real 'fuel killers'. If fuel is not correctly managed, then not only will it degrade over time naturally, but its storage environment will work against it. Un-maintained fuel will typically contain water from condensation, gum from aging, bacteria, yeast and fungus (which all grow in the water and feed from the fuel's hydrocarbons). These infections can have the unhappy side effect of creating more water – which in turn means more contaminate can grow. This cycle can reproduce rapidly, and if left unattended can spoil an entire tank.

### DIRT

Dirt, dust, sand and similar contaminants commonly enter through fill pipes, access hatches and breather pipes. The amount of contamination will be noticeably worse in dusty areas. Normally they settle on the bottom of the storage tank and do not cause a problem unless they are stirred up or held in suspension by some other contamination. After filling a storage tank it should be left for a period of time to allow dust and dirt to settle.

### RUST

Metallic contaminants, notably rust, occur mostly as corrosion debris from storage tanks and distribution system parts. These contaminants can plug filters, and can also support fungal growth and encourage fuel degradation. Fungal contamination if left untreated will increase corrosion producing more rust.

### WATER

Water can enter the fuel system as part of the refining process, as rain, or as condensation. Water dissolved in the fuel will not change its appearance, whereas un-dissolved water will form droplets which make the fuel appear hazy or milky. Water can enter fuel tanks in air, and will condense when the ambient temperature drops low enough. Water in the fuel system will cause corrosion, and promote fungal growth. All storage tanks should have a drain valve at the lowest point through which water can be drained off at regular intervals.

Various species of fungus, bacteria, and yeasts are able to grow in fuel, provided water is present. Most of these organisms produce acids, which can corrode engine parts. Microbiological contamination is prevalent in parts of the fuel system where fuel is allowed to remain still, where water (eg. spots of condensation) may be present. Colonies of organisms can plug filters and screens in the fuel system.

Normally bugs appear as slimes and scums.

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And in the same vein, another BP document expands on these problems:



The common causes of filter blockage are:-

### **SUSPENDED WATER**

Suspended water appears as a haziness in the fuel and is normally a cold season problem. When diesel fuel cools down during storage dissolved water will be released as small droplets. If the droplets do not drop to the bottom they will form a haze. This can be seen on cold mornings after overnight storage and it will disappear when the fuel warms up. Generally seen as a greasy emulsion on blocked filters which disappears when the filter is dried. This problem can be resolved by ensuring that any settled water is drained from the tank each morning.

### **SUSPENDED PARTICULATE MATTER**

Dirt, rust or oxidised fuel may form a fine suspension of brown or red particles, causing a greasy black deposit on the fuel filter. Laboratory analysis of the filter and fuel may be required to establish the cause. Resolution of the problem may require change of fuel and/or improved fuel storage management.

Under cold conditions wax can be seen as a light yellow suspension in the fuel. When the fuel is cooled below the temperature at which the wax comes out of solution (cloud point) it can block filters by forming a yellow waxy deposit. This is a result of using the incorrect fuel for the season or region, eg. using summer grade ADF in winter or bringing an ADF from warmer areas to a colder area during winter. The problem can be fixed by waiting for the fuel to warm up and changing the filter or by lowering the cloud point by the addition of up to 30% of heating oil to the fuel. To help prevent waxing problems you should always ensure that all fuel is changed over to fresh fuel by May at the latest. There is a two month lead time in the distribution of the fuel to ensure that all fuel available by May is winter grade for the cold period between the start of May and the end of July.

### **FUNGAL CONTAMINATION**

Fungal contamination is a symptom of poor water draining. It is normally associated with long standing free water, hazy fuel, suspended water and dirt. Fungals are detected as a black/brown chocolate mousse blocking filters. Laboratory analysis of the filter and fuel may be required to confirm that active fungal growth is present. Fixing this problem will require changing of filters, frequent and regular draining of water, slime, sediment and hazy fuel from all storage tanks. Serious contamination may require thorough tank cleaning and treatment with a biocide. Normally a warm season problem. Prevention is by frequent and regular draining of all water.

### **ADDITIVES**

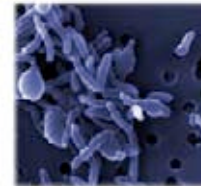
Sometimes customers treat fuels with additives, if they are not mixed with the fuel correctly then they may block filters. The appearance of the filters and contents of the filter bowl will depend on the additive used. Sometimes the additive will discolour water in the filter bowl so it looks like fuel. Combustion improvers may look waxy. The first use of detergent additives will probably carry rust and dirt on to the filter. The problem is usually fixed by changing the filter after finding out what additives are used.

### **NOTE**

A problem with one truck is indicative of a problem with fuel on the trucks' tank. Problems with a number of trucks indicates a problem in the main storage tank and investigations should concentrate on that tank.

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BP also have a technical description of the issues relating to bacterial growth in diesel fuel.



## **MICROBES IN FUEL**

Left unattended, fuel in storage tanks can sometimes develop a dirty slime at the fuel/water interface. Apart from being unsightly it can block tank strainers and vehicle fuel filters. If left unattended it can spoil the fuel and contribute to tank corrosion.

### **WHAT IS IT?**

It is mainly a fungal growth. Fuel is its main food source; it prefers kerosine or automotive diesel fuel to petrol. It is often described as looking like a "chocolate mousse". When the conditions are right, growth will occur at the fuel/water interface. Large mats of slime can form quickly and block filters. Reduced fuel stability and corrosion can also occur. The most prevalent fungus that grows in fuel is *Cladosporium Resinae*. Commonly called "clad" it caused widespread problems in the aviation industry before it was recognised and controlled.

### **WHERE DOES IT COME FROM?**

Fungi are natural soil inhabitants. Their spores, which are like very small seeds, easily become airborne and all fuels will contain some. Spores by themselves cause no problems, but when they germinate and grow the problems begin.

### **WHAT CONDITIONS PROMOTE THEIR GROWTH?**

Essentials - water

- food source; a suitable fuel
- correct temperature range (10°C - 40°C)
- 

If any of the above are absent the spores will remain dormant until suitable conditions are present. Petrol is not a good food source; its composition is rarely suitable and lead when present, acts as a poison.

### **CONTROL**

The key to fungal control is removal of water. The low points of tanks and pipework must be drained regularly. If all water is removed one of the essential conditions is absent and fungi cannot grow. There are several options available to treat fungus, once it has been confirmed that this is the problem.

One option is to clean the tank thoroughly, preferably by steam cleaning. Any small residue of fungus or dirt remaining will help the fungus re-establish. A biocide may then be added as a preventative measure. Biocides are chemicals which act as a fungal poison, killing the existing fungus and preventing a recurrence of the problem.

Alternatively, treatment with a biocide may be all that is required. A biocide should only be added to a fuel tank after any free water and sludge has been drained off.

If fungal contamination is suspected, samples can be tested. It is important to draw samples from the fuel/water interface and the tank bottoms.

Please use these chemicals in accordance with the manufacturer's instructions, and dispose of any fuel or tank washings properly.

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As can be seen, this is a serious issue. For everyday diesel usage such as in cars, vans, trucks and busses, the problem simply will not occur. The fuel is not kept long enough for the growth to occur/ however where the diesel is stored for long periods of time – storage tanks for back up generators, bulk fuel storage on farms and industrial plants, reserve storage for vehicle fleets etc – then the problem will soon become all too apparent.

So what can be done? Fuel maintenance is unfamiliar to many companies, BP and other suppliers offer some advice, however this is often costly, time consuming and in some cases unpractical.



### PROLONGING THE STORAGE LIFE

Prolonging the storage life is achieved by removing or controlling the conditions described in the previous section. Important measures to take are as follows:

- Ensure that the fuel is not in contact with any surfaces containing zinc or copper or compounds containing those metals (eg. brass). If those metals are present then a metal deactivator additive may help.
- Establish a regular fuel maintenance program to ensure that water and dirt is removed from storage tanks. This will also remove any chance for fungus to grow.
- Water should be drained from the storage tanks weekly. The frequency can be extended if the tank shows no tendency to collect water but should be done at least monthly.
- Tanks should be kept full to reduce the space for water to condense, maintaining tanks half full increases the water build up and promotes corrosion in the top half of the tank. Most water will come from condensation as the tank breathes, the rate at which water collects will depend on local climate and will be higher in hot humid coastal areas.
- Tanks should have a well defined low point where water will collect and can be drained. For example, cone down bottoms.
- Establish a system for filtering the contents of the main storage tank through a re-circulating filter system. This can be made automatic and will reduce the potential for problems by removing sediment and gums. The filters should be checked and changed at regular intervals. When the filter change interval reaches a certain frequency then the fuel should be changed over.
- Tanks should be emptied and cleaned at least once every 10 years, or more frequently if there is a major contamination.
- Ensure that the fuel supplied conforms to a recognised specification and ensure the fuel matches the winter cloud point for the area to avoid filter blocking by wax drop out in cold weather.
- Always purchase fuel to replenish stocks in the winter season April - August. This will ensure that the fuel will not cause wax problems whatever season it is used.
- Obtain assurances from the supplier that all components are fully refined to promote stability.
- Establish a monitoring program whereby samples are taken at regular intervals to monitor the condition of the fuel. The samples can be examined at the site visually for evidence of haziness, sediment, darkening or sent to a laboratory for testing.
- Regularly turn the fuel over. If possible, plan the fuel usage so that it will all be used within 1-5 years and replaced with fresh fuel.

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These recommendations make a lot of sense, but consider how many companies or businesses actually follow these guidelines? For example:

- Ensure that the fuel is not in contact with any surfaces containing zinc or copper or compounds containing those metals (eg. brass). If those metals are present then a metal deactivator additive may help.

This would normally be achieved at the point of installation. But what happens after a system has been installed? Do businesses regularly check their fuel storage and supply systems to ensure no zinc or copper compounds are present?

- Establish a regular fuel maintenance program to ensure that water and dirt is removed from storage tanks. This will also remove any chance for fungus to grow.

This is a very good point, in recent research we found most companies we have spoken to had no fuel maintenance schedule in place. They were concerned with looking after the back-up generators, but not the actual fuel.

When the other points are considered, the argument for a separate fuel maintenance system starts to become clear.

- Water should be drained from the storage tanks weekly.
- Tanks should be kept full to reduce the space for water to condense
- Tanks should be emptied and cleaned at least once every 10 years, or more frequently if there is a major contamination.
- Establish a monitoring program whereby samples are taken at regular intervals to monitor the condition of the fuel.
- Regularly turn the fuel over. If possible, plan the fuel usage so that it will all be used within 1-5 years and replaced with fresh fuel.



Consider the issues listed above, now think of a system that could ensure the stored fuel is kept in optimum condition. As BP say in their document 1402 “Establish a system for filtering the contents of the main storage tank through a re-circulating filter system” and “Establish a regular fuel maintenance program”.

### Costing it out

Some companies already take their fuel quality seriously – taking 15-20 litre samples ever year to 18 months and getting them tested for issues. At the time of writing a typical quote for this process is about £100. It is worth noting that whilst this process is important, it would only highlight that further action is required, and not actually deal with the problem in hand.

BP advises to change the fuel every 5 years or so, at the time of writing the pump cost of diesel is approximately £1 per litre. A typical back up generator tank can vary between 5,000 to 30,000 litres depending on the size of the business. That kind of expense every few years is not a cost effective way of dealing with the issues of stored fuel. Notwithstanding the issue of getting rid of the expired fuel, after all it cannot be used in cars or vans and so it could be burnt off– with the associated problems of trying to use old fuel as listed before. Alternatively, it must be correctly disposed of – another expensive process as it cannot be simply poured down the drain.

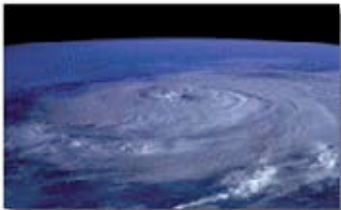
Finally the recommendation of a thorough tank cleaning every 10 years. This is not the fuel itself but the metal of the tank that must be cleaned. Again this is not a low cost exercise, and however important it may be, it is often put off or ignored by companies as an unnecessary expense.

At the time of writing, the cost of fuel management if the process as set up by BP was followed could be anything up to £36,000 if a company had a large backup tank. Even with a modest tank of 2,000 or 3,000 litres, the 10 year cost would be approximately £9,000 for testing, replacement fuel every 5 years and tank cleaning every 10 years.

It is worth pointing out that whilst approximate, these figures do not even take into account the maintenance and time costs of the other processes involved. Moreover they do not take into account the cost to any business if their backup system fails? What would a business loose if it were to loose power for an hour?

Do companies actually take care of their stored fuel? A surprisingly large amount of them are not even aware of the issue, and many who are simply do not invest the time and money to follow the guidelines as laid out by BP (or other oil companies).

If these procedures are not followed, *what is the worst that can happen?*



Well consider the issues experiences in Florida recently. After Hurricane Katrina, power outages were experienced in the Fort Lauderdale / Miami area – in some cases lasting up to 4 weeks. Many companies had back-up generators, and with regular maintenance these companies were confident of being able to see out the power shortage and ensure their business continuity.

However, without fuel management whist the back up generators started, the primary filters blocked after 1 to 2 hours of running. This naturally mean the generators stopped, starved of fuel.

There was a simple answer to this problem – to replace the primary filter elements. However this took time, time where the companies in question are without power. This would naturally affect their ability to trade, loss of customers and loss of income. Furthermore, the problem is not actually solved, the generators were restarted but the problem re-occurred, again after about 1 to 2 hours of running.



Changing the elements had not solved the problem, only given the company another short burst of power. After 3 to 4 weeks of changing elements every couple of hours, the cost and time lost to this problem caused many companies to search for a permanent solution.

The real problem was three fold, and exactly matched BPs acknowledged issues with stored diesel fuel.

1. Stored diesel degrades – causing large deposits of gum and other conglomerates in the fuel.
2. Florida has a hot climate, meaning the fuel degraded much faster than anticipated.
3. Water in the stored diesel had caused bacterial growth, and other contaminate.

All these causes added together to create stored diesel that would allow a generator to start and run for a short period, but then rapidly block the fuel filters. Of course this is the job of the filter – to stop contaminate from reaching the engine / generator, but relying on an in line system mean that these company paid a high price for their lack of fuel management.

It is also worth considering that this is not a specific Florida problem, here in the UK we do not experience hurricanes very often if at all, but there are many other reasons when UK businesses will need to rely on their back up systems.

**BBC News:** UK 'at risk from power blackouts'  
<http://news.bbc.co.uk/1/hi/england/tyne/3154001.stm>

**The Telegraph:** And the forecast for this winter is... bitterly cold with heavy snow and power blackouts  
<http://www.telegraph.co.uk/news/main.jhtml?xml=/news/2005/09/18/nchill18.xml>

**BBC News:** Floods leave homes without power  
<http://news.bbc.co.uk/1/hi/uk/4156017.stm>

**The London Assembly “London power cuts” report**  
<http://www.london.gov.uk/assembly/reports/pubserv/powercut.pdf>

**RICS:** Putting your business at risk from power cuts  
<http://www.rics.org/Management/Businessmanagement/Businesscontinuity/Putting%20your%20business%20at%20risk%20from%20power%20cuts.html>

**BBC News:** Power cuts 'could hit UK by 2006'  
<http://news.bbc.co.uk/1/hi/business/3496844.stm>

And at the time of writing, London was once again hit by power cuts, directly effective business both large and small.

**BBC News:** Sweltering Soho hit by power cuts (27<sup>th</sup> July 2006)  
<http://news.bbc.co.uk/1/hi/england/london/5221188.stm>

West End facing more power cuts (28<sup>th</sup> July 2006)  
<http://news.bbc.co.uk/1/hi/england/london/5222996.stm>

**EDF Energy** Power supply interruptions in the Soho area of London – Update (28<sup>th</sup> July 2006)  
<http://www.edfenergy.com/html/showPage.do?name=edfenergy.media.news.item.til&msPage=/opencms/export/www.edfenergy.com/media/news/20060728.html>

**The Times:** Thousands face second Central London blackout (28<sup>th</sup> July 2006)  
<http://www.timesonline.co.uk/article/0,,2-2289828,00.html>

## So what is the answer?

According to BP's guide for long term storage of diesel, fuel additives are a possibility, but they have their drawbacks:



### **ADDITIVES TO IMPROVE STORAGE LIFE**

The following additives can improve fuel storage life:

- Metal deactivators. These work by stopping copper, zinc and other reactive metals from reacting with the fuel.
- Fungicides/Biocides. These work by stopping fungus and bacteria from growing in the fuel and so prolong the life of the fuel. They are only effective on fungus and bacteria and will not stop other oxidation reactions from taking place. They are normally active at the water fuel interface where the fungus and bacteria grow. If fungus is present then a kill dose is required. Otherwise a maintenance dose is used to stop fungus growing. The disadvantages of biocides are:
  - Handling and mixing is hazardous because they are poisons.
  - For a kill dose, killing the fungus can lead to a build up of dead matter which will block filters and also cause the fuel to oxidise.
  - Ideally, the fungus should be killed and then the tank emptied and drained out.
  - Maintenance doses are effective but no more so than regular water draining.
  - Disposal of water bottoms requires special handling with due regard to the environment.

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As can be seen, fuel treatments do have advantages and are infinitely better than doing nothing at all. However their many disadvantages, not least hazardous handling and storage requirements mean that most companies are simply not equipped to handle them without ensuring their health and safety policies have been updated.

Staff who handle biocides need to be specially trained and have attended the correct courses to handle the biocide and the product must be correctly stored.

Moreover, biocides do not clear the whole problem, they treat the infection, but as can be seen the contaminate remains in the fuel – and will stay there until removed by either clearing the whole tank or being strained out by the primary filter.

So if a short term liquid treatment does not solve the problem what will?

With the time and expense of training staff counting out the fuel additives, and the standard BP procedures being too expensive and time consuming – there must be a better way?

## The Separ Fuel Polishing System

Since its introduction, the Fuel Polishing System (FPS for short) has proved to be a reliable, electro/mechanical solution to the issues related to storing diesel.

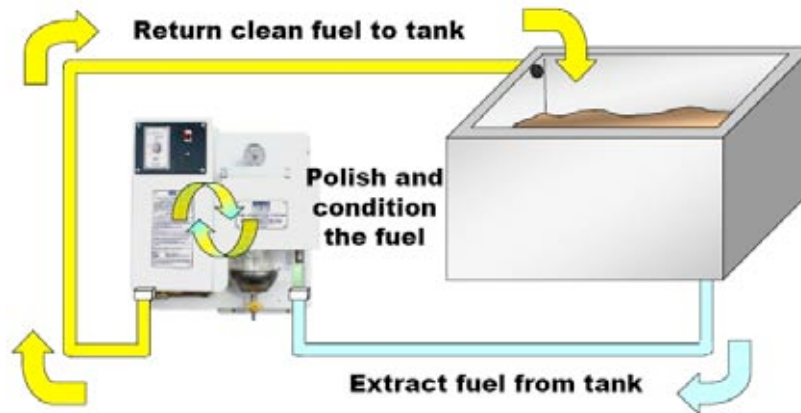
When compared to the cost of managing the stored diesel, the FPS is a highly cost effective solution. If compared to the cost of performing the correct maintenance as specified by BP, then the FPS is a clean winner when considering effective fuel management.



By conditioning, cleaning and optimising the fuel, it ensures stored diesel is kept ready to be used whenever required. Moreover it is designed as an “offline system” meaning it can process the stored fuel separately to any fuel being used to run a generator etc.

The system removes water, bacterial growth and other contaminate from diesel, and being an electro/mechanical process can be operated without requirement for specialised hazardous substances training.

The FPS is designed to be mounted on or next to the fuel tank, and is designed to be used as a totally independent solution. By that we mean it should ideally be plumbed to pull fuel from the bottom of the storage tank, process it and then return it to the top, opposite end of the same tank.



Electrically, the equipment can be supplied to operate with 12vDC, 24vDC, 110vAC and 220/240vAC, and the range is wide enough to cover all sizes of storage tank.

Advances in filtration technology have meant this 7 stage system can independently process diesel as part of a regular maintenance schedule. This means there would be no requirement to regularly check the fuel for water or contaminate as the FPS will achieve just that, whilst also ensuring that should any issue be present, it is immediately dealt with – thus ensuring clean fuel, ready for use.

The FPS is simple to install and simple to operate. Once power is applied to the unit, the system is designed to be simply operated by use of a timer. Select how long the unit should operate for (and hence how much fuel to process), and then the operator is free to perform other maintenance tasks in the area. The FPS requires no external assistance in operation and will inform the user should any problems arise, furthermore clever electronics in the control system will ensure the FPS is automatically shut off should fuel contamination mean the internal element requires changing. This system protects the FPS, the fuel and the pipe work ensuring trouble free operation.

Being an offline system, should the fuel be full of contaminate - any cleaning and related maintenance requirements can be processed at a non critical time. Attempting to clean the fuel at the point of delivery (online filtration) was the downfall of companies in the earlier Florida example.

## The Separ Fuel Polishing System



- ⇒ Extremely cost effective solution
- ⇒ Unique service filter alarm
- ⇒ Eliminates the build-up of bacteria
- ⇒ Eliminates the build-up of water
- ⇒ Reduces cost of filter maintenance
- ⇒ Self contained
- ⇒ 99 % Water and Particulate removal per fuel pass
- ⇒ Compact
- ⇒ Easy Connection
- ⇒ Wide product range

When re-considering BP's requirements from earlier on, the FPS excels as the perfect solution

BP fuel management requirement	Fuel Polishing System	Alternative solutions
Cost effectiveness. Fuel sample every year, new fuel every 5 years, tank cleaning every 10 years. Permanent water / contaminate straining.	Single purchase to ensure optimum fuel quality. Will rapidly pay for itself compared to approved procedure.	Depending on tank size, can be up to £30,000 over 10 years at current pricing.
Ensure water and dirt is removed from storage tanks. This will also remove any chance for fungus to grow	Standard feature on all FPS units	Many separate procedures required
Water should be drained from the storage tanks weekly.	Standard feature on all FPS units	Requires special tank design
Tanks should be kept full to reduce the space for water to condense	FPS removes the need for this	Costly, especially if samples are often taken
Tanks should have a well defined low point where water will collect and can be drained.	FPS removes the need for this	Requires tank design
Establish a system for filtering the contents of the main storage tank through a re-circulating filter system.	The FPS is the solution	Customers must establish their own procedures
Tanks should be emptied and cleaned at least once every 10 years, or more frequently if there is a major contamination.	The FPS will keep sorted fuel in optimum condition	Costly and time consuming. Removal of old fuel an issue.
Establish a monitoring program - to monitor the condition of the fuel.	FPS removes the need for this	Cost associated with each check. Secure delivery of fuel to testing facility an issue.
Regularly turn the fuel over. If possible, plan the fuel usage so that it will all be used within 1-5 years and replaced with fresh fuel	FPS removes the need for this	Costly and time consuming. Removal of old fuel an issue
The key to fungal control is removal of water.	Standard feature on all FPS units	Customers must establish their own procedures
Clean the tank thoroughly, preferably by steam cleaning.	FPS removes the need for this	Customers must establish their own procedures, potential large cost.

So when considering effective fuel management, what should one consider?

The message is clear, stabilise your fuel, remove the water, remove the contaminate, maintain your fuel quality – It sounds easy, but there are many factors to consider.



### 1. **Cost**

With any procedure, this has to be the first consideration. However it is not just the cost of the fuel, or the equipment, one must also consider the cost of maintenance, the cost of any tests required, and the cost involved in finding specialist products and companies to perform the required tasks.

The FPS will pay for itself rapidly, the first time a back up generator fires up. When viewed against standard fuel management solutions, the cost effectiveness of the FPS is crystal clear.

### 2. **Timescale**

Effective fuel management is not a 5 minute job. When looking at the fuel stored, one must consider how long it has been held for and how long it will remain in the tank.

The FPS means customers will get the maximum value out of their stored fuel, ensuring it is kept in optimum condition, and is ready to use – whenever it is required.

### 3. **Functionality**

When considering how to manage stored fuel, there are several stages in BP's recommendations that need extra attention. For example, BP recommend the fuel is changed every 5 years – how is old fuel disposed of? How is it drained from the tanks? What cost is involved and what time scale is needed?

The Separ FPS means companies no longer need to worry about expensive fuel handing processes, or specialist companies. It will keep the stored diesel in the best condition possible, meaning no special training is required. Moreover its stand alone design means it can be operated as part of the standard maintenance schedule.

### 4. **Practicality**

Fuel is an unknown commodity to many companies, it has been a popular misconception with some that diesel is 'good for life'. The reality of effective fuel management means work and investment, and for any organisation, the smaller the time and outlay the better.

Standard procedures can be time consuming and can involve many different companies. The Separ FPS ensures the procedure of fuel management is quick and painless, whilst maintaining highest possible fuel quality for lowest outlay.

## 5. Ease of use

How easy is it to move fuel? At a petrol station customers use special pumps, complete with safety features such as extra strength hoses, auto shut off valves, maximum flow restrictors etc. The same cannot always be said for back up fuel tanks. How easy would it be to remove all the fuel from a storage tank? Where would it be stored? How would perform the tasks? And of course, how much would it cost?



The FPS is designed with ease of use at its heart. After initial connection (electrical connection – 1 cable, and the fuel in/fuel out lines) the operation is as simple as an on switch and a timer to instruct the unit how long to run for. No extra fuel handling is required, no special training. The FPS is self contained, independent and will instruct the user if fuel issues are found. Simply put the FPS is peace of mind.

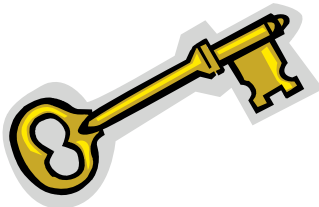
## 6. Support / Backup

Conventional fuel management solutions require on many different companies and individuals. A company with back up generators will no doubt have to rely on specialised fuel testing companies, qualified fuel handling companies (for taking and shipping samples), tank cleaning companies, fuel disposal companies, etc. If they are to use micro biocides as well, their own staff must also be trained up.

The FPS removes all these worries and will ensure that a company performing routine generator or engine maintenance can also perform fuel maintenance. Cutting costs and complication from the process.

Separ Distribution UK offer peace of mind, flexibility and a product that will take the effort and expense out of effective fuel management. Moreover, the FPS provides excellent quality results without the effort and cost.

### ***The key point to remember with fuel management is:***



When you need your fuel the most, when your backup generator must run to keep you business, company, office, working, when there is a power cut and you are relying on your emergency systems, you have to be confident in your diesel. The Separ Fuel Polishing System will give you the best possible fuel condition – finding problems offline before they become “generator stoppers”.

Ask yourself what it would cost your business if your systems lost power for 5 minutes, 10 minutes, 30 minutes?

How much money would be lost, how much data, how many potential customers, and how many sales?

If the cost of maintaining fuel quality is not high on the agenda in your business, it is worth taking the time to consider the ramifications. Many companies do not consider the fuel as a maintenance issue – but if ignored fuel will degrade, and if left water can and in most cases will form – causing a real danger of bacterial growth which will accelerate the fuel degradation and cause by product to clog filters.

**Effective fuel management is not a wish; it is a must.**

## Further Reading / References

Fuel management is a complex topic, the FPS is the perfect solution to make these issues simple. However if further reading is required we can recommend the following documents:

ADF 0907	Common diesel problems 1
ADF 1006	Common diesel problems 2
ADF 1107	Common diesel problems 3
ADF 1402	Long term storage of diesel
ADF 0509	Microbes in fuel
ADF 0406	Adulterated fuel
ADF 1502	Fungal contamination of boats
ADF 2102	Fuels – winter diesel additives
ADF 2302	Fuels – winter diesel problems summary
ADF 0207	Fuels – winter understanding CFPP
June 2005	BP New fuel guarantee
ADF 0806	Automotive diesel fuel Q A
ADF 1203	Diesel engine emissions
ADF 0607	Diesel engine filters
ADF 0705	Different slant on diesel
ADF 1301	Factors effecting diesel emissions



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### Products and Services Benefits and Recommendations for Diesel

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[http://www.exxon.com/USA-English/GFM/Products\\_Services/Fuels/Diesel\\_Fuels\\_BenefitsRecs.asp](http://www.exxon.com/USA-English/GFM/Products_Services/Fuels/Diesel_Fuels_BenefitsRecs.asp)

### Products and Services - Diesel FAQs

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[http://www.exxon.com/USA-English/GFM/Products\\_Services/Fuels/Diesel\\_Fuels\\_FAQ.asp](http://www.exxon.com/USA-English/GFM/Products_Services/Fuels/Diesel_Fuels_FAQ.asp)



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<http://www.chevron.com/products/prodserv/fuels/bulletin/diesel>

### Diesel fuel specification and testing

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[http://www.chevron.com/products/prodserv/fuels/bulletin/diesel/L2\\_5\\_fs.htm](http://www.chevron.com/products/prodserv/fuels/bulletin/diesel/L2_5_fs.htm) or

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T.K. Garrett, *Automotive Fuels and Fuel Systems, Vol. 2: Diesel*. Pentech Press, London, 1994.

#### Engines

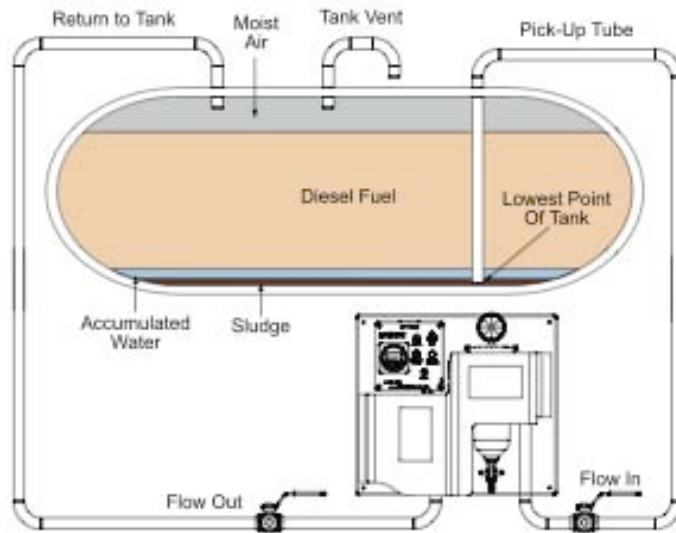
Karl W. Stinson, *Diesel Engineering Handbook*, 12<sup>th</sup> Edition. Business Journals, Norwalk, Connecticut, 1981.

John B. Heywood, *Internal Combustion Engine Fundamentals*. McGrawHill, New York, New York, 1988.

Ulrich Adler Ed., *Diesel Fuel Injection*. Robert Bosch GMBH, Stuttgart, Germany, 1994.



Reverso oil change systems are known and trusted by boat builders and boaters throughout the world. The same quality and dependability is found in our line of fuel polishing systems, which feature Separ and Racor® filters. Reverso fuel polishing systems eliminate 99.9% of water and dirt to keep fuel clean and reliable.



**How it works:**

Reverso Fuel Polishing Systems are designed to remove sludge and water that can accumulate at the bottom of your tanks. Our system takes fuel from the tank and passes it through a fuel water separator. This removes the bulk of large particulate and water.

An additional benefit is the reduction of dirty fuel going to the engine fuel system.

Note: For Best Result

Position your pick up line as close to the bottom of the tank and the return at the top.

**Our systems act as an insurance policy against bad fuel. With Reverso’s Fuel Polishing System you control the quality of your fuel.**



FPS-80



FPS-150



FPS-600 Cart