Diesel Fuel Additives

Technology Differentiation

Additive Categories

Conventional Diesel Fuel Additives	Biocides	Filming Amine Technology
Designed to clean downstream of fuel supply	Designed to kill bacteria and fungi	Dissolve biofilms (sludge)
Clean injectors with detergents, enhance lubricity, cetane boost, anti-corrosion additives, winter additives	Bacteria presence results in formation of biofilms (sludge)	Biofilm is a bacterial colony formed inside the tank by the bacteria and water present

Additive Objectives

Conventional Diesel Fuel Additives	Biocides	Filming Amine Technology
Designed to clean downstream of fuel supply	Designed to kill bacteria and fungi	Dissolve biofilms (sludge)
Boost cetane rating to increase BTU's		Prevent biofilm (sludge) formation
Detergents clean injectors Improve emissions and reduce particulates at exhaust		Protect all surfaces against MIC (microbiological induced corrosion) – pitting corrosion
Improve lubricity Eliminate water (beware!) Neutralize acidic components in fuel (stabilize)		Coat all surfaces including tank, pump, filter and injectors to prevent clogging and fouling

Quick Comparison

Conventional Diesel Fuel Additives	Biocides	Filming Amine Technology
More than 2000 additives on the market	Highly controlled by government agencies	FUEL RIGHT INNOVATION
Toxic ingredients	Extremely toxic	Irritant only
Varied results	Not overly effective with highly developed biofilm (sludge) issues	Extremely effective method to dissolve and prevent further formation of biofilm (sludge)
High dose rates	Moderate dose rates	Low dose rates (1:15,000, 1:30,000)
Moderately expensive	Very expensive	Economical

Ingredients (may contain)

Conventional Diesel Fuel Additives	Biocides	Filming Amine Technology
Trimethyl benzene	5-chloro-2-methyl-4-isothiazolin-3-one	Petroleum distillates (<10%)
Hydrocarbon naphtha	2-methyl-4-isothiazolin-3-one	Neutralizing amines
Naphthalene	Magnesium chloride	Filming amines
Aliphatic naphta	Magnesium nitrate	
Methylcyclopentadienyl manganese tricarbonyl	Water	
1-Methyl-1,2-Ethanediyl		
Nitrilonethylidyne		
Xylene		
Propylbenzene		

Summary

Conventional Diesel Fuel Additives	Biocides	Filming Amine Technology
Toxic (Poison)	Very Toxic	Irritant to eyes and skin
Contains volatile organic compounds (VOC's)	Highly controlled by government agencies	high flash point (combustible – packing group III)
May contain marine pollutants	Slowly being forced off the market through legislative efforts	Easy to transport via ground transport
	Contains marine pollutants	

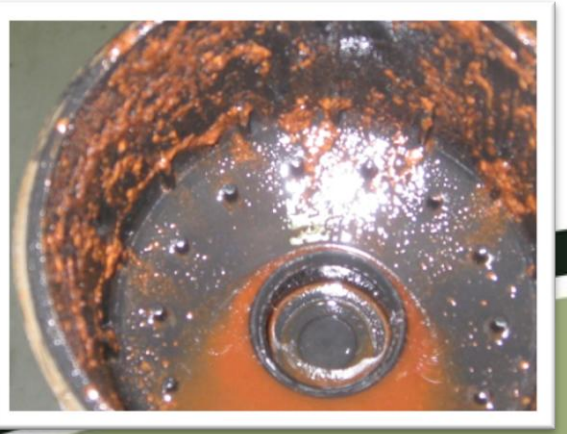
FUEL RIGHT Filming Amine Properties

Characteristic	Function
Alkaline (basic chemistry)	Neutralizes hydroperoxides in fuel to prevent breakdown of fuel while in storage (stabilizer)
Electrical Insulator (impedence)	Acts as electrical insulator between tank wall and fuel to inhibit electron transfer and formation of MIC sites (pitting corrosion)
Water proof	Protective tank lining to protect surface from corrosion in the presence of water or any biofilm presence
Low surface energy	Act as natural surfactants (not a detergent) that helps to keep system clean and free from fouling – protects injectors from corrosion and break down
Ability to break down EPS (dissolves sludge)	EPS is the exo-polysacharide (glue) that holds bio-colonies (sludge) together allowing it to grow and proliferate resulting in fouling and filter plugging. Removing the sludge eliminates fouling, filter plugging and helps prevent MIC.

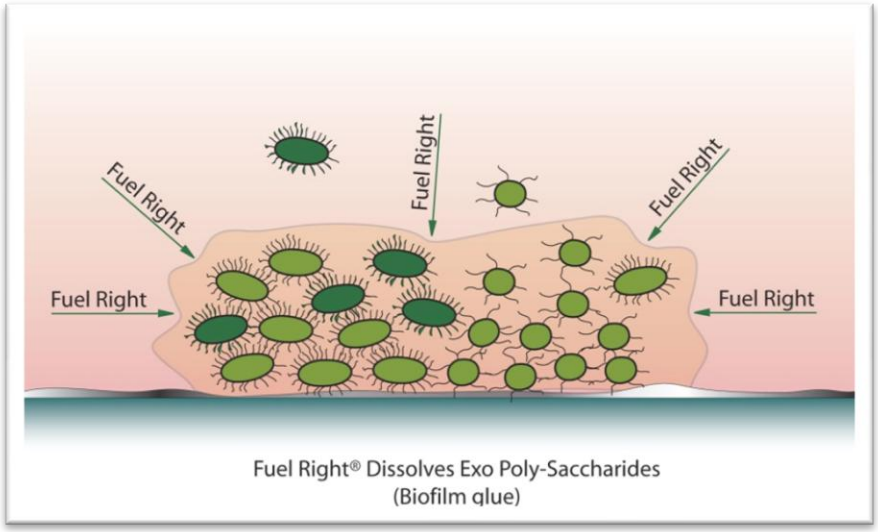
What does biofilm look like? (sludge)

Fuel Right's unique chemistry dissolves the glue binding the sludge together allowing it to be re-dispersed back into the fuel microscopically to be burned off without harm to the fuel system.

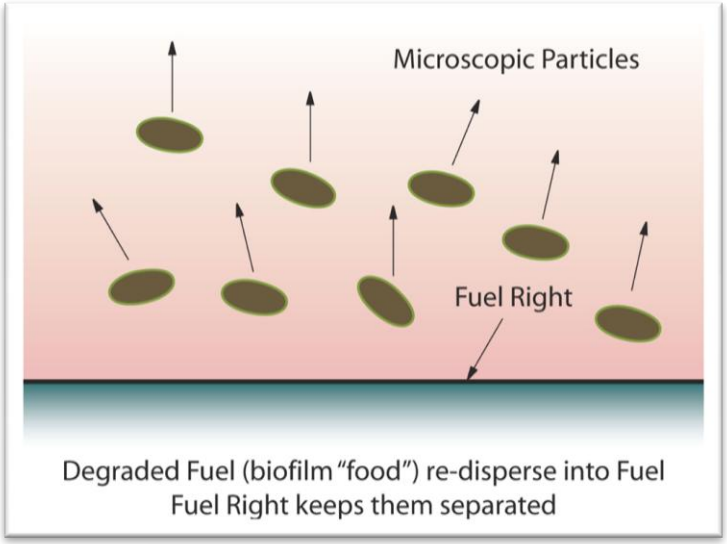
The end result is clean fuel with the threat of fouling and filter plugging eliminated.



Dissolving Sludge – How it Works



Fuel Right® Dissolves Exo Poly-Saccharides
(Biofilm glue)



Degraded Fuel (biofilm "food") re-disperse into Fuel
Fuel Right keeps them separated

Fuel Right is designed to dissolve the "glue" (exo poly-saccharides) that binds and protects the biocolonies (sludge). This is unique to Fuel Right technology.

Dissolve Biofilm (Sludge)

Untreated Diesel Fuel

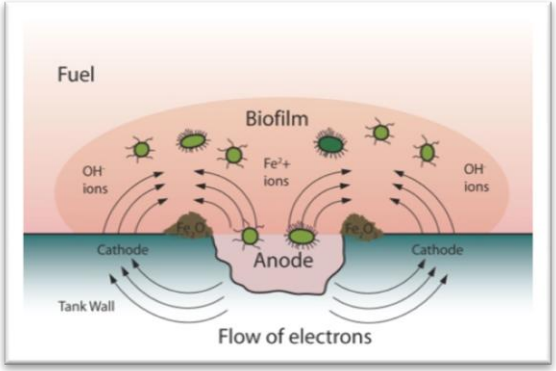
Treated Diesel Fuel

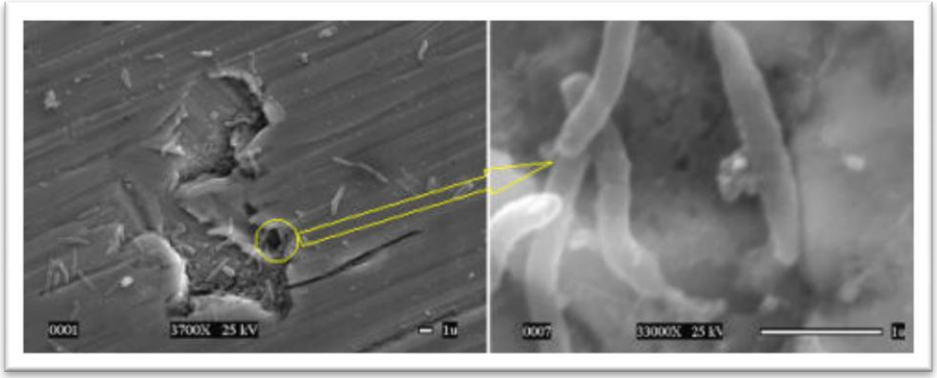
"Stabilizer"

- Commonly used term in the industry
- Less relevant today with ULSD
- However, hydro-peroxides formed during the refining process are present
- Hydro-peroxides are "acidic" and do contribute to fuel break down

- Fuel Right filming amine technology is ***"alkaline" chemistry***
- ***Neutralize hydro-peroxides*** reducing the threat of fuel breakdown

Corrosion Protection

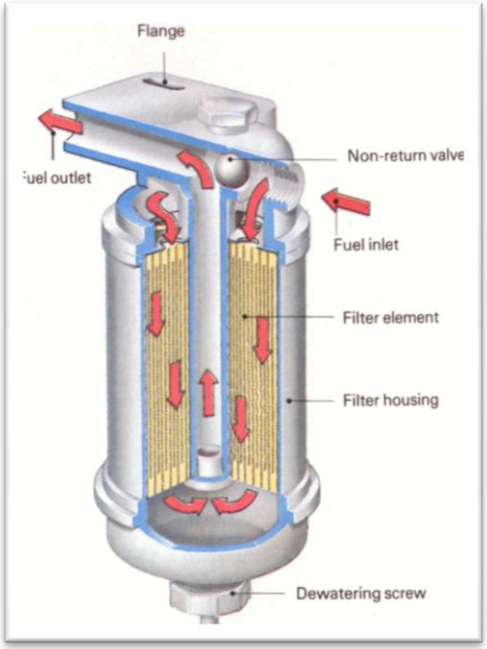




Fuel Right filming amine technology provides a microscopic lining throughout the fuel system acting as a waterproof barrier and protects against the formation of corrosion cells that can lead to pitting corrosion.

Fuel Right's removal of the sludge plays a role in assisting this process as sludge is acidic providing the electrolyte to accelerate the corrosion process.

Fuel Filters / Strainers



Fuel Right breaks down sludge on fuel filters and strainers.

Clean fuel that is free of sludge results in extended filter life and eliminates filter clogging issues.

Nozzles / Injectors

Fuel Right filming amines coat nozzles and injectors that helps to prevent fouling and break down.

The nozzles all have similar operating hours. The corroded nozzles operated in untreated fuel. The center nozzles were operated without treatment for a period of time and then Fuel Right was introduced.

The nozzles on the far right were only operated in a Fuel Right environment.

Implications of Clean / Protected Injectors

- Extended injector life
  - Expensive to repair / replace
- Protected if water passes through the system
  - Filming amines protect injector
- Optimal fuel atomization
  - Optimal ignition conditions
- Improved BTU production
  - Optimal engine performance
- Optimal fuel economy

Summary

- Greener technology when compared to conventional diesel fuel additives and biocides
- Maintains clean diesel fuel storage systems
  - Dissolves sludge
  - Prevents formation of sludge
- Prevents corrosion
  - Protective layer between tank lining and corrosive elements including water and sludge
- Extends filter life
  - Prevents filter and strainer clogging
  - Dissolves existing sludge that may be present on filter / strainer
- Ensures optimal operating parameters
  - Protects injectors / nozzles to extend service life
  - Helps to prevent injector fouling leading to optimal fuel atomization
  - Optimal fuel atomization enables optimal BTU performance and cleaner fuel burn
- Cost effective