



## Miscibility studies

Ethanol can be obtained from renewable biological sources. It is combustible and being a liquid is easy to handle. By comparison, diesel is primarily produced by extraction from fossil fuels and can be regarded as coming from an unrennewable source.

Mixtures of ethanol and diesel were explored as possible alternatives to pure diesel. The two areas to be examined were the ability to form a one-phase liquid and the stability of such mixtures.

Ethanol and diesel were mixed with a wide variety of surfactant agents. Included in this list was additive mk 11 and the components involved in its formulation. The long-term miscibility and stability of the resulting mixtures were studied.

Since ethanol has been introduced to both diesel and petroleum fuels as a standard component, there is already concern being expressed by the industry and users about the effect of its application as a bio fuel and the problems that can occur.

## Winter Diesel

### Aquasolve™

(providing Antifreeze protection to all Hydrocarbon fuels) and (Anti-Gel protection to all Diesel fuels)

#### Technical Information

Aquasolve™ is an ashless, non-metallic, combustion enhancing, fuel additive designed to “Solubilize” controlled amounts of water in diesel fuel or gasoline in order to eliminate water contamination and condensation in fuel tanks. This has the added benefit of preventing the water from freezing in the fuel lines and fuel filters - a major cause of cold-weather engine shut down. A treatment ratio of 1:250 to 1:500 is recommended for initial treatment, and after the initial treatment, prophylactic doses of 1:1000 are recommended to keep your fuel system completely free of water.

With moderate agitation (such as occurs in normal driving) this will solubilize approximately an equal amount of water into tiny droplets (too small for the eye to see!) which are actually incorporated into the fuel. The effect of this is to reduce the freezing point of the fuel to -5°F (-20°C). Please note that diesel normally freezes at -14°C.

Greater concentrations of Aquasolve™ can be added to remove greater concentrations of water from the fuel. In addition, Aquasolve™ provides natural lubricants which will improve the lubricity of the treated fuel enough that it will provide lower friction and wear than untreated fuel alone. The natural lubricants in Aquasolve™ will reduce the friction sufficiently (even in dry fuels) to provide engine efficiency improvements of up to 10% based on bench engine and chassis dynamometer tests.



## Benefit Summary

- Solubilizes water in diesel fuel and gasoline
- Prevents rust and corrosion
- Prevents Diesel Bug - by removing free water, a necessary ingredient for microbial growth which can cause diesel filter plugging
- Reduces the freezing point of water in fuel
- Acts as a natural lubricant to the fuel
- Improves fuel quality
- Stabilises all hydrocarbon fuels
- Cleans injectors and carburetors
- Improves engine efficiency up to 10%
- Removes water & reduces fuel line freeze

Aquasolve™ is designed to remove water from a diesel or gasoline fuel system by a process known as “SOLUBILIZATION”. By doing so, it significantly reduces the freezing point of water in the fuel system. There are many products on the market which claim to remove water and prevent fuel line freeze up. Most can even demonstrate their effectiveness by adding equal amounts of water directly to the fuel additive which shows complete solubility of the water in the additive. However, these tests are completely misleading. The water/additive combination will behave differently when added at the recommended concentration in the fuel, and those materials which demonstrate an ability to dissolve the water will not dissolve water in the fuel at additive concentrations lower than about 5%. Almost all of these products are based on alcohols or glycol ethers. Alcohols like methanol and isopropyl alcohol will not dissolve water in the fuel and will instead phase separate, going partly go into the water phase and actually increasing the volume of the water phase and significantly making the water phase more corrosive. However, these alcohols will reduce the freezing point of the water in the fuel. Methanol and ethanol are more effective than isopropanol, but methanol, in particular is more damaging to the seals and fuel system components. For this reason, Isopropanol is now more popular, but it requires larger amounts to reduce the freezing point and it will actually increase the friction in the injectors and pumps. The glycol ethers are less damaging to the fuel system components, but they are also less effective at reducing the freezing point of water.

In fact, none of the products currently marketed as water removers for fuels literally removes water from the fuel. Aquasolve™ works in two stages; first, by solubilizing the free water in the fuel and then removing it from the fuel system in the most effective way, incorporated as an integral part of the fuel in normal operation of the engine.

Aquasolve™ does not attempt to disperse the water into a separate alcohol phase to remove it, but instead “Solubilizes” controlled amounts into microscopic droplets which are now an integral part of the fuel, and which will easily pass through the fuel filters into the engine where the water actually contributes to the combustion process. Agitation of the fuel tank through normal driving is all that is required to achieve the solubilization of free water. Once the water is solubilized, it will not cause fuel injector or pump damage, in fact, fuel lubricated with Aquasolve™ has much better friction and wear properties than fuel alone, and water bound by the solubilization process is no longer corrosive.



By incorporating the free water contamination in the solubilization process, Aquasolve™ acts as a very effective corrosion inhibitor to prevent rust and corrosion of the fuel system components. Aquasolve™ will solubilize approximately an equal amount of water into the diesel fuel. A typical treatment to remove the water of condensation is a 1 litre bottle to 1000 litres of fuel. This treatment will also reduce the freezing point of the water normally present in diesel fuel below -20°F. For larger amounts of water in the fuel it will reduce the freezing point to -5°F when an equal amount of Aquasolve™ is added.

As a reference, 250 litres of diesel fuel, which is clear and shows no signs of water can actually contain more than one ounce of water dissolved in the fuel. As the temperature is reduced, this water falls out of the fuel and if it is below freezing, ice crystals will form. Larger amounts of water can be present in a fuel tank if the truck was filled soon after the underground storage tank was filled, thereby mixing the bottoms water into the fuel. Even at this rate, one bottle per 1000 litres should take the fuel to 0°F, unless a large volume of water has been added into the fuel.

A unique feature of the chemistry utilized in Aquasolve™ is that the active ingredient is incorporated with the water throughout the fuel, thereby permanently reducing the freezing point of the water, even if untreated fuel is added to the tank. A competitive product which is based on isopropanol, will reduce the freezing point of this normal water in diesel to 0°F when used at 750ml per 68 litres, but since the water is not removed in the process, and if untreated fuel is then added to the tank, the freezing point for this water in the fuel is now 23°F. In other words, this alcohol chemistry requires large concentrations of very expensive chemicals to be used continuously in order to even be mildly effective.

Reduces Rust and Corrosion - Aquasolve™ acts as a potent corrosion inhibitor to help control fuel system corrosion even in the presence of water.

#### Anti-Rust Test

Aquasolve™ has been subjected to extensive testing of the anti-corrosion actions using both the ASTM test method, as well as the Colonial Pipeline Corrosion tests.