Product Bulletin 03-11

Product Group 03 – Fuel Conductivity Improvers

Safety, the electrical conductivity of Gasoline and Stadis® additives

Trends in Gasoline

In the past it was normal to consider gasoline and other high vapour pressure fuels as too volatile to require additive treatment to boost electrical conductivity. An American Petroleum Institute publication on the 'Recommended practice for protection against ignitions arising from static discharges' stated: "these are products such as aviation and motor gasoline" and "products in this category will produce too rich a mixture to be flammable in a restricted vapour space. Therefore, static sparks within this vapour space will not result in ignition."

The principle being that, when loading a bulk road tanker for example, the gasoline evaporates so quickly that it floods the tanker air-space, driving out the air (and oxygen), preventing the formation of a flammable or explosive fuel / air mixture. Even if a spark occurs there is only a low probability of ignition inside the tank.

Recent developments in engine and vehicle design, coupled with on-going environmental concerns have prompted significant changes in the specifications and refining techniques for most road fuels. Deeply hydrogenated, low and ultra-low sulphur content fuels having reduced levels of electrical conductivity have entered the market.

Today, gasoline continues to evolve to meet changing market needs:

- Low sulphur content gasolines for use in urban environments will have lower conductivity and may require adjustment with additive treatment if safety margins are to be maintained
- Performance packages (which increase conductivity as a side effect) are often added at the loading rack or terminal rather than in the refinery blending unit, this delays the availability of enhanced conductivity unless the base fuel is treated
- Vapour pressures have been reduced to minimize volatile hydrocarbon losses
- Formulated gasolines containing alcohols or other oxygenates may have different volatility and flammability properties. Gasolines containing alcohols will probably have high conductivity owing to the polar nature of the alcohol.
- The negative effects of low temperature on fuel conductivity have also been more widely recognized, aviation gasoline is routinely treated with Stadis® 450 in Canada for this reason.

These changes suggest that the conventional policy regarding the electrical conductivity of gasoline may need to be reconsidered, especially in locations where operating temperatures are, or can be, below zero Celsius.

Fuel suppliers considering the use of Stadis® additives as part of a general safety policy should identify the points in the distribution system where high speed pumping, fine filtration or switch loading may take place. Switch loading presents the highest risk amongst these processes. High conductivity through the use of Stadis® in the fuel at these points will enhance safety.

Electrostatic charging during fuel handling

During the transfer of fuels, including gasoline, electrostatic charge can accumulate in the flow lines and in the receiving vessel. A typical example might be the loading of a road tanker from bulk storage at the refinery or terminal where the fuel in the road tanker could become electrostatically charged. If an electrostatic discharge occurs between the fuel and the tank wall whilst the fuel / air mixture inside the tank is flammable then explosion or fire may result. This hazard is well known within the industry and it has become standard practice to use Stadis® Fuel Conductivity Improver additives (also known as Static Dissipator Additives or SDA) to minimize risk when used in conjunction with other safety measures such as earthing the equipment.

'Switch Loading' hazards

Experience has shown that the highest risk of an electrostatic incident occurs when 'Switch Loading' operations are carried out. 'Switch loading' means the loading of a distillate fuel such as diesel into a road tanker or other vessel previously used to transport another fuel, for example gasoline. Flammable fuel / air mixtures are more likely to be present during Switch Loading than during the repeat loading of gasoline. Use of conductivity improver in the fuels will minimize the risk of an incident. The use of Stadis® conductivity improvers has become part of industry standard practice and a minimum fuel conductivity level of 50 pS/m is widely recognized as satisfactory for the rapid relaxation of electrostatic charge and safer operation.

'Fine filtration' hazards

Fine filtration involves use of filter coalescers, micronic filters or other filters with smaller pore size than metallic screens. The fuel conductivity should be 50 pS/m or more at the ambient temperature at the time of loading to assure rapid electrostatic charge dissipation, because filters with micronic porosity have an enormous capacity to generate electrostatic charge. To avoid electrostatic problems the filters must be located at least several minutes upstream of inlet to loading and the fuel should be treated with conductivity improver.

Temperature / Conductivity relationships

Experience has also shown the importance of understanding the Temperature / Conductivity relationship for each particular fuel. Conductivity falls as viscosity increases and viscosity increases as temperature falls. Stadis® additive treat rates must be adjusted in production to anticipate the level of conductivity needed at the actual operating temperature. Tanker loading at -20°C will still require 50 pS/m or higher for safety, the same as for loading at +20°C. Development of a temperature / conductivity response curve for the fuel will enable the necessary treat rate to be forecast with adequate precision.

See Product Bulletin 03-61 'How to Use Stadis® additives' Part 2 for further information

Temperature / Conductivity relationships in Gasoline

Recent trends in refining such as the development of Low and Ultra-Low Sulphur content fuels have raised concerns about electrostatic effects on gasoline, especially at low temperatures. This prompted an evaluation of the temperature / conductivity relationship of gasolines using example fuels treated with Stadis® 450.

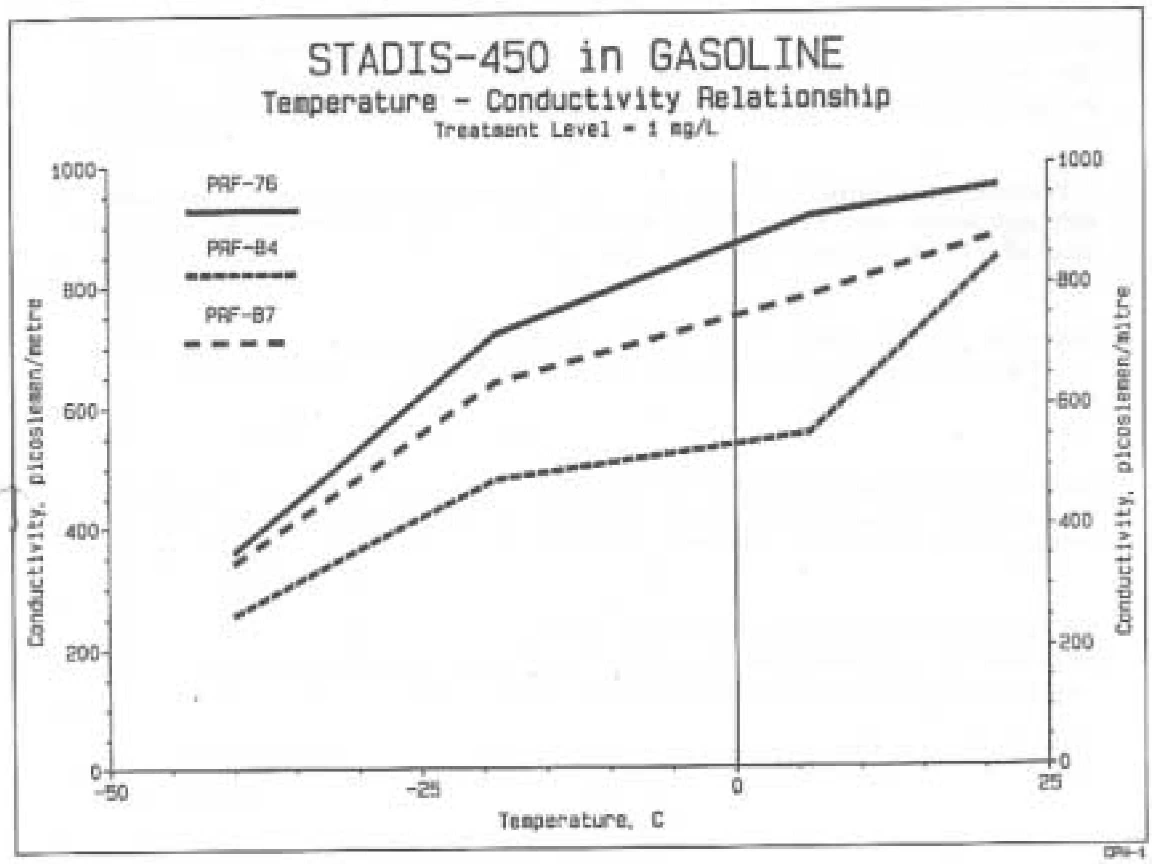
Conductivity response is inversely related to fuel viscosity; low viscosity promotes a high response and vice versa. The excellent conductivity response to the addition of Stadis® 450 in all three of these gasolines is in line with our normal predictions.

Conductivity measurements show that values of 250 pS/m or more can be obtained at -40°C with a treat rate of 1 mg/L of Stadis® 450.

In general practice a treat rate of 1.0 mg/L will provide a conductivity of 50 pS/m or more in gasoline, enhancing the safety of normal ambient temperature handling and loading operations. As shown in the chart illustrated below, this same treat rate may also be used in low temperature environments or during seasons when ambient temperatures below -20°C are anticipated.

In this evaluation three reference gasolines having conductivities of between 2 and 8 pS/m were treated with 1.0 mg/L of Stadis® 450 and then allowed to stand for several days. The samples were then cooled on successive days from +22°C down to +6°C, then to -19°C and finally to -40°C.

Comparison of conductivity response of three gasoline samples to 1.0 mg/l Stadis® 450 expressed as a Temperature / Conductivity relationship



We are not aware of any significant differences between the performance of Stadis® 425 and Stadis® 450 in gasoline. At the treat rates likely to be employed, we do not anticipate any significant interaction effects on the the performance of either the Stadis® additive or the fuel itself in gasoline applications.

Where refineries produce both jet fuel (aviation kerosene) and ground fuels (heating oil, gas oil, diesel fuel etc) the use of Stadis® 450 as the sole static dissipator is recommended, both to simplify house-keeping and eliminate all risk of using a non-approved additive in the jet fuel.