Fuel Additives for Ultra Low Sulphur Diesel
Innospec’s Fuel Specialties business is comprised of a number of dedicated teams. The Refinery Specialties team supplies refinery fuel additives and provides advice to refineries all over the world. When combined with the teams serving the needs of the performance diesel and gasoline, power, heating, marine and fuel borne catalysts markets, we offer unparalleled coverage of the global fuel additive market.
Innospec’s Refinery Specialties team is working at the cutting edge of fuel additive technology. The team has the experience and expertise to develop bespoke additive solutions on both a local and an international scale.

To achieve bespoke solutions we work closely with customers to offer a site-specific service that helps refiners meet product specifications cost-effectively. We draw on our portfolio of proven products to create innovative solutions that overcome the problems faced by refineries in their processing and handling of fuel.

Innospec’s Refinery Specialties team is committed to ‘going that extra mile’ to deliver exceptional customer service by drawing on the global reach and financial resources that few of our competitors can match. This means our customers profit from a worldwide supply chain, outstanding market knowledge, extensive research capabilities and first-class application technology support.

We were quick to spot the worldwide trend, driven by environmental, regulatory and marketing pressures, towards ultra low sulphur diesel (ULSD) fuel. This has presented new challenges to the refiner as well as new unique market opportunities.

The hydro-desulphurisation process used to remove sulphur from refinery streams has severe effects on other fuel properties because it also removes many other functional species in the fuel. In addition to sulphur, nitrogen and oxygen are removed from the fuel.

Whilst the effect of these changes on fuel lubricity is well recognised and widely understood, the effect on the fuel’s electrical conductivity, thermal stability, vulnerability to peroxide formation, cetane number and low-temperature handling is less well documented.

To improve the properties of ULSD, Innospec was the first company to launch an entire product range of fuel additives designed to boost the performance of ULSD fuel. Most of these additives are essentially sulphur-free. Those that do contain sulphur have such low treat rates that, in using them, the refiner can be assured there is minimal sulphur contribution to the fuel being treated.
Additives to boost performance

Innospec’s range of ULSD fuel additives are designed to boost the performance of diesel fuel. Our product line includes additives to improve lubricity, cold flow, conductivity, stability and cetane number.

**Lubricity**

A fuel with adequate lubricity is critical to the satisfactory operation of diesel engines. The engine relies on the fuel to lubricate many of the moving parts within the fuel injection system.

Rotary fuel pumps in passenger cars and light commercial vehicles in particular depend on the lubrication provided by the fuel for normal operation and long service life. However, the fuel components that inherently provide protection, such as polycyclic aromatics containing nitrogen and oxygen, are rendered ineffective by the hydro-desulphurisation processes. This means ULSD typically has poor lubricity.

Lubricity-improving additives are the most cost-effective way of achieving the lubricity specification for ULSD. Our additives have been developed to meet the industry’s most stringent performance requirements and are used throughout the world where ULSD is produced and marketed. They improve the lubricity of low sulphur fuels and restore protection for the rotary fuel pumps. High fuel lubricity also prevents pump-sticking in the In-Line fuel pumps used in heavy-duty vehicles and equipment.

Our Refinery Specialties team has developed two distinct ranges of lubricity improvers for ULSD.

The OLI-9000 range is based on high performance synthetic esters. It has pipeline approvals and is also available in pre-diluted form to meet viscosity needs. When measured using all industry-standard procedures OLI-9000 series products demonstrate superior performance. These additives have excellent low-temperature stability and show no tendency to crystallise.

The OLI-5000 range is based on monoacid chemistry. OLI-5000 products perform well in the industry-standard laboratory rig-tests and provide a highly cost-effective solution to automotive diesel lubricity problems. OLI-5800 series additives offer superior low-temperature storage and handling properties.
冷流

冷流改善

ULSD自然润滑油性差，但ULSD燃料供应商可以通过添加Innospec的冷流改善剂来满足低温性能要求，同时可将硫含量保持在50ppm以下。OLI-9000产品是唯一完全合成、非相互作用、非酸化的超低硫润滑油改善剂，可在整个燃料分配系统中使用。

Cold Flow

The introduction of low sulphur diesel was a major challenge to the low temperature performance of diesel fuel. Normal paraffins (n-paraffins) can account for up to 30% of a typical diesel fuel and range from 10 to 36 carbon numbers, depending on the distillation range of the finished fuel.

When sulphur is removed from diesel fuel by hydro-desulphurisation, the unsaturated hydrocarbons become saturated and the fuel becomes more paraffinic. This can have the effect of increasing the wax content of the fuel with a consequent worsening of low-temperature handling. This is because the large wax crystals can block fuel filters, pipes and hoses and cut off the supply of fuel to the engine, until the wax can be removed or re-dissolved into the fuel.

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There are a number of ways to maintain the low-temperature handling properties of ULSD. The refinery might blend wax-free kerosene with the diesel to reduce the wax content. However, this also lowers density and cetane number, damaging both fuel economy and engine performance.

Reducing the amount of heavy components in the blend may also lower the wax content but it also reduces both fuel density and the refinery’s production flexibility.

Both options can add significant cost to the production of the fuel. This makes them poor choices compared to the most cost-effective option of using a Cold Flow Improver additive to achieve the performance targets.

Innospec’s OFI-7000 series of Cold Flow Improvers is designed to offer solutions to a range of operational problems posed by low temperature. The OFI-7000 series includes additives that can lower Cloud Point, Cold Filter Plugging Point (CFPP) or Pour Point and Wax Anti-Settling Additives (WASA) that prevent the settlement of wax crystals in the cold fuel.

We can provide the key technical service of matching the complex distribution of waxes in each specific fuel to the optimum OFI-additive for that particular fuel. This matching technique enables the refiner to formulate fuels to meet his customers’ needs whatever the climate or conditions.
Conductivity

ULSD normally exhibits low conductivity due to the removal of the naturally occurring conductive polar species during the hydro-desulphurisation process. In order to minimise risk of Electro-Static Ignition (ESI) with low conductivity fuels the European Petroleum Industry recommends that either conductivity be increased or pumping speed reduced.

Switch loading, the practice of successively loading low conductivity diesel fuel into a tanker previously containing a high volatility fuel such as gasoline, creates a highly hazardous situation. A single static discharge from the electrically charged diesel to the tank wall can ignite the gasoline vapour, causing an explosion. Under these circumstances grounding and bonding are not enough to prevent a fire from starting. The problem is increased at low operating temperatures because the conductivity of the diesel fuel is further reduced and the gasoline will more readily form an explosive vapour mix in these conditions.

Fuel Conductivity Improvers help reduce the electrostatic hazards associated with the transfer, mixing and loading of petroleum fuels. Rapid flow rates and fine filtration of low conductivity fuel will encourage electrostatic charges to build up quickly. Low fuel conductivity prevents this charge leaking away to earth quickly enough to prevent the charge building up to arcing potential.

Innospec’s Fuel Conductivity Improver Stadis® 450 increases the electrical conductivity of the fuel and reduces the risk of static discharge and ESI at minimal treat rates. The use of Stadis® 450 Static Dissipator Additive is mandatory in most aviation turbine fuels for either civil or military use. Stadis® is widely used in ground fuels as ‘best practice’ to improve operational safety.

In today’s market, highly refined, low conductivity, low sulphur fuels are increasingly the norm. We suggest treatment of all distillate fuels with Stadis® 450 in order to assure high fuel conductivity levels at the point of high flow-rate transfer operations. For aviation fuels, this occurs at the time of aircraft fuelling. For ground fuels it is usually the time when tankers are filled for delivery to customers. Innospec offers a premium level of technical support for Stadis® 450 to help customers overcome conductivity problems.

Typical low sulphur diesel conductivity improvement using static dissipator additives

Typical low sulphur diesel conductivity improvement using additives to dissipate static
Stability
The hydro-treatment necessary to reduce the sulphur levels in diesel fuels also acts to reduce the level of unstable unsaturates present in the fuel. The end result is diesel that appears to have improved stability characteristics as measured by standard methods, such as ASTM D6468 and ASTM D4625.

Analysis of various low sulphur diesel fuels using accelerated peroxide forming tests showed that all the fuels consistently formed peroxides during testing. Traditional stabilizer additives for middle distillate ground fuels are not effective in preventing peroxide formation.

Innospec supplies two ranges of antioxidant additives. One is phenylene diamine based (AO-22 and AO-24) and the other is phenolic based (AO-29, AO-30, AO-31, AO-32, AO-70 and AO-80). By using these and other additives, Innospec has developed ULSD stabilizers that prevent peroxide formation.

Changing diesel fuel quality also has an impact on other middle distillate products like heating oils because of the increased quantities of lower quality blending components directed to non-road and burner fuels. Because of this, the demand for middle distillate stabilizers and dispersants, such as Innospec’s range of FOA-additives, has increased significantly.

Cetane Number
A diesel fuel’s Cetane Number is a measure of its ignition quality. It is widely recognised that high Cetane Number diesel fuels offer a number of benefits that are important for both engine performance and environmental health.

When sulphur is removed from diesel fuel through hydro-desulphurisation, the unsaturated hydrocarbons become saturated, making the fuel more paraffinic. This increase in paraffin content and the associated decrease in olefin content are beneficial to the natural Cetane Number of the stream. In practice, this increase is limited to, at most, a few Cetane numbers.

Innospec supplies a variety of Cetane Number Improvers to meet local needs. We are a major supplier of the industry standard 2-ethyl hexyl nitrate (2EHN).
Responding to market needs

Our team of technicians, engineers and product managers can provide advice and guidance across our complete product range. We combine unrivalled support with the ability to deliver products anywhere in the world through our international network of sales offices.

Working closely with the refinery, we can help meet a particular operational objective or fuel specification. Recognising that different customers wish to pursue different marketing strategies, we offer comprehensive marketing support to help get new products to market. Our team has a wealth of technical data available to support our customers’ advertising campaigns. This helps our customers get ahead of their competitors in the fight for market share.

So, from developing new products to following specific delivery instructions, you can rely on Innospec to get it right and add value to your business operations every step of the way.

As a company, Innospec has invested heavily in its scientific capabilities, both in terms of human and physical resources.

Our technical personnel are highly skilled experts that understand the chemistry that defines additive performance and the needs of our customers. Additive design is optimised by using state-of-the-art scientific techniques such as computer modelling and test simulation.

On-site we can provide a complete technical support service. When fuel specifications are changed or a new additive used for the first time, we offer on-site monitoring and assessment of the production streams to ensure that product quality is maintained.

Our Refinery Engineering Services team provides the expertise to help customers optimise their fuel additive dosing installations. This includes the design, construction, delivery and commissioning of new blending plant and dosing equipment as well as advice on safety and maintenance of these units.

By continually pushing the boundaries of technology, service and support, Innospec can respond to our customers’ ever changing needs in a rapidly changing market.

Our worldwide fuel testing and laboratory facilities are used to test fuel additives for performance and cost-effectiveness. We can optimise our formulations in line with customer requirements and specifications.
For more information on how Innospec’s Refinery Specialties team can work with you, please contact one of our sales offices.

This international office network offers unrivalled product support and has the resources to deliver fuel treatments to customer specification anywhere in the world.

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