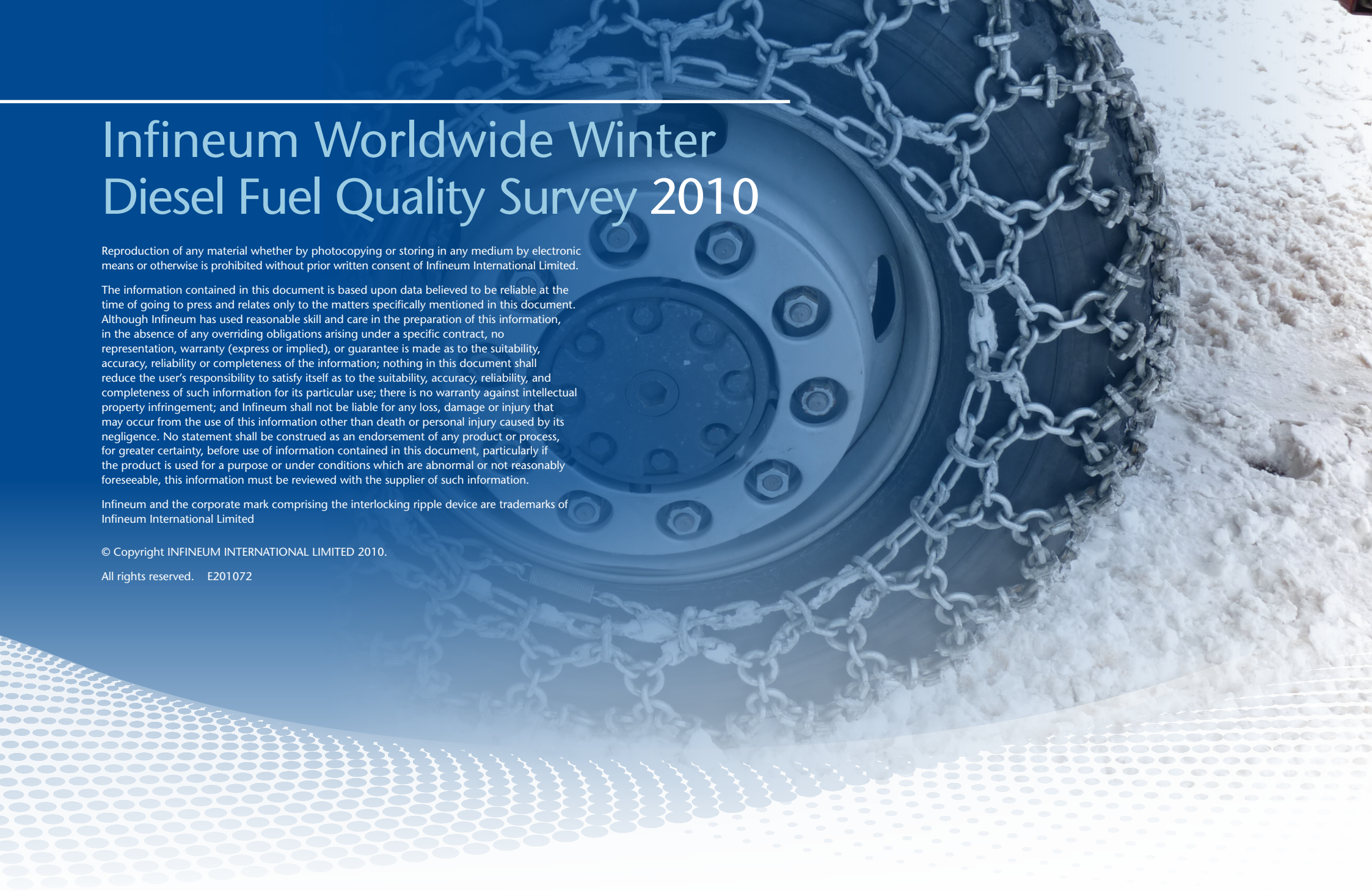
Infineum Worldwide Winter Diesel Fuel Quality Survey 2010



Introduction

The Infineum Worldwide Winter Diesel Fuel Quality Survey aims to provide the petroleum refining and distribution industry with an overview of the quality of automotive diesel in the marketplace, allowing tracking of international trends. To achieve this purpose, the Survey needs to cover as much of the globe as possible. For the winter 2010 survey, some 348 samples were collected in 40 countries around the world. The majority of samples were collected during January and February, deep winter months in the northern hemisphere. In southern hemisphere countries, sampling was delayed until later in the year when true winter grade samples could be obtained.

Samples need to be representative of the diesel purchased by the average consumer so they are gathered from service stations by Infineum colleagues at local area offices. As a general principle, Infineum tries to get one sample that represents the production from each refinery or region in a given country. To minimise the possibility of taking multiple samples from a single refinery, knowledge of local exchange agreements and distribution systems is used to select where each sample is collected. For the larger diesel consuming countries, this procedure results in samples that represent a reasonable average of the overall quality. However, for smaller countries or specific producers, spot sampling over a short period of time will effectively only provide a snapshot of production quality, with data derived from only one or two samples. This can make it more difficult to evaluate trends with any accuracy.

Analysis

The analyses applied to each sample are those we consider to be of most interest to the diesel producers, marketers, distributors and consumers. They cover areas of national specification, exchange specification and performance parameters. A degree of standardisation has been applied to enable diesel from all countries to be compared and the data analysed as a single set. Standardisation, however, means that not all national specifications are reported.

Wherever possible, industry standard test methods have been applied and in-house test methods avoided. This has been done so that the data published here most accurately reflect the results which could or would be generated by organisations within the petroleum industry.

When considering our data, in particular when comparing the various test results with the national specifications, it should be noted that a number of the tests have quite wide reproducibility bands, and very little repeat testing has been conducted to determine compliance or otherwise with specifications.

Test Methods

The majority of testing was carried out at quality accredited laboratories in the USA, Japan and the UK using the test methods below. Samples collected in Saudi Arabia and China were tested at local laboratories, using the same or similar test methods.

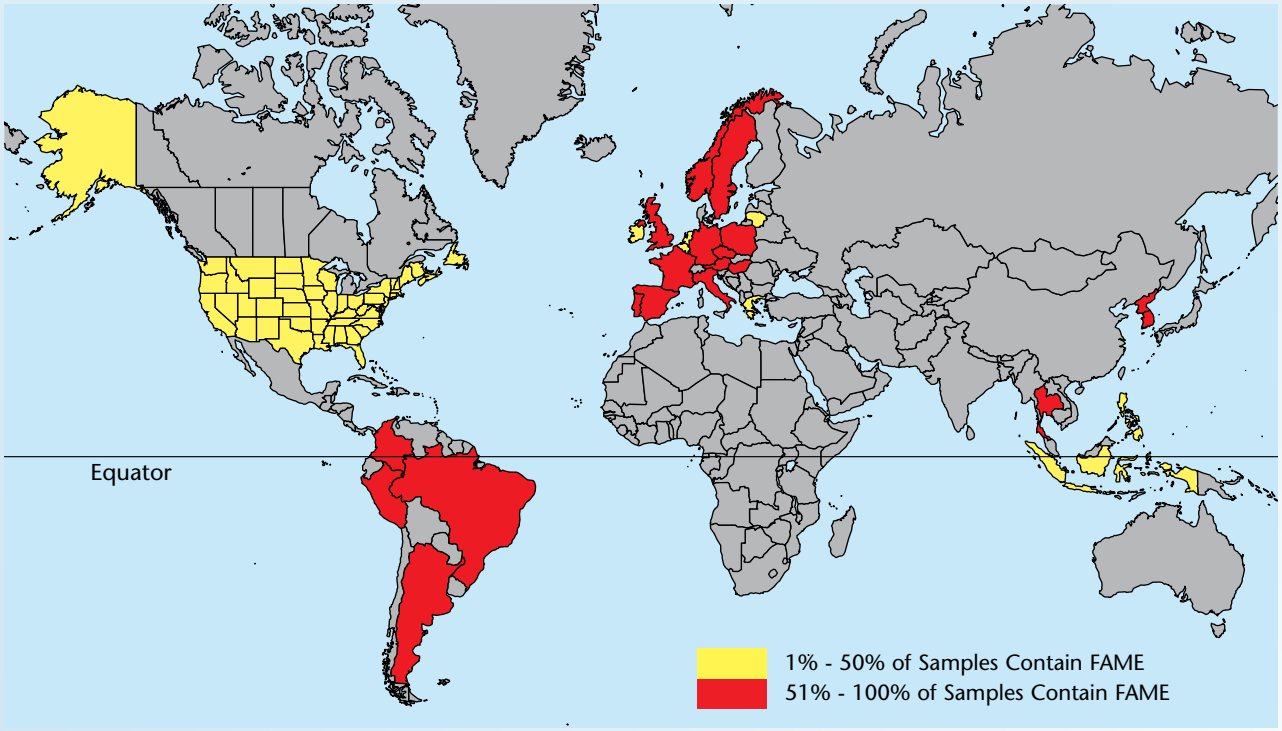
Density	ASTM D4052
Kinematic Viscosity	ASTM D445
Sulphur Content	ASTM D2622 / ASTM D4294
Cetane Number	ASTM D613 / IP365
Cetane Index	ASTM D4737 / ASTM D976
Pour Point	ASTM D97 / ASTM D5950
Distillation	ASTM D86
Cloud Point	ASTM D2500 / ASTM D5772 / ASTM D5771
CFPP	IP309 / ASTM D6371
HFRR	ISO 12156-1 / ASTM D6079
Wax Content	Differential Scanning Calorimetry
LTFT	ASTM D4539
FAME Content	EN14078
Rancimat	EN 15751 (mod)

The Trends

Since publication of the previous Infineum Worldwide Diesel Fuel Survey in 2008, world financial markets have experienced their greatest turmoil since the 'Great Depression' of the 1930s. A number of banks collapsed, others only managed to survive following enormous injections of public money, and recession became a byword as national and regional economies slipped into negative or slow growth. The adverse effects of these factors on the oil industry have been unavoidable; fuel demand has fallen taking down refinery utilisation rates and profitability, while costs have continued to rise under inflationary pressure. Yet, despite the difficult times, the current diesel survey points strongly to maintenance of quality standards and a continued drive towards meeting ever more ambitious renewable fuel requirements:

- Within Europe the Biofuels Directive, which required a 5.75% share of transportation energy to be supplied from renewable sources in 2010, has been superseded by the Renewable Energy Directive (RED) that now requires 10% of transportation energy to come from renewable sources by 2020.
- In the US the National Renewable Fuels Standard Program (RFS2) stipulates a total renewable fuels volume of 12.95 billion gallons in 2010, rising annually to 36 billion gallons in 2022.

In addition many biofuels schemes have been given an injection of credibility as lifecycle greenhouse gas emissions, fuel quality and sustainability become key elements of renewable fuel policies and supporting specifications.



Given the emphasis being placed on renewable fuels targets by many governments, it seems appropriate that our analysis of the 2010 diesel survey data concentrates on evaluating progress being made towards these targets. At present the alternatives for renewable diesel fuel are Fatty Acid Methyl Ester (FAME) and Hydrogenated Vegetable Oil (HVO). Addition of HVO introduces components to the fuel blend that are already present in the fossil diesel so it is generally difficult to detect. FAME, on the other hand, is easy to detect and is currently much more commonly used than HVO; therefore our analysis of the survey samples has concentrated on the presence of FAME.

FAME

Taking a global view initially, the map above provides a clear indication of the major FAME consumers today. Yellow shading indicates that between 1% and 50% of samples collected from these countries contain FAME, while red shading indicates that between 51% and 100% of samples collected contain FAME. Key areas of interest are thus; The European Union (EU), USA, South America, and part of Asia Pacific.

The Trends (continued)

European Union

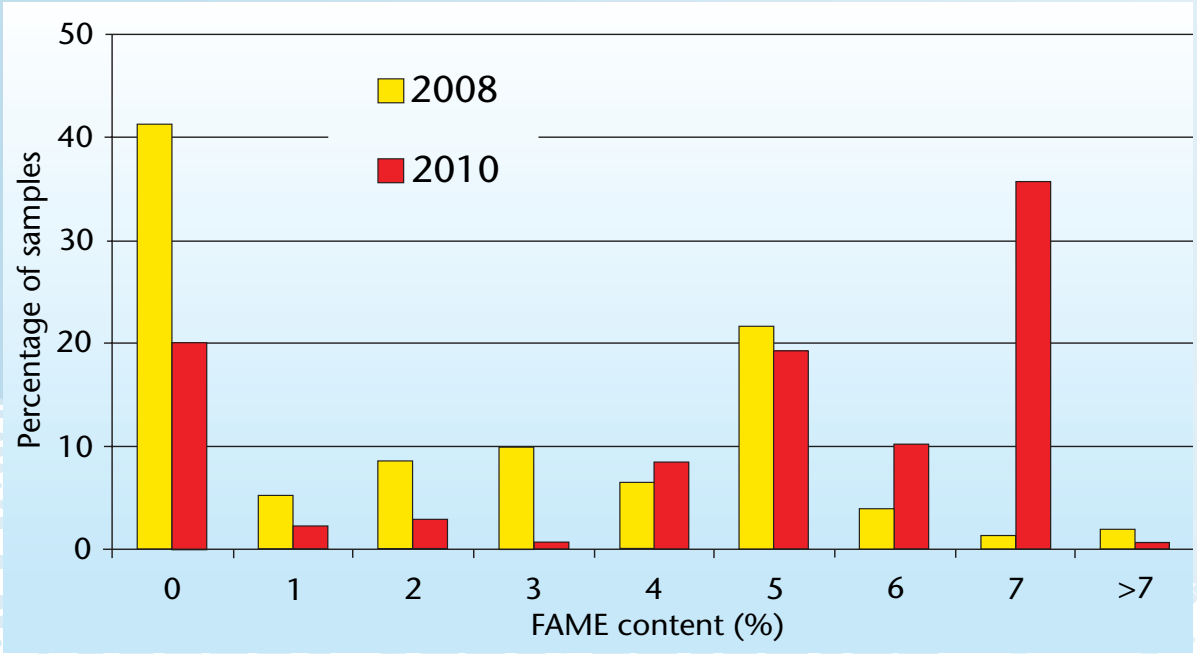
In previous surveys we have concentrated on charting the progress of FAME introduction by measuring the percentage of samples collected in each country that contained FAME in any proportion. However, this approach has become less valuable for Europe as most EU countries now use FAME in a very high proportion of diesel blends. Consequently this year we have taken the approach of estimating the percentage of FAME contained in each sample collected, and comparing results with similar data generated, but not published, during the 2008 survey (see FAME chart below).

This provides an interesting insight into FAME penetration in blends with fossil diesel (Bx) within the EU. In 2008, FAME was detected in just fewer than 60% of the samples collected with the peak concentration being the concurrent EN590 limit of 5%. Today, FAME is present in 80% of samples collected with the concentration peaking at the current EN590 limit of 7% and with over 65% of samples containing 5% or more. The renewable fuels regulatory mandate is clearly taking effect.

Given that the demographics of the survey sample collection in Europe are a close match to the demographics of EU crude oil consumption, it becomes possible to take this evaluation to a higher level; the total percentage of FAME penetration as Bx during the survey period in the region can be estimated:

- For the 2008 survey the estimated penetration of FAME as Bx is 2.2% of the diesel pool, a figure that is comfortably close to the total renewable transportation fuels value for 2007 of 2.6% published by the EU in its Renewable Energy Progress Report in April 2009.
- For 2010, the survey detects a substantial increase in the quantity of FAME being used in Bx blends. It is now estimated that 4.5% of the diesel pool is FAME, though it is difficult to tell how much of a rise in overall FAME consumption this represents as some of the rise in Bx is likely to be offset by reductions in use of B100.

Volume of FAME in EU Samples



The Trends (continued)

Alongside EU requirements to use more renewable fuels, the diesel fuel specification, EN590, has been modified to retain fuel quality in light of the higher FAME limit. One of the amendments is the inclusion of Rancimat oxidation stability (EN15751) of greater than 20 hours for any diesel blend containing more than 2% FAME on a volume basis. As such Rancimat measurements have been added to the survey for the first time this year.

Results show that some fuels fell short of EN590 requirements at the time of testing, but care should be taken not to interpret this as a failure to meet the specification at the time of production. The time elapsed between fuel production and testing is likely to have had a negative impact on the oxidation stability measured. However, the results do show that 90% of fuels surveyed are highly stable despite the increased FAME content. Investigation is underway to establish if linkages exist between the less stable fuels, but it is currently too early to make any comment. Infineum will include Rancimat measurements in future surveys to see how this evolves.

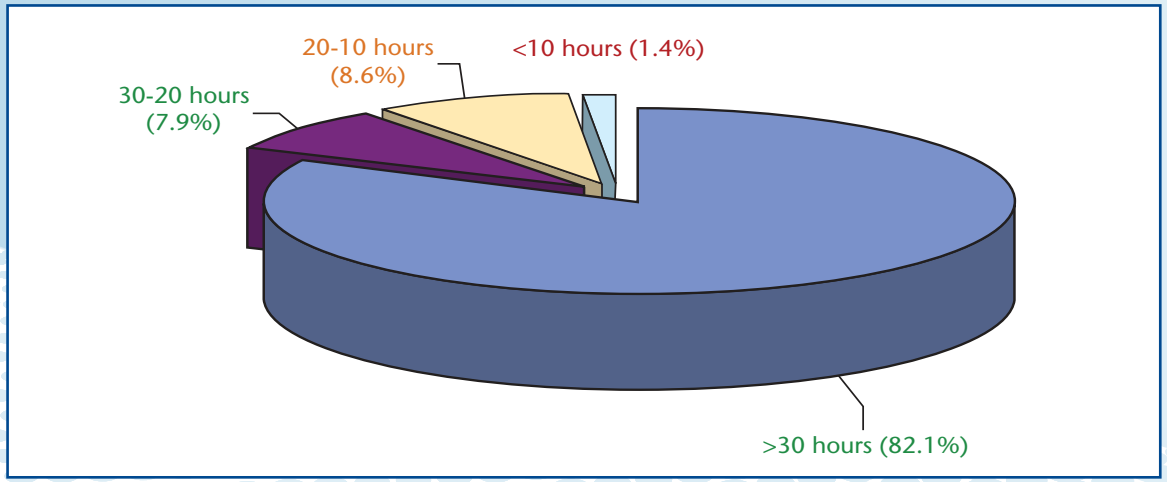
Rest of the World

South America: Biodiesel regulatory mandates that came into force in December 2009 and January 2010 in Columbia (B7-B10), Brazil (B5), Argentina (B5), and Peru (B2) are clearly visible within the survey fuels.

North America: A state regulatory mandate for biodiesel in Minnesota (B5) and a tax incentive encouraging use of biodiesel in Illinois (B10) are readily detectable in the survey samples. By contrast most other samples collected in the US were FAME free, though Washington State and Oregon, both with biodiesel regulatory mandates at the time of the survey, were not sampled. Similarly, mandates in the Canadian Provinces of Manitoba (B2) and British Columbia (B5, relaxed to B3 for 2010) are not detectable in the survey as samples were not collected in these provinces. However, it is expected that FAME detection in both the US and Canada should increase by the 2012 survey as other states and provinces introduce local mandates and the US RFS2 legislation starts to take effect.

Asia Pacific: Samples from three Asia Pacific countries; Thailand, South Korea and Indonesia were seen to contain FAME. Of particular note is Thailand. At the time the survey samples were collected Thailand had a B2 mandate, subsequently increased to B3, but all samples contained between 2% and 5% FAME, returning an overall average of 4%.

EU Rancimat Results



The Trends (continued)

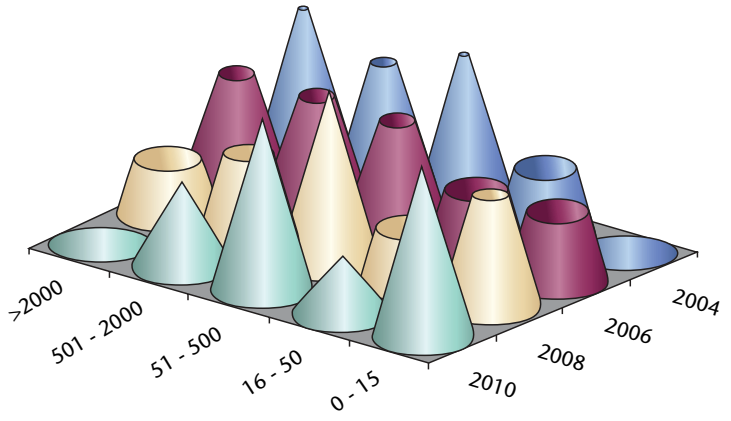
Sulphur Content and Lubricity

While renewable fuel content may be the new trend, diesel sulphur reduction and the associated lubricity performance debit is still continuing in some parts of the world. This year, rather than attempt to portray a global position, we have decided to remove the USA and European Union countries (that have already reached fuel minimum sulphur levels) in order to provide a clearer picture of what is happening in the rest of the world.

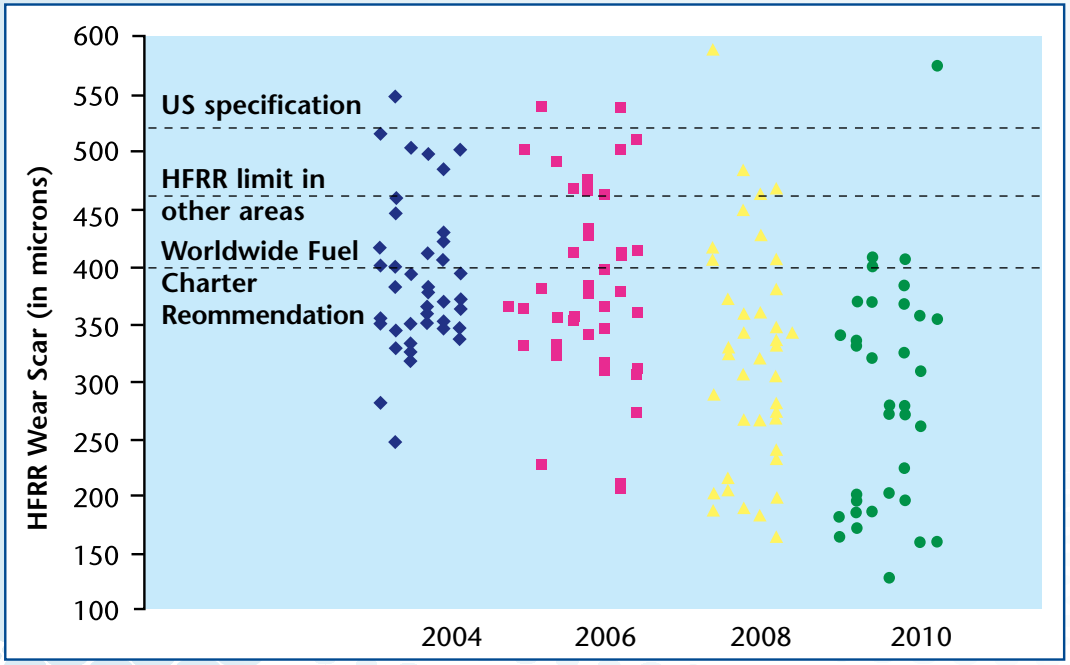
As can be seen from the chart below, removal of the US and EU countries leaves a slower rate of change of fuel sulphur content than we have become accustomed to seeing in previous surveys. As would be expected, there are some countries that have reached 10ppm sulphur but a similar number are still at 500ppm and a significant minority have yet to go below 2,000ppm. While progress is certainly being made, it may take some time before all diesel fuels can be considered as 'ultra low sulphur'.

On the other hand, a mixture of additive treatment and increasing FAME usage paint a rapidly improving picture for lubricity. Average High Frequency Reciprocating Rig (HFRR) wear scar diameters continue to fall, such that the majority of countries surveyed now have an average HFRR wear scar diameter below the Worldwide Fuel Charter recommendation of 400µm (see chart below).

Height of cones represents the percentage of countries in the survey that fall within each sulphur band (excludes Europe and US)



Sulphur Content (ppm)



The Trends (continued)

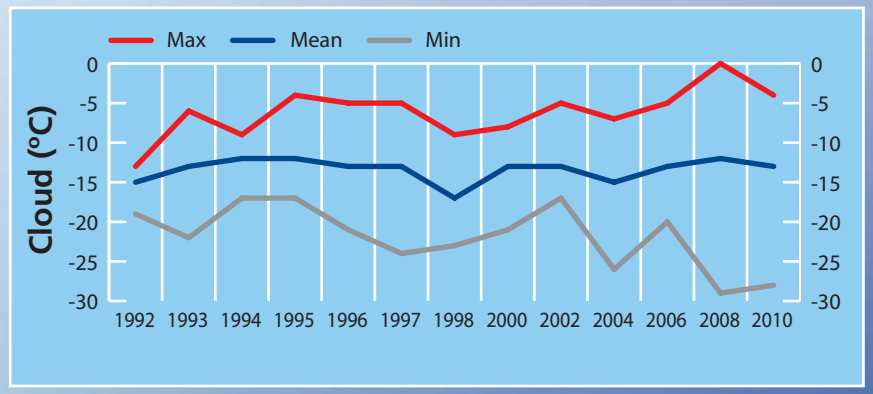
Looking Forward

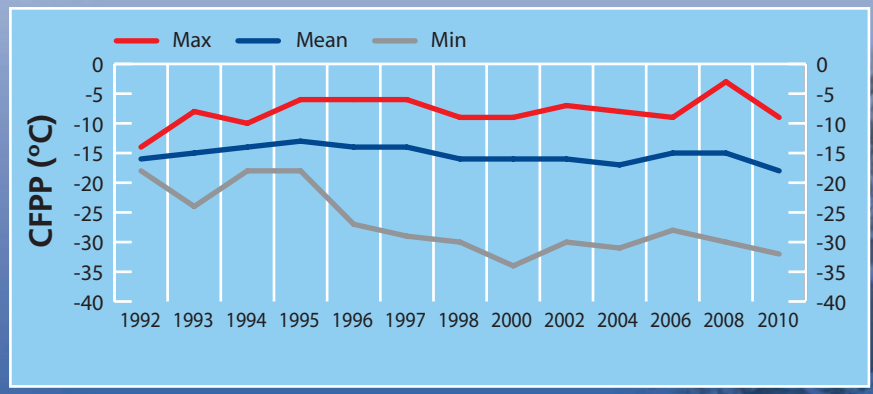
As an increasing number of countries, American states and Canadian provinces introduce renewable fuel regulatory mandates it will be interesting to see if biofuel feedstock availability is able to keep pace with demand and indeed if biofuels from alternative raw materials can start to fill any shortfall. It is expected that feedstock sourcing will increasingly become an issue for the industry.

Despite biofuel feedstock prices having dropped significantly in the past 12 months, it remains to be seen what effect a continued worldwide recession will have on the fuels market in general, and in particular, on the producers of renewable fuels that typically require tax incentives and generous investment support in order to maintain a viable business model. It is expected that the dominant feedstocks of rapeseed in Europe, palm in Asia Pacific, and soy in the Americas will remain, and that the EU RED greenhouse gas saving targets will put pressure on palm and soy, while encouraging the use of biodiesel made from animal fats and other waste. In addition, new EU legislation banning the use of certain fertilizers will cut production of rapeseed based products and force the region to look at other local feedstocks or to increase imports.

Whatever happens, it is clear that renewable fuels are here to stay and that increasing legislative mandates will secure production into the future. However, care must be taken to avoid fuel versus food conflicts, ensure true sustainability, achieve the desired greenhouse gas reductions and, retain the biodiversity of our planet… And this must all be achieved without sacrificing quality.

USA - West


Max
Mean
Min
Cloud (°C)
0
-5
-10
-15
-20
-25
-30
1992 1993 1994 1995 1996 1997 1998 2000 2002 2004 2006 2008 2010


Max
Mean
Min
CFPP (°C)
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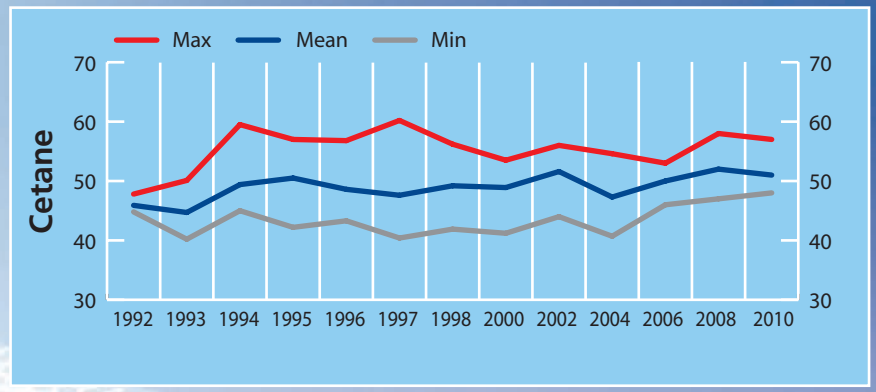
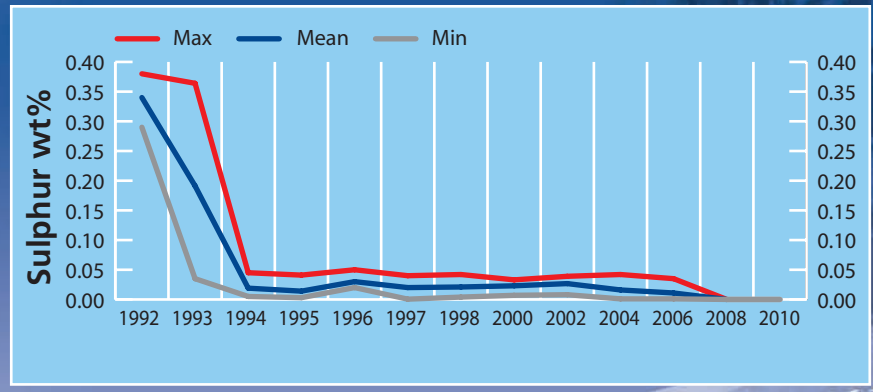
-5
-10
-15
-20
-25
-30
-35
-40
1992 1993 1994 1995 1996 1997 1998 2000 2002 2004 2006 2008 2010


Max
Mean
Min
Cetane
70
60
50
40
30
1992 1993 1994 1995 1996 1997 1998 2000 2002 2004 2006 2008 2010


Max
Mean
Min
Sulphur wt%
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1992 1993 1994 1995 1996 1997 1998 2000 2002 2004 2006 2008 2010