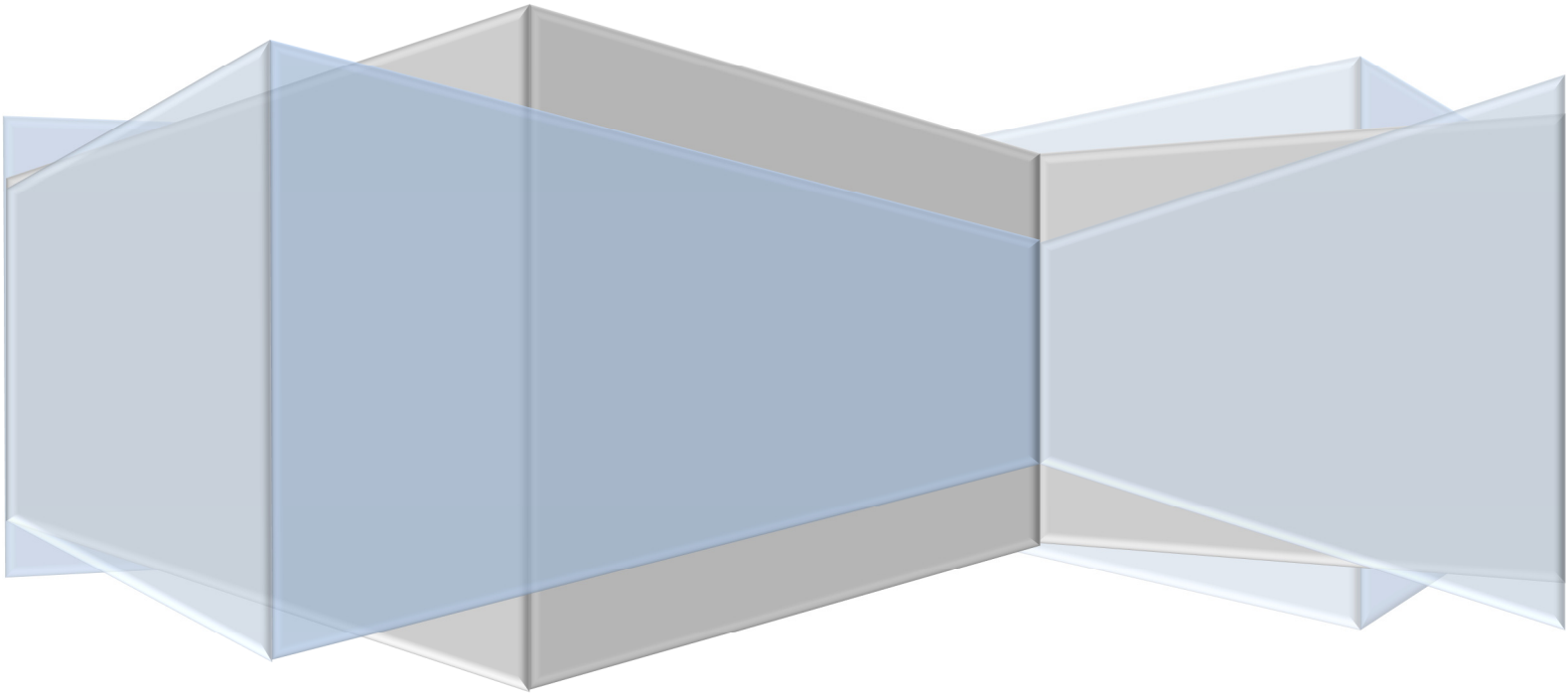
Revision A

Standard Diesel & FCC Additive Technical Analysis

ADDF-REP-TA-0001

Michelle Lam



STANDARD DIESEL & FCC ADDITIVE TECHNICAL ANALYSIS

ADDF-REP-TA-0001

Revision Number: A
Revision Date: 12/12/2016

PREPARED BY

Name	Designation	Signature	Date
Michelle Lam	Senior Chemical / Process Engineer (Chartered Professional Engineer Engineering Council UK (CEng) Reg. No. 594288, MIChemE No. 99887878)		14/12/2016

REVIEWED BY

Name	Designation	Signature	Date
Justin West	Australasian Business Development Manager		

Approved by

Name	Designation	Signature	Date

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

Fuel Conditioner Concentrate (FCC) is added directly to fuel storage tanks to eliminate the problems associated with water contamination. FCC ensures that vehicle fuel systems remain clean and free from corrosion, gums, and varnishes. The main benefit of the FCC is derived from its regular use to maintain fuel systems free from liquid water. This prevents biological activity, reduces corrosion and inhibits reaction of the fuel with water. Regular use of FCC ensures that carburetors and fuel injectors work at peak performance eliminating poor running problems and expensive maintenance. The benefits of FCC extend throughout the fuel system.

Key summary based on the technical analysis of the Standard Diesel spiked with FCC improves and enhances the diesel fuel properties in categories below:

Safety

- FCC does not impact the hazard level classification of the fuel which determines and affects the storage and handling fuel. With a low moderate hazard level fuel, the classification and hazard level remains unchanged with addition of FCC (minimal change in Flash Point).

Environmental

- FCC reduces hydrocarbon and Carbon Monoxide (CO) emissions (increase in T95)
- FCC reduces white smoke on startup, and reduce NOx (Nitrogen Oxide) and Particulate Matter (PM) emissions (Increase in Cetane Index)
- FCC decreases density in fuel which:
  - Reduces the NOx emission and results in large decrease in PM for high emission emitting engine (heavy duty diesel emissions),
  - Results in relatively large decrease in PM for both Direct and Indirect Injection Engines for current light duty diesel vehicle.

Combustion, Fuel Efficiency

- FCC improves fuel combustion (Increase in Cetane Index)

Performance, Maintenance

- FCC improves lubricity by 3.8% which improves durability of equipment and premature wear of equipment by allow equipment to operate to its intended design life.
- FCC maintains this important characteristic of the fuel for Filter Blocking Tendency (FBT) which affects performance and lifetime of the engine.

2 INTRODUCTION

FCC is an innovative and scientifically proven blend of surfactants (detergents), oxygenates and corrosion inhibitors developed to meet the challenge of today's engines. It's a non-hydrocarbon fuel conditioner that cleans fuel and improves performance whilst lowering emissions and increasing fuel efficiency. It is suitable for use for a large variety of fuel types.

With FCC, improvements in fuel efficiency and savings in maintenance costs are achieved through cleanliness and a better burn; as opposed to tampering with the combustion characteristics of the fuel.

2.1 BACKGROUND

FCC is a blend of blend of surfactants (detergents), oxygenates and corrosion inhibitors developed to meet the challenge of today's high performance engines. The Primary benefits of FCC are:

- Solubilises liquid water into the fuel.
- Reduces or eliminates the conditions favourable to the growth of microorganisms.
- Stabilises fuel by inhibiting the formation of gums and varnish.
- Inhibits corrosion of fuel system components.
- Promotes a uniform fuel spray pattern in combustion chambers, thus reducing carbonisation and improving combustion efficiency.
- Inhibits formation of corrosive acids in combustion chambers.

2.2 DOCUMENT SCOPE

The intent of this document scope is to provide technical analysis on Standard Diesel (fuel quality within specification) properties after addition of fuel additive, herein referred to as FCC (spiked with ratio of 1:4000). Analysis is made in comparison to Standard Diesel (control sample) and the properties assessed (based on Certificate of Analysis – Attachment 1) are:

- Flash Point,
- Filter Blocking Tendency,
- Lubricity,
- Cetane Index,
- Density and
- Distillation T95.

2.3 SPECIFICATION OF CLEAN FUEL

Clean fuels are fuels that contain very few of components that may harm the environment, like sulphur, nitrogen, and organometallic compounds (Benzene can also be included along with polycyclic aromatic hydrocarbons (PAH)).

The key specification for diesel as summarised in Table 2.1 and Table 2.2 below:

Table 2.1: Key Specification / Parameter for Diesel

Specification	Euro 2000	Euro 2005	USA 2005	Canada 2005	Australia
Sulphur max (wppm)	50	50	15	50	10
Density (kg/m³)	820 – 845	820 – 845	840	N/A	820 – 860
Cetane Number	> 51	> 51	> 51	> 51	48
PAH (wt%)	< 11	N/A	11	N/A	11
T95 (°C)	< 360	N/A	N/A	N/A	360

Table 2.2: Key Specification / Parameter for Diesel in the ASEAN Region

Specification	Malaysia	Thailand	Singapore	Indonesia	Philippines	Vietnam
Sulphur max (wt%)	0.05	0.05	0.5	0.5	0.5	0.3
Density (kg/m³)	N/A	820 – 890	860 (max)	820 – 870	N/A	860 (max)
Cetane Number	50	N/A	N/A	45	N/A	N/A
PAH (wt%)	N/A	N/A	N/A	N/A	N/A	N/A
T90 (°C)	370	338	370	N/A	N/A	370
T95 (°C)	N/A	N/A	N/A	N/A	N/A	N/A

3 ABBREVIATIONS & DEFINITIONS

3.1 ABBREVIATIONS

Abbreviations	Definition
AddFuel	AddFuel Pty. Ltd.
ASTM	American Standard Test Method
CO	Carbon Monoxide
CN	Cetane Number
FBT	Filter Blocking Tendency
FCC	Fuel Conditioner Concentrate
IEC	International Electrotechnical Commission
IP	International Protection
ISO	International Organization for Standardization
NATA	National Association of Testing Authorities, Australia
NOx	Nitrogen Oxide
PAH	Polycyclic Aromatic Hydrocarbons
PM	Particulate Matter

3.2 DEFINITIONS

The property's definitions are summarised as below:

Property	Definition
Flash Point	The lowest temperature at which a volatile liquid will produce sufficient amount of vapour above the liquid such that spontaneous ignition will occur if a spark is present in air, at a given pressure.
Filter Blocking Tendency	FBT is a calculated dimensionless value that defines the tendency of particulates in a fuel to plug or block a filter.
Lubricity	Ability of a lubricant (in this case diesel fuel) to minimize friction between and damage to surfaces in relative motion under load.
Cetane Index	Measures the performance / quality of a fuel in a diesel engine by its ability for auto-ignition.
Density	Characteristics of a substance indicated as Mass per unit volume varies with temperature and pressure. This variation is typically small for solids and liquids but much greater for gases.
Distillation T95	Temperature at which 95% of diesel evaporates.

3.3 REFERENCES

The references used in this document are:

1. Certificate of Analysis Submission No: 58649 (PO: 3806), 25-Oct-2015 (Att. 1).
2. Dictionary of Chemical Engineering, Schaschke, Carl (ISBN 978-0-19-965145-0)
3. http://www.engineeringtoolbox.com/flash-point-fuels-d_937.html
4. Gasoline, Diesel and Ethanol Biofuels from Grasses and Plants,1st Edition, Ram B. Gupta, Ayhan Demirbas.
5. Diesel Fuel Technical Review, Chevron.
6. Practical Lubrication for Industrial Facilities 2nd Edition, Heinz Bloch.
7. The Significance of Test of Petroleum Products, 7th edition, Salvatore J. Rand.
8. Fundamentals of Petroleum Refining, 2010, Fahim, Mohamed A.; Alsahhaf, Taher A.; Elkilani, Amal.
9. Policy Guidelines for Reducing Vehicle Emissions in ASIA.
10. Lee, Robert, Hobbs, Christine H., and Pedley, Joanna F.: “Fuel Quality Impact on Heavy Duty Diesel Emissions: A Literature Review,” Document Number 982649, SAE Technical Papers, http://www.sae.org/technical/papers/982649/
11. http://www.environment.gov.au/topics/environment-protection/fuel-quality/standards/diesel
12. https://www.dieselnet.com/tech/fuel_diesel_lubricity.php

3.4 ATTACHMENTS

1. Intertek Geotech, Certificate of Analysis Submission No: 58649 (PO: 3806), 25-Oct-2015.
2. Australia Government Department of Environmental and Energy, Fuel Quality in Australia – Diesel Fuel Quality Standard.

4 PROPERTY OF DIESEL

4.1 FLASH POINT

4.1.1 DEFINITION

The lowest temperature at which a volatile liquid will produce sufficient amount of vapour above the liquid such that spontaneous ignition will occur if a spark is present in air, at a given pressure. The rapid combustion occurs in the form of momentary flash point. Flash point data is important for the safe storage and transportation of volatile liquids. Flash Point for typical Diesel and Fuel Oils are tabulated in Table 4.1 below:

Table 4.1: Flash Point for Diesel / Fuel Oils

Fuel	Flash Point (°C)
Standard Diesel	71.00 (Att. 1)
Standard Diesel + FCC	67.00 (Att. 1)
Biodiesel	130.00
Diesel Fuel (1-D)	37.78
Diesel Fuel (2-D)	52.22
Diesel Fuel (4-D)	54.44
Fuels Oil No.1	37.78 – 72.22
Fuels Oil No.2	52.22 – 95.56
Fuels Oil No.4	61.11 – 115.56
Fuels Oil No.5 Lite	68.89 – 168.89
Fuels Oil No.5 Heavy	71.11 – 121.11

4.1.2 ANALYSIS

A low flash point is a high fire hazard. The minimum Flash Point is 52°C based on ASTM D975 requirements for Diesel Fuel Oils (Ref. 5) and 61.5°C based on ASTM D93 (Ref. 11) for safe storage and handling of diesel.

Standard Diesel (control sample – Attachment 1) Flash Point is 71°C (Fuel Oil No. 1 – 5) and with addition of FCC, the Flash Point is slightly lowered to 67°C, which is within the moderate low hazard level classification. Hence, addition of FCC does not greatly impact on Flash Point of the diesel and the storage and handling of the fluid. Flash Point Hazard Level classification is summarised in Table 4.2 below:

Table 4.2: Hazard Level Classification based on Flash Point

Hazard Level	Flash Point (°C)
Very low hazard	> 93
Moderate low hazard	66 to 93
High to Moderate Hazard	38 to 66
Extremely High to High Hazard	-18 to 38
Extreme Hazard	< -18

4.2 FILTER BLOCKING TENDENCY

4.2.1 DEFINITION

FBT is a calculated dimensionless value that defines the tendency of particulates in a fuel to plug or block a filter. Unstable diesel fuels can form soluble gums or insoluble organic particulates. Both gums and particulates may contribute to injector deposits, and particulates can clog fuel filters. The formation of gums and particulates may occur gradually during long-term storage or quickly during fuel system recirculation caused by fuel heating. Sometimes a combination of fuel behaviour and fuel system design can cause filter plugging.

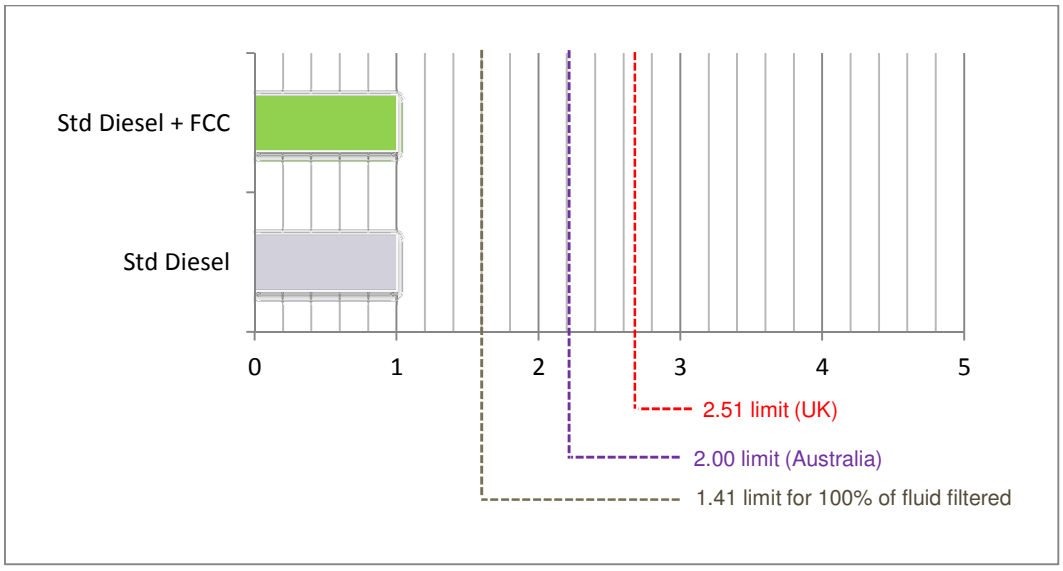
4.2.2 ANALYSIS

Based on the test results, there is no change in FBT after addition of FCC as the Standard Diesel used as control sample has a low FBT. This low FBT of Standard Diesel (control sample) and Standard Diesel + FCC is 1.00, which is below 1.41, which means all of the volume 100% of flow could be filtered. This indicates that FCC maintains this important characteristic of the fuel for FBT which affects performance and lifetime of the engine.

The FBT limits are detailed below and illustrated in Figure 4.1:

- FBT values exceeded 1.41 indicates that not all of the volume could be filtered.
- Australia FBT limit value of 2.0 for Diesel fuels (Ref. 11).
- United Kingdom FBT limit < 2.51 (UK EN590 Specifications).

Figure 4.1: FBT (Diesel Specifications)



4.3 LUBRICITY

4.3.1 DEFINITION

Some moving parts of diesel fuel pumps and injectors are protected from wear by the fuel. Lubricity is ability of a lubricant (in this case diesel fuel) to minimize friction between and damage to surfaces in relative motion under load. The lubrication mechanism is a combination of hydrodynamic lubrication and boundary lubrication. In hydrodynamic lubrication, a layer of liquid prevents contact between the opposing surfaces. For diesel fuel pumps and injectors, the liquid is the fuel itself and viscosity is the key fuel property. Fuels with higher viscosities will provide better hydrodynamic lubrication. Diesel fuels with viscosities within the ASTM D975 specification range provide adequate hydrodynamic lubrication. Boundary lubrication becomes important when high load and/or low speed have squeezed out much of the liquid that provides hydrodynamic lubrication, leaving small areas of the opposing surfaces in contact. Boundary lubricants are compounds that form a protective anti-wear layer by adhering to the solid surfaces.

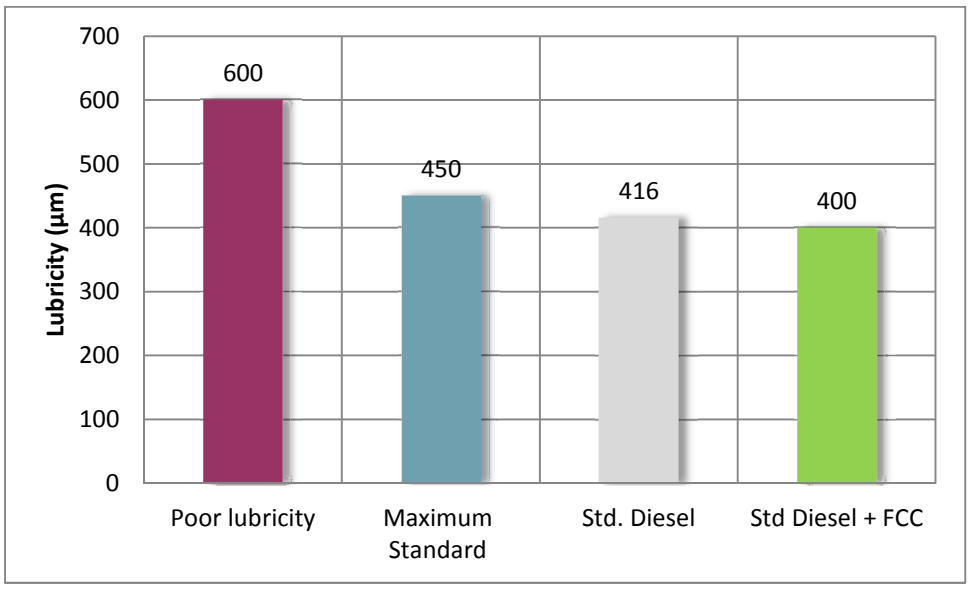
4.3.2 ANALYSIS

The maximum standard lubricity is 450 µm (Ref. 11) to ensure sufficient lubricity for the engine's operation. Poor lubricity (>600 µm) could potentially causes excessive wear and at the extreme, causes catastrophic failure.

The lubricity improves by 3.8% with addition of FCC from 416 µm to 400 µm. This increase in lubricity will improve durability of equipment and premature wear of equipment by allow equipment to operate to its intended design life.

The specification of lubricity as illustrated in Figure 4.2 below.

Figure 4.2: Lubricity (Diesel Specifications)



4.4 CETANE INDEX

4.4.1 DEFINITION

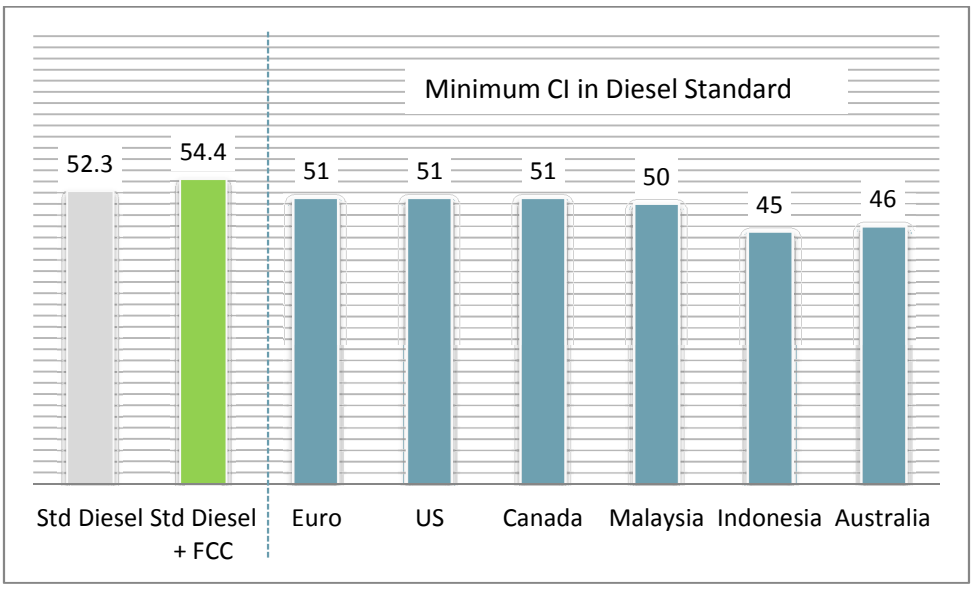
The quality of diesel fuels can be expressed as cetane number or cetane index. The cetane number (CN) is expressed in terms of the volume % of cetane (($C_{16}H_{34}$) which has high ignition (CN = 100)) in a mixture with alpha-methyl-naphthalene (($C_{11}H_{10}$) which has low ignition quality (CN = 0)) that has the same ignition characteristics as a diesel fuel being tested in a standard diesel engine. It is therefore, an indication of ease of self or auto-ignition characteristic of a fuel. The cetane index (CI) is a number calculated from the average boiling point and density of a petroleum fraction in the diesel fuel boiling range, which then estimates the CN of the fraction.

4.4.2 ANALYSIS

Based on the laboratory analysis by Intertek (Attachment 1), addition of FCC has improved the CI by 4% from 52.3 to 54.4. The increase of CI on the fuel increase the ease of self-ignition of the fuel and therefore enables engine to operate more effectively and improves engine performance.

The specification of CI range from 45 to 51 and as illustrated in Figure 4.3 below.

Figure 4.3: Cetane Index (Diesel Specifications)



Increasing the cetane number improves fuel combustion, reduces white smoke on startup, and tends to reduce NOx and PM emissions. NOx seems to be reduced in all engines, while PM reductions are engine-dependent. For high speed diesel engine, high CI fuels are desirable as engine performance improvement on the high speed engine is evident in comparison using low CI fuels.

4.5 DENSITY

4.5.1 DEFINITION

Characteristics of a substance indicated as mass per unit volume varies with temperature and pressure. This variation is typically small for solids and liquids (non-compressible) but much greater for gases (compressible). Non compressible liquids / solids have relatively higher density than gas.

4.5.2 ANALYSIS

Changes in fuel density affect the energy content of the fuel brought into the engine at a given injector setting. Reducing fuel density tends to decrease NOx emissions in older technology engines that cannot compensate for this change. Emissions from modern engines, with electronic injection and computer control, are not influenced by the density of the fuel.

The density of diesel specification is from 820 (min) to 850 (max) kg/m³ (Ref. 11). Standard Density (control sample) is 838.2 kg/m³ and with addition of FCC, the density is reduced by 0.6% to 833.2 kg/m³.

For heavy duty diesel emissions, the decrease in density with FCC has a favourable impact on NOx and PM as this will reduce the NOx emission and a relatively large decrease in PM for high emission emitting engine (no effect on low emission emitting engine).

For current light duty diesel vehicle, decrease in density (828 - 855 kg/m³) will have a relatively large decrease in PM for both Direct and Indirect Injection Engines. However, for NOx emissions, a decrease in density has no impact on Indirect Injection Engines and a small increase in NOx for Direct Injection Engines.

4.6 DISTILLATION

4.6.1 DEFINITION

T95 is the temperature at which 95 percent of a particular diesel fuel distils in a standardized distillation test (ASTM D86). It is an indirect measure of volatility of the fluid where the T95 temperature is where 95% of the fluid (i.e. diesel) is vapourised and only 5% remain in liquid state. Lower T95 indicates a more volatile fluid and where 95% of the fluid vapourises at a lower temperature.

4.6.2 ANALYSIS

The maximum limit of T95 temperature for diesel specification is 360℃ (Ref. 11).

From the Intertek analysis (Attachment 1), T95 increases from 337.7℃ to 344.9℃ which is still below the specification at 360℃. The increase in T95 reduces hydrocarbon and CO emissions but increases NOx emissions slightly. PM emissions are unaffected.

5 SUMMARY

Property	Definition	Test Method	Effect of Property on Performance / Significance of Property	Limits / Specifications	Required Specification	Standard Diesel + FCC
Flash Point	The lowest temperature at which a volatile liquid will produce sufficient amount of vapour above the liquid such that spontaneous ignition will occur if a spark is present in air, at a given pressure.	ASTM D93	Indication of fire and explosion hazard which is important for the safe storage and transportation of volatile liquids. A low flash point is a high fire hazard.	• Very low hazard > 93℃ • Moderate low hazard 66 to 93℃ • High to Moderate Hazard 38 to 66℃ • Extremely High to High Hazard -18 to 38℃ • Extreme Hazard < -18℃	51℃ (min)	67℃ (5.6% reduction from 71℃).
Filter Blocking Tendency	FBT is a calculated dimensionless value that defines the tendency of particulates in a fuel to plug or block a filter.	IP 387 (Procedure A)	At low temperatures below the cloud point of diesel fuel, wax precipitates from fuel and can cause filter blocking and affecting quality of fuel.	If values exceeded 1.41 not all of the volume could be filtered. Limit < 2.51 (UK EN590 Specifications).	< 1.41	1.00 – No change / impact.
Lubricity	Ability of a lubricant (in this case diesel fuel) to minimize friction between and damage to surfaces in relative motion under load.	IP 450	Poor lubricity causes excessive wear and at the extreme, causes catastrophic failure.	>600 µm might not prevent excessive wear <450 µm should provide sufficient lubricity	<450 µm	400 µm (3.8% reduction / improvement from 416 µm)

Property	Definition	Test Method	Effect of Property on Performance / Significance of Property	Limits / Specifications	Required Specification	Standard Diesel + FCC
Cetane Index	Measures the performance / quality of a fuel in a diesel engine by its ability for auto-ignition.	ASTM D4737	Increase in Cetane will reduce emission of NOx [(a)]. High speed diesel engine operates more effectively with high CI fuels.	• CI of 45 (Diesel No. 1) is used in high speed engines, trucks and buses. • CI of 40 (Diesel No. 2). • CN = 30 is used as Railroad diesel fuels (similar to the heavier automotive diesel fuels, but have higher boiling ranges up to 400℃.	40 (min)	54.4 (4% increase from 52.3).
Density	Characteristics of a substance indicated as Mass per unit volume varies with temperature and pressure.	ASTM 4052	Affects heating value and hence fuel economy. Density to be used in equation along with Heating Value to determine Heat of Combustion which consequently affects engine performance. Reduction in density will reduce NOx emissions [(a)].	Range from 820 – 890 kg/m³ depending on country / location.	820 – 890 kg/m³	833.2 kg/m³ (0.6% decrease from 838.2 kg/m³)
Distillation T95	Temperature at which 95% of diesel evaporates.	ASTM D86	Reduction of T95 will marginally reduce NOx emissions [(a)] and a relatively large reduction of particulates (PM) emission [(a) (b)].	Maximum temperature of 360℃.	360℃ (max)	344.9℃ (2.1% increase from 337.7℃).

(a) For heavy duty diesel emissions.
(b) High emissions emitting engine

Key summary based on the technical analysis of the Standard Diesel spiked with FCC on a comparative basis to Standard Diesel:

1. Flash Point: Marginal decrease with no change in classification of hazard level (moderate low hazard). Hence, addition of FCC does not greatly impact on Flash Point of the diesel and the storage and handling of the fluid.
2. No change in FBT. FCC maintains this important characteristic of the fuel for FBT which affects performance and lifetime of the engine.
3. **Lubricity:** Improves by 3.8% with addition of FCC from 416 µm to 400 µm. This increase in lubricity will improve durability of equipment and premature wear of equipment by allow equipment to operate to its intended design life.
4. **Cetane Index:** Increasing the cetane number improves fuel combustion, reduces white smoke on startup, and tends to reduce NOx and PM emissions.
5. **Density:** For heavy duty diesel emissions, the decrease in density with FCC has a favourable impact on NOx and PM as this will reduce the NOx emission and a relatively large decrease in PM for high emission emitting engine (no effect on low emission emitting engine).
   For current light duty diesel vehicle, decrease in density relatively large decrease in PM for both Direct and Indirect Injection Engines. However, for NOx emissions, a decrease in density has no impact on Indirect Injection Engines and a small increase in NOx for Direct Injection Engines.
6. T95: Marginal increases from 337.7℃ to 344.9℃ which is still below the specification at 360℃. The increase in T95 reduces hydrocarbon and CO emissions but increases NOx emissions slightly. PM emissions are unaffected.

41-45 Furnace Road, Welshpool
Western Australia, 6106
Tel : (08) 9458 8877
Fax : (08) 9458 8857
Email: ocm.perth@intertek.com
www.intertek.com

ChoiceChem
27 Boulder Road
Malaga WA 6090

25-October-2016

Attention: Peter Spry
Purchase Order no. 3806
Your reference Standard Diesel and Additives
Our Ref No: Submission No: 58649

CERTIFICATE OF ANALYSIS

Introduction:

A sealed can of Standard Diesel and an additives bottle were received on 12 October 2016. The Standard Diesel was divided in two portion.The first portion was spiked with the additives with a ratio of 1:4000, spike:Diesel and the second portion was considered as the control sample. Both samples were tested as per client request and they were labelled as follows:

Standard Diesel Lab No: 326771
Standard Diesel + Additives Lab No: 326776

Method of Analysis & Testing:
The analysis was carried our according to quote CRQU051016Rev.

Results:

Property	Test Method	Unit	Standard Diesel	Standard Diesel + Additives
Flash Point	ASTM D93	°C	71.0	67.0
Filter blocking tendency/ Procedure A	IP 387	unit	1.00	1.00
Lubricity	IP 450	µm	416	400
Cetane Index	ASTM D4737	unit	52.3	54.4
Density	ASTM 4052	kg/L	0.8382	0.8332
Distillation T95	ASTM D86	°C	337.7	344.9

The analysis results denoted by are part of the laboratory NATA accreditation 13658. Accredited for compliance with ISO/IEC 17025

Chetna Ragoo
Industrial Chemist

Report enquiries to: Industrial Chemist

Report Reviewed

Attachment 2

Online Services

Australian Government
Department of the Environment and Energy

Diesel fuel quality standard

Management of Diesel Oil Burn Systems

The use of oil burn systems in diesel vehicles can potentially breach section 20 of the *Fuel Quality Standards Act 2000* if the addition of oil to the diesel within the engine results in the diesel not complying with the Fuel Standard (Automotive Diesel) Determination 2001.

As the Australian Government is committed to international best practice regulation of fuel quality, it has been decided not to amend the determination to allow the use of oil burn systems in any diesel vehicles operating in Australia.

It is considered that there is enough concern about the potential impacts on sulfur levels in diesel from the addition of used motor oil to warrant this decision.

Management of Diesel Oil Burn Systems - position paper

Environmental standards

The first suite of national fuel standards, which came into force on 1 January 2002, regulates petrol and diesel parameters that have a direct impact on the environment ('environmental standards').
The standards will have a major impact on the amount of toxic pollutants in vehicle emissions, such as benzene and particles, with studies estimating reductions of up to 50 per cent for some pollutants over 20 years. This is great news for our health, with cleaner air helping to reduce the number of serious respiratory illnesses and asthma cases, particularly in children.

Operability standards

A second suite of national fuel standards came into force on 16 October 2002. These standards ('operability standards') address those parameters of diesel that do not have a direct impact on emissions but, if not controlled, can have adverse impacts on the efficient operation of the engine.

Further operability standards are being developed that may include:

- for diesel - the parameters are appearance, acidity, cloud point and cold filter plugging point.

Summary table

The environmental and operability standards are consolidated in the following tables. The legal instrument implementing the standard is:

Fuel Standard (Automotive Diesel) Determination 2001

Diesel standards

Parameter	National standard	Date of effect	Test Method
Biodiesel [1]	5.0% volume by volume (max)	1-Mar-09	EN 14078
Sulfur	500 ppm (max)	31-Dec-02	ASTM D5453
	50 ppm (max)	1-Jan-06	
	10 ppm (max)	1-Jan-09	
Cetane Index	46 (min) index	1-Jan-02	ASTM D4737
Derived Cetane Number (of diesel containing biodiesel)	51.0 (min)	21-Feb-09	ASTM D6890
Density	820 (min) to 860 (max) kg/m^3	1-Jan-02	ASTM D1298
	820 (min) to 850 (max) kg/m^3	1-Jan-06	
Distillation T95	370°C (max)	1-Jan-02	ASTM D86
	360°C (max)	1-Jan-06	
Polyaromatic hydrocarbons (PAHs)	11% m/m (max)	1-Jan-06	IP391
Ash	100 ppm (max)	1-Jan-02	ASTM D482
Viscosity	2.0 to 4.5 cSt @ 40°C	1-Jan-02	ASTM D445
Carbon Residue (10% distillation residue)	0.2 mass % max	16-Oct-02	ASTM D4530
Water and sediment	0.05 vol % max	16-Oct-02	ASTM D2709
Water (all diesel containing biodiesel)	200 mg/kg (max)	21-Feb-09	ASTM 6304
Conductivity @ ambient temp	50 pS/m (Min) @ambient temp (all diesel held by a terminal or refinery for sale or distribution)	16-Oct-02	ASTM D2624
Oxidation Stability	25 mg/L max	16-Oct-02	ASTM D2274
Colour	2 max	16-Oct-02	ASTM D1500
Copper Corrosion (3 hrs @ 50°C)	Class 1 max	16-Oct-02	ASTM D130

Attachment 2

Flash point	61.5°C min	16-Oct-02	ASTM D93
Filter blocking tendency	2.0 max	16-Oct-02	IP 387
Lubricity	0.460 mm (max) (all diesel containing less than 500 ppm sulfur)	16-Oct-02	IP 450

[1] The biodiesel component of diesel must meet the requirements of fuel quality standard for biodiesel set out in the Fuel Standard (Biodiesel) Determination 2003.

Disclaimer

The information contained on this page is of a general nature only and should be read in conjunction with the *Fuel Quality Standards Act 2000*, Fuel Quality Standards Regulations 2001 and the Fuel Standard (Automotive Diesel) Determination 2001. Fuel suppliers may wish to seek legal advice about their obligations under this legislation.