

IBIA Annual Convention 2015 .

Residual Fuel Oil – Is This The End Of The Road?

Intertek ShipCare Services.

Michael Green.

Global Technical Manager – Bunker Fuel Testing.





IBIA Annual Convention 2012.

The Death of Residual Fuel?

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Residual Fuel

1948 to 2020

- Marpol Annex VI introduced 19th May 2005
- First major step in regulating marine emissions
- Introduced emission restrictions on a regional & global level
 - ECAs - As far as requirements within an ECA are concerned, the sulphur content of fuel oil used on board ships shall not exceed the following limits:
 - 0.10% m/m on and after 1st January 2015
 - Global Regulations - The Sulphur content of any fuel oil used on board ships shall not exceed the following limits:
 - 0.50% on or after the 1st January 2020

- 2015 ECA 0.10% = increased demand for distillate product.
- Not all distillate fuels are low Sulphur; therefore lower Sulphur content requires additional treatment processes
- Treatment processes can have a detrimental effect on final fuel quality causing issues such as:
 - Lubricity Issues
 - Reduced Oxidation Stability
 - Poor combustion characteristics
 - Possible presence of FAME
 - Reduced Flash point

- 1.00% Sulphur residual fuel provided a number of challenges:
- Lower Sulphur specs = Increased blending
- This leads to increased use of blend / cutter stocks
- This can lead to increased problems:
 1. high levels of Cat Fines within fuels
 2. Increased stability related issues
 3. Increased frequency of instances of “Chemical Contamination”.

Residual Fuels – Quality Issues

Intertek

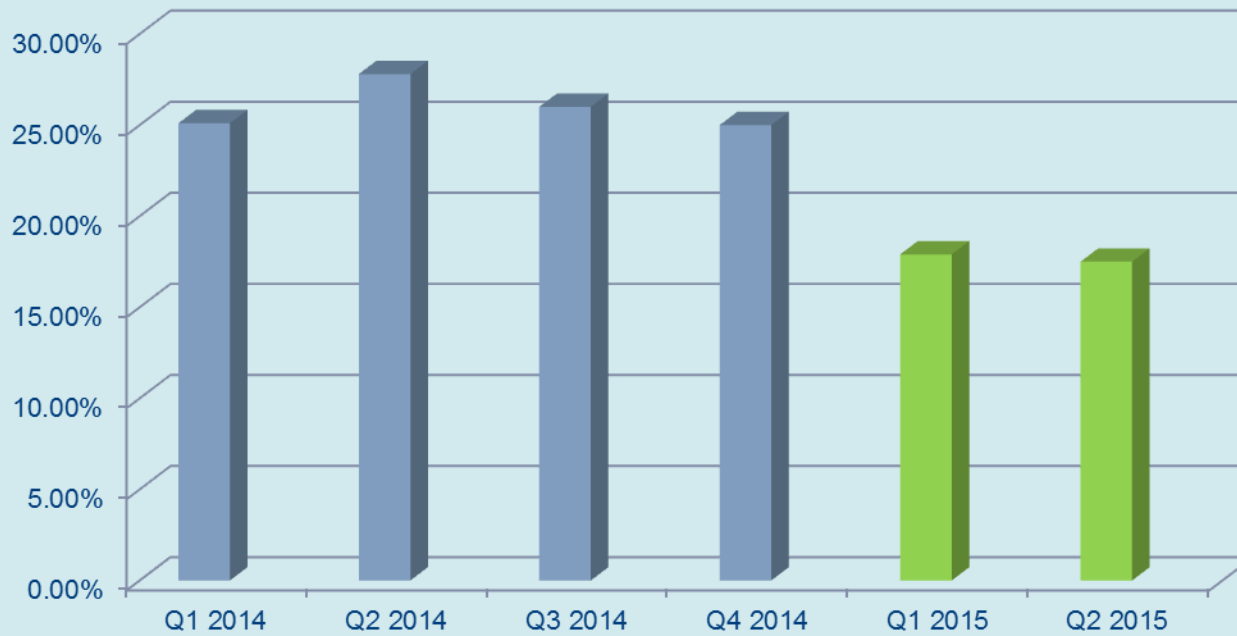
Valued Quality. Delivered.



- What happens after 2015?
- No demand for 1.00% Sulphur Fuel!!
- A significant decrease in intensive blending.
- This should result in a significant reduction in issues currently associated with HFO!

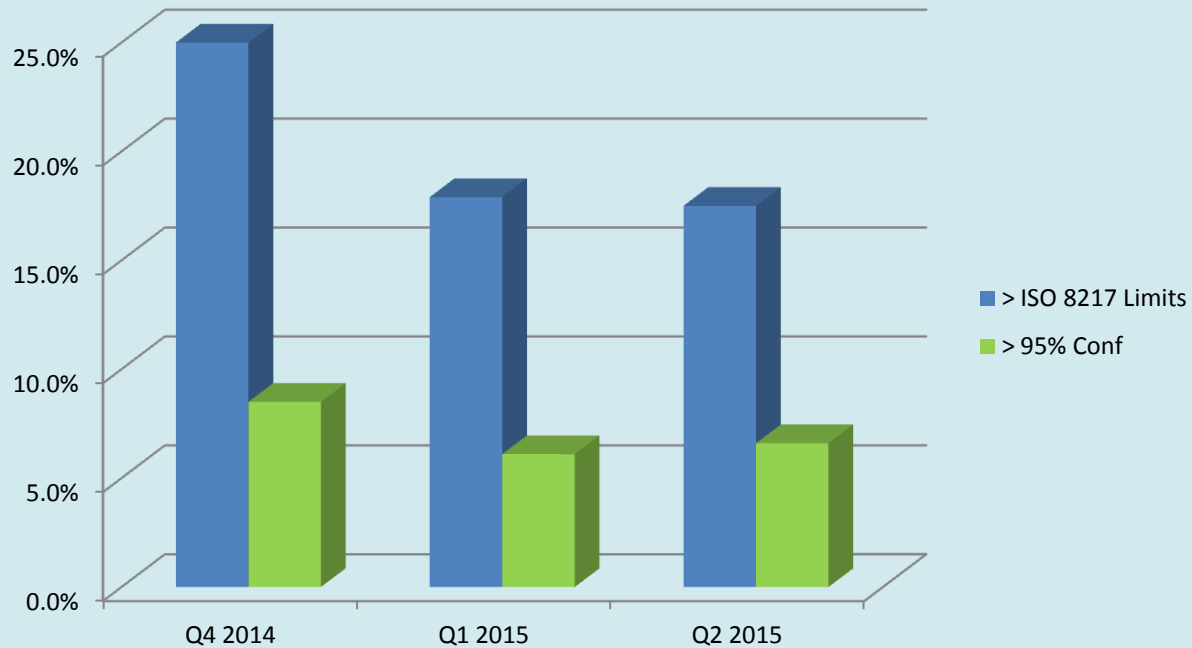


% > ISO Limits 2014 / 2015



| 2014 / 2015 | Q1 2014 | Q2 2014 | Q3 2014 | Q4 2014 | Q1 2015 | Q2 2015 |
|-------------------|---------|---------|---------|---------|---------|---------|
| > ISO 8217 Limits | 25.1% | 27.8% | 26.0% | 25.0% | 17.9% | 17.5% |

2014 / 2015 - "Off Spec" Data



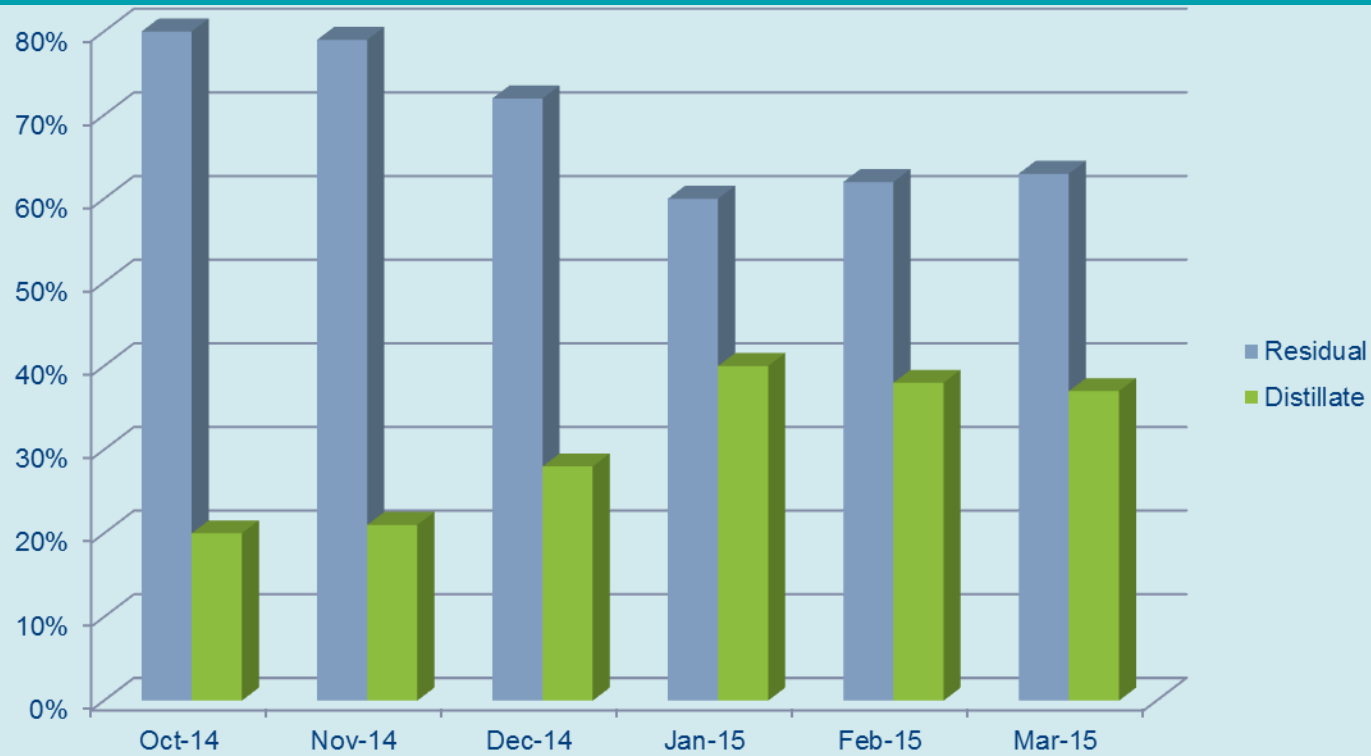
| 2014 / 2015 | Q4 2014 | Q1 2015 | Q2 2015 |
|-------------------|---------|---------|---------|
| > ISO 8217 Limits | 25.0% | 17.9% | 17.5% |
| > 95% Conf | 8.5% | 6.1% | 6.6% |

The End of RFO?



Valued Quality. Delivered.

Sample Submission Rates - 2014 / 2015



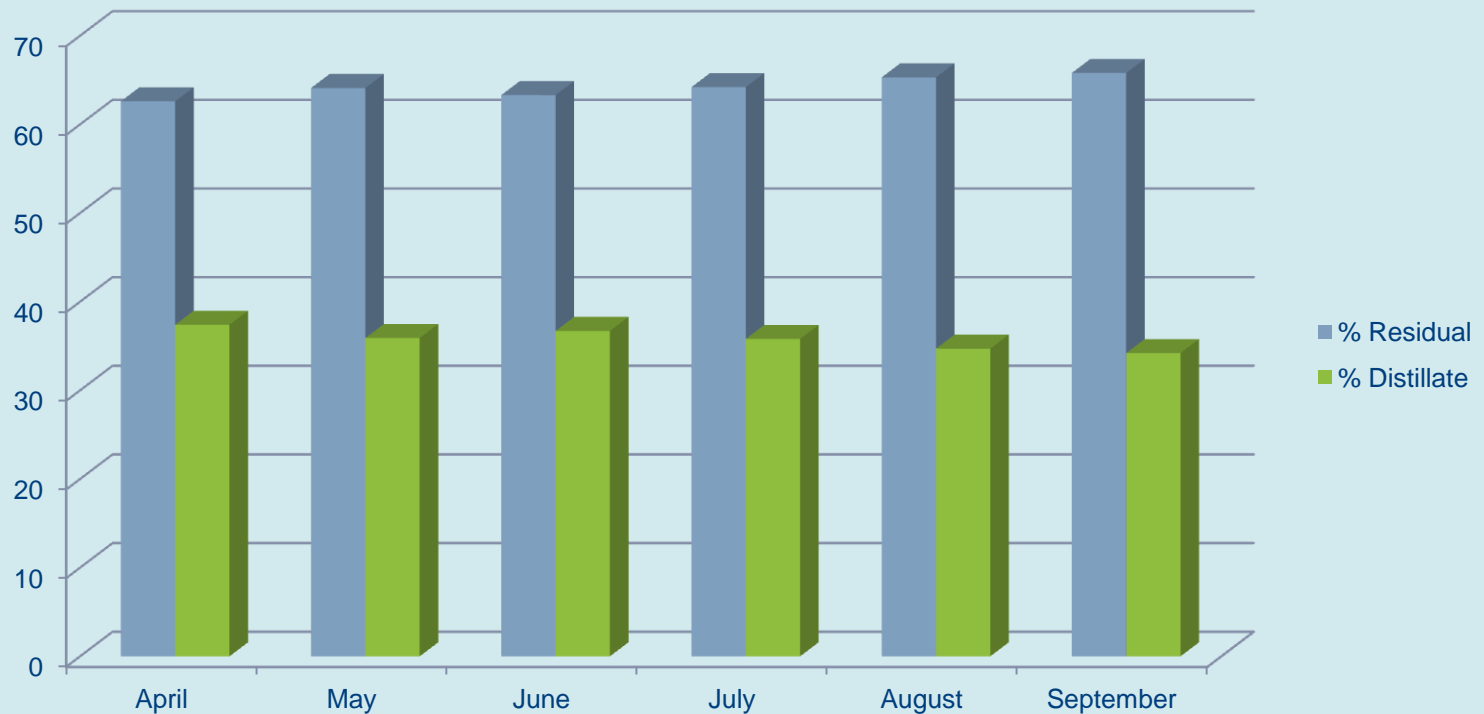
| Sample Submission Rates | Oct-14 | Nov-14 | Dec-14 | Jan-15 | Feb-15 | Mar-15 |
|-------------------------|--------|--------|--------|--------|--------|--------|
| Residual | 80% | 79% | 72% | 60% | 62% | 63% |
| Distillate | 20% | 21% | 28% | 40% | 38% | 37% |

The End of RFO?



Valued Quality. Delivered.

Sample Submissions 2015 - RFO vs MGO



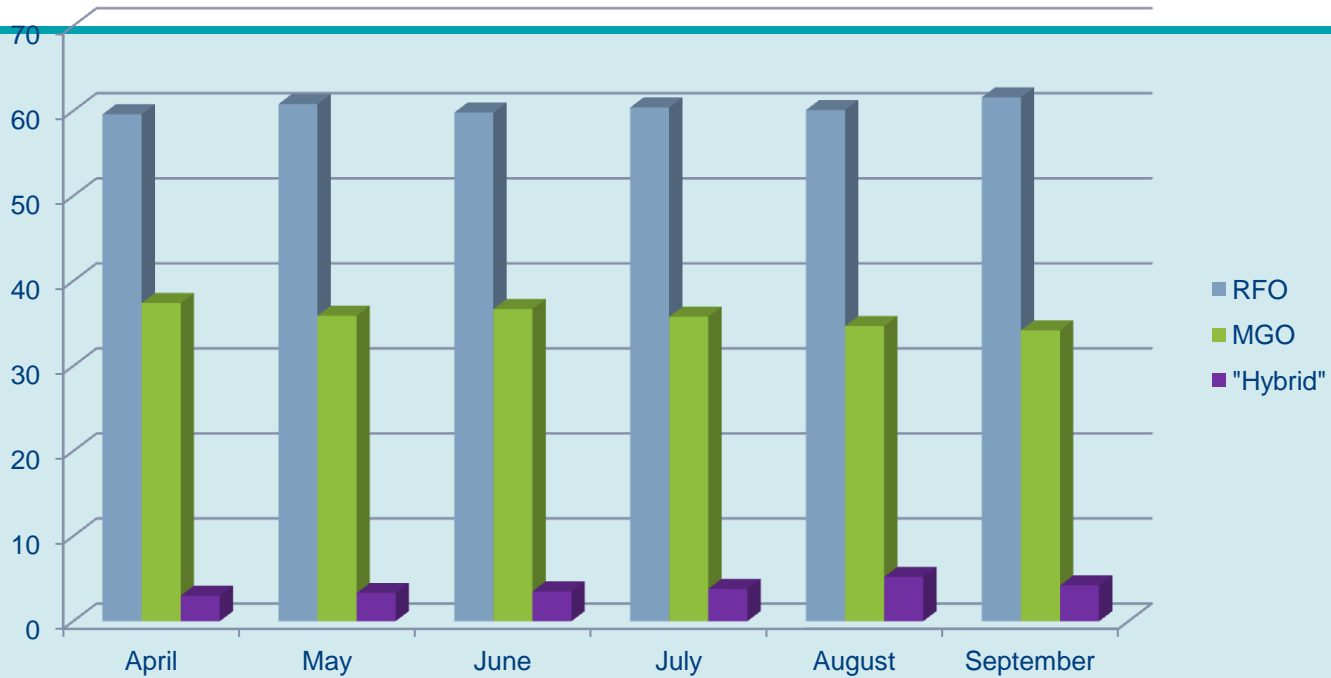
| | Month | | | | | |
|--------------|-------|-------|-------|-------|--------|-----------|
| | April | May | June | July | August | September |
| % Residual | 62.2% | 64.1% | 63.3% | 64.2% | 65.3% | 65.8% |
| % Distillate | 37.4% | 35.9% | 36.7% | 35.8% | 34.7% | 34.2% |

The End of RFO?



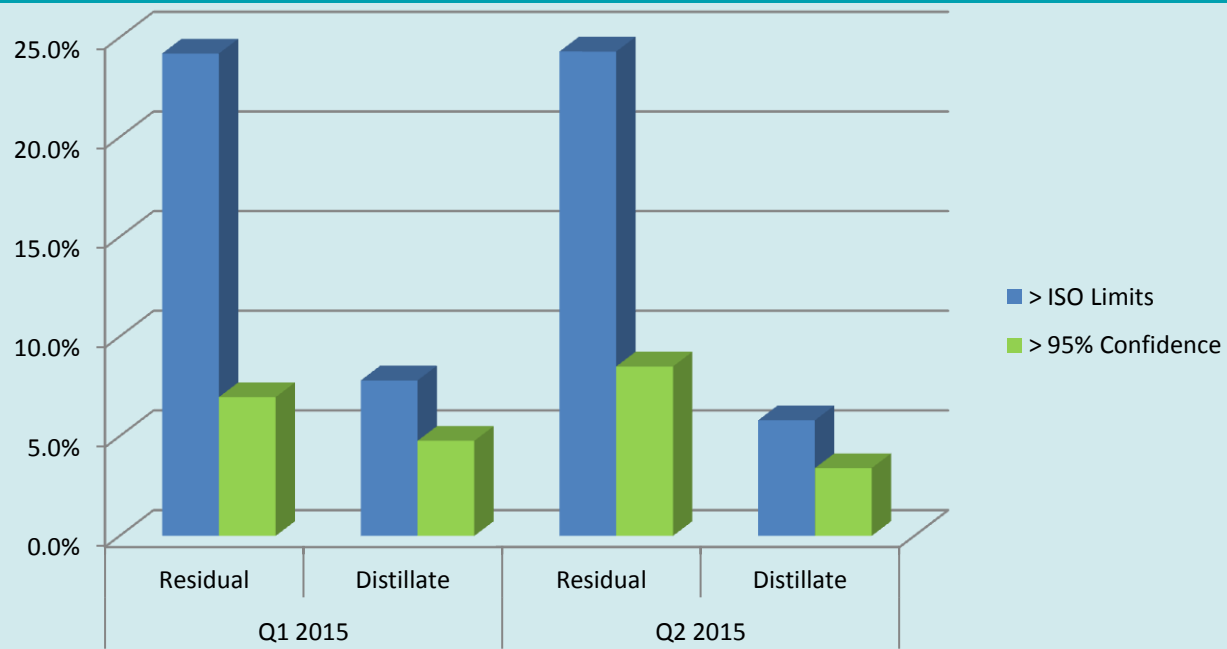
Valued Quality. Delivered.

Sample Submissions 2015 - Fuel Type



| | | Month | | | | | |
|-----------|--------------|-------|-------|-------|-------|--------|-----------|
| | | April | May | June | July | August | September |
| Fuel Type | RFO | 59.6% | 60.8% | 59.8% | 60.4% | 60.1% | 61.6% |
| | MGO | 37.4% | 35.9% | 36.7% | 35.8% | 34.7% | 34.2% |
| | Hybrid / NEF | 3.0% | 3.3% | 3.5% | 3.8% | 5.2% | 4.2% |

2015 - HFO vs MGO



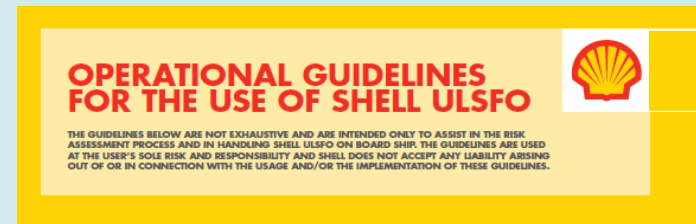
| | Q1 2015 | | Q2 2015 | |
|----------------------------|----------|------------|----------|------------|
| | Residual | Distillate | Residual | Distillate |
| > ISO Limits | 24.2% | 7.8% | 24.3% | 5.8% |
| > 95% Confidence | 7.0% | 4.8% | 8.5% | 3.4% |

The End of RFO - Hybrid Fuels / NEFs.



Valued Quality. Delivered.

- New fuels designed to meet the 0.10% max Sulphur ECA limit.
 - ExxonMobil HDME 50
 - Cepsa DMB 0.1%
 - Lukoil Eco Marine Fuel
 - Shell ULSFO
 - Gazprom 0.10% Product
 - Chemoil



CEPSA launches a new marine fuel containing only 0.1% sulphur

- **Density**
 - Average Density 887kg/m³ with a range of 833 to 949 kg/m³
- **Viscosity**
 - Average Viscosity 24.9 cSt with a range of 2.6 to 84 cSt @ 50° C
- **MCR**
 - Average MCR 2.6% with a range of 0.01 to 8.6%
- **Al + Si**
 - Average Al + Si 7ppm with a range of 2 to 32ppm
- **Pour Point**
 - Average Pour 17.9° C with a range of -12 to 33° C

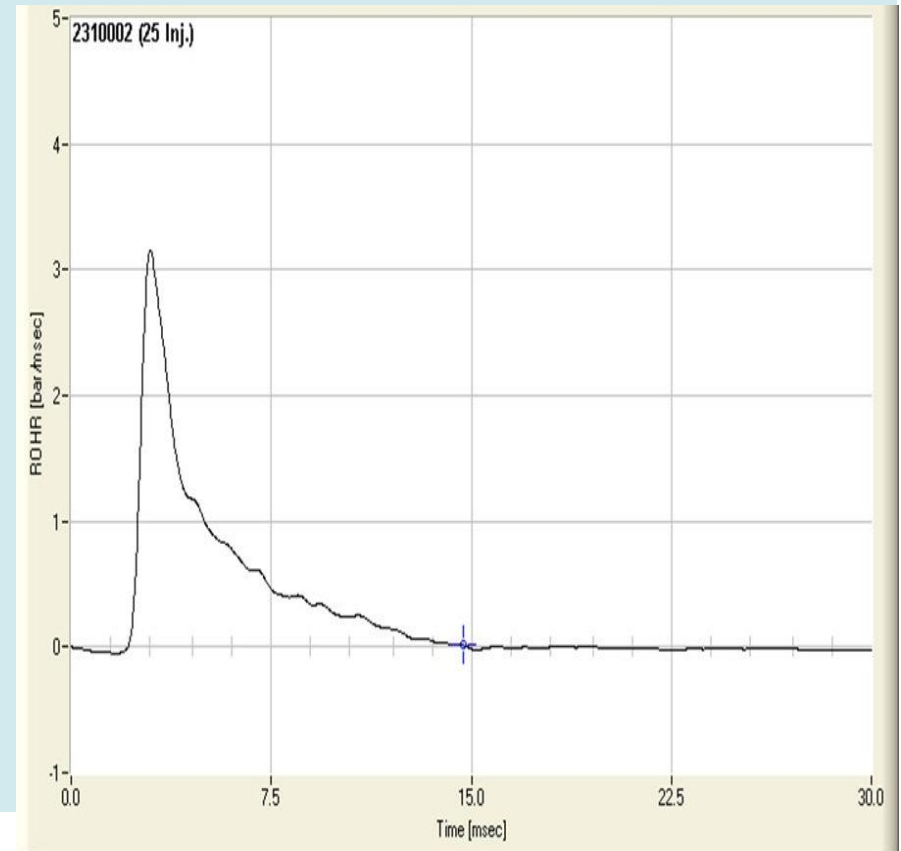
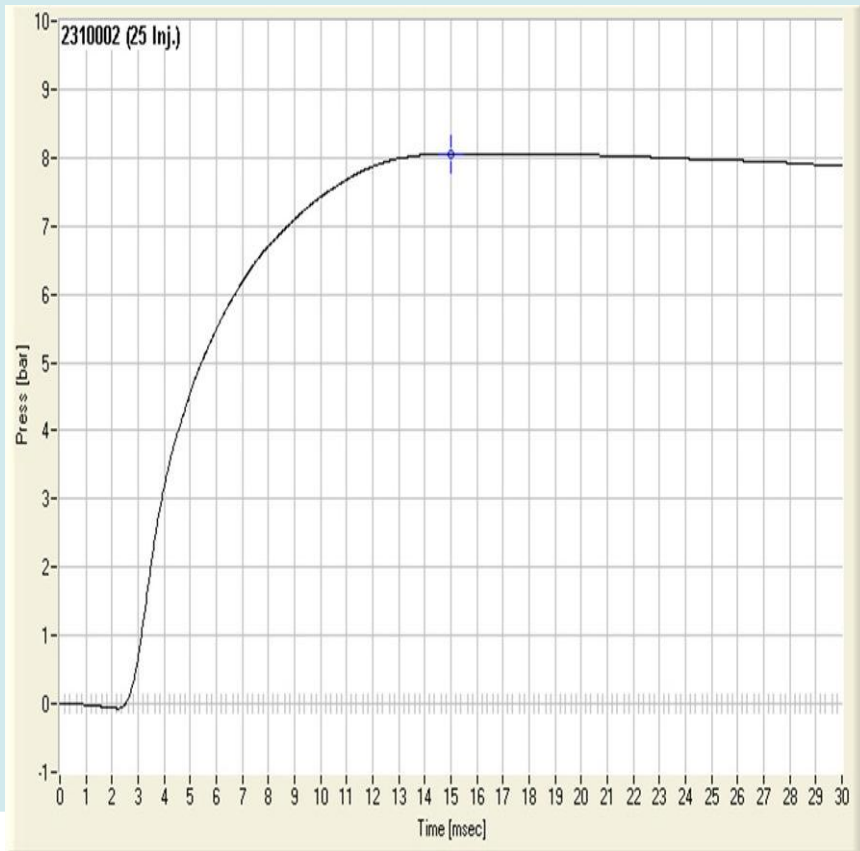
Hybrid Fuels – Test Data FIA



Valued Quality. Delivered.

| Test | Method | Units | Hybrid "A" | Hybrid "B" | Hybrid "C" | Hybrid "D" |
|---|---------------|----------|------------|------------|------------|------------|
| FIA100 | IP 541 | | | | | |
| Estimated Cetane Number (ECN) | | | >40.0 | >40.0 | >40.0 | >40.0 |
| Ignition Delay (ID) | | msec | 2.68 | 2.77 | 2.48 | 2.88 |
| Main Combustion Delay (MCD) | | msec | 2.97 | 3.07 | 2.78 | 3.16 |
| End of Main Combustion (EMC) | | msec | 9.75 | 9.48 | 9.67 | 9.66 |
| End of Combustion(EC) | | msec | 13.44 | 13 | 13.21 | 13.41 |
| Pre Combution Period (PCP) | | msec | 0.29 | 0.3 | 0.3 | 0.29 |
| Main Combustion Period (MCP) | | msec | 6.78 | 6.4 | 6.89 | 6.49 |
| After Burning Period (ABP) | | msec | 3.69 | 3.53 | 3.54 | 3.76 |
| Maximum Rate of Heat Release (MaxROHR) | | bar/msec | 3.74 | 3.29 | 3.46 | 3.74 |
| Post of Maximum Rate of Heat Release (PM) | | msec | 3.08 | 3.16 | 2.9 | 3.29 |
| Accumulated Rate of Heat Release (AR) | | bar | 7.73 | 7.91 | 7.75 | 8.04 |

Hybrid Fuels – Combustion Profile

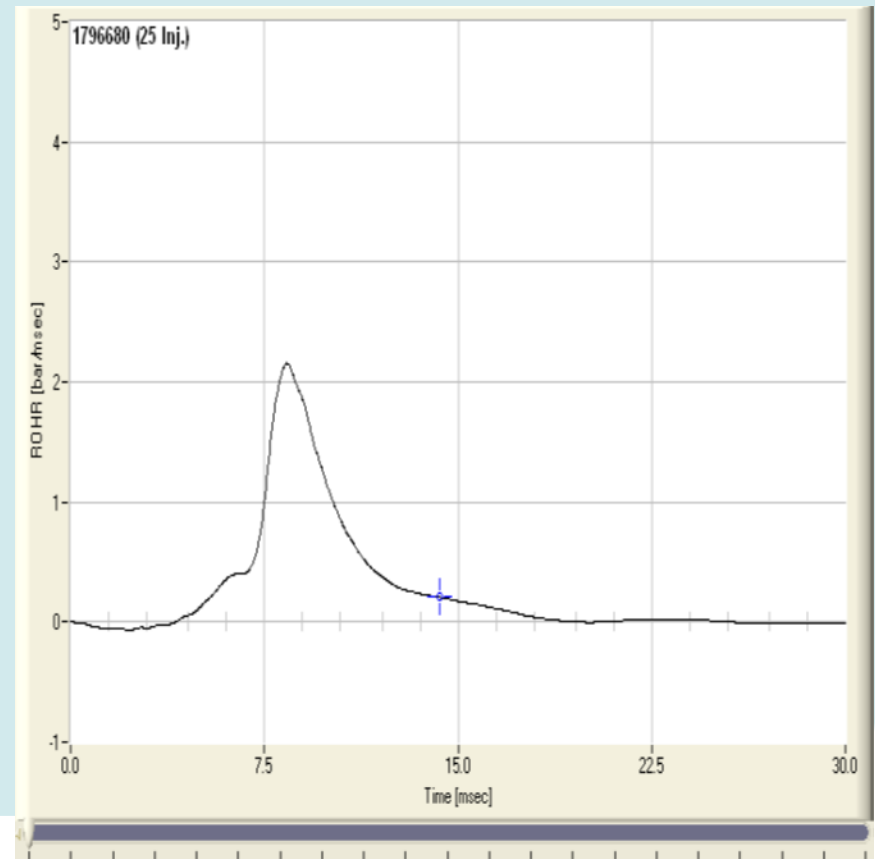
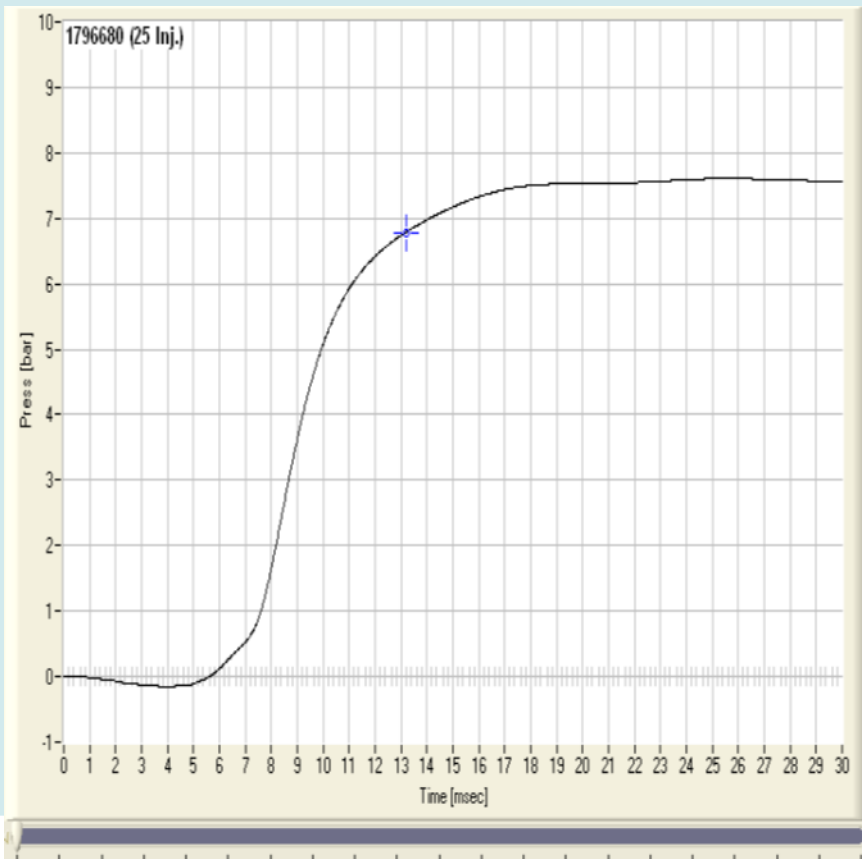


Hybrid Fuels – Combustion Profile



Valued Quality. Delivered.

Residual Fuel – ECN 18.9





- **LNG**
 - Is LNG still a good alternative to Residual Fuel?
 - What are the logistical issues surrounding supply of LNG?
 - What is the cost differential between LNG and RFO?
 - Is there an increased safety risk?
 - Is LNG a reasonable option for all Owners / Operators?
- **Abatement Technology**
 - Is Abatement Technology a viable option?
 - Are “Scrubber” systems a cost effective solution?
 - What benefits do “Scrubbers” offer to Owners / Operators?
 - Can “Scrubbers” offer a one fit solution for all Owners / Operators?



- Considerations and other alternatives
 - Refinery / Supplier Capabilities.
 - CE Delft / IMO Review – 2020 or 2025?
 - Further Fuel Options:
 - 2nd Generation Hybrid Fuels
 - Methanol
 - Fuel Cells
 - Bio Fuel

- Is this the end of the road for RFO - a dead technology?
- Significant change in buying / analysis patterns since end 2014 / beginning 2015.
- Overall improvement in quality particularly RFO – removal of 1.00% m/m sulphur fuels.
- Wider use of “Hybrid” / NEF products – in line with RMD 80 grade fuels.
- Future Fuels – LNG, Methanol, Bio.....
- Can “Greener” alternative fuels totally replace RFO?

THANK YOU.