Fuel Additives & Fuel Blending

Presentations & sponsor documents:
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Page 11: John LaRese, ExxonMobil Marine Fuels
Page 15: Aderco company information

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Part of Marine Fuels Webinar Week
29 June-3 July 2020
Aderco VLSFO (Very Low Sulphur Fuel Oil) Fuel Guide

THE FIVE KEY OIL ISSUES

- SLUDGE
- STABILITY
- CAT FINES
- ASPHALTENE
- COMPATIBILITY

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VLSFO FUEL CATEGORIES AND THEIR RELATED ISSUES

**CATEGORY 1**

Viscosity: From 5cSt to 60cSt
Contains more paraffinic fractions
- High stability issues
- More paraffinic HC – more waxing - more sludge
- High pour point – fuel handling issues
- High sediment value – TSP
- Chemical contaminants
- Commingling risk with Category 2 and Category 3

VLSFO Category 1
Drop Test
33.64cSt

**CATEGORY 2**

Viscosity: From 61cSt to 120cSt
A mix of paraffinic – light and heavy aromatic fractions
- Moderate stability issues
- Sediments value – TSP
- Compatibility issues
- Commingling risk with Category 1
- Chemical contaminants

VLSFO Category 2
Drop Test
108cSt

**CATEGORY 3**

Viscosity: From 121cSt to 300cSt
Mostly a mix of light and heavy aromatic fractions
- Possible stability issues
- TSP usually better
- Paraffinic fractions can cause issues
- Commingling risk with Category 1

VLSFO Category 3
Drop Test
278cSt

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Our technical department has tested the efficiency of Adero 2055G for each VLSFO Category. Test date 12 March 2020.

**DROP TESTS WITHOUT ADERCO**

- **Category 1**: 33cSt
- **Category 2**: 109cSt
- **Category 3**: 278cSt

**DROP TESTS WITH ADERCO 2055G**

- **Category 1**: 33cSt
- **Category 2**: 109cSt
- **Category 3**: 278cSt

- Improved fuel stability
- Reduced commingling risk with Category 2 & Category 3
- Chemical contaminants – BFP

- Improved fuel stability
- Reduced commingling risk with Category 1
- Chemical contamination – BFP

- Improved fuel stability
- Reduced commingling risk with Category 1

BFP*: Bad Fuel Procedure
COMPATIBILITY TEST

After testing the efficiency of Aderco 2055G for each category of VLSFO, a Compatibility Blending Test (ASTM D4740) has been implemented.

Tests By: Aderco Marine
Year: 2020

**Left: Mix VLSFO**
Mix VLSFO categories at a ratio of 10% (Category 1) and 90% (Category 3)

**2055G Drop Test Result**
The heavy aromatic fraction of Category 3 is better dispersed. Upon close analysis, the clear paraffinic ring is thinner on the outskirt.

**Right: 2055G Drop Test Result**
Mix VLSFO categories at a ratio of 10% (Category 3) and 90% (Category 1)

The heavy aromatic fraction of Category 3 is much better dispersed with the Category 1 paraffinic fraction. Aderco 2055G helps to reduce fuel incompatibility within storage tanks, preventing sludging and easing filtration, purification and injection.
COMPARATIVE FUEL TESTS WITH AND WITHOUT ADERCO 2055G

SLUDGE TEST

VLSFO tanks deposit free.
Test by: Aderco Marine
Year: 2019-2020
File: 2020 ship tanks cleanliness follow-up

Figures 5, 6 & 7: No sludge deposits from VLSFO tanks after 4 months using Aderco 2055G

CAT FINES TEST

Settle down effect of Aderco.
T=0H fuel +92 ppm AL +116 ppm
T=48H with Aderco = >80% of both are settled down.
Product: Aderco 2055G
Test By: CRIQ
File: PE48844
Year: 2019

Figure 8: Test start: T= 0
Left flask: fuel + cat fines
Right flask: fuel + cat fines + Aderco 2055G*

Figure 9: Test start: T= 24H
Left flask: fuel + cat fines
Right flask: fuel + cat fines + Aderco 2055G*

Figure 10: Test start: T= 48H
Left flask: fuel + cat fines
Right flask: fuel + cat fines + Aderco 2055G*

*60% - 70% of the cat fines are rejected during the water draining at the settling tank.
STABILITY TEST

Asphaltenes stability within the Aromatic 70% vs Aliphatic 30% components.

Containing: 2% asphaltenes
Test By: CRIQ
File: 640-PE2646
Year: 2000-2018-2020

Figure 1: Non-evaporated solution containing 2% asphaltene and no ADERCO 2055G in benzene (magnification: 290X)

Figure 2: Non-evaporated solution containing 2% Shell asphaltene and ADERCO 2055G in benzene (magnification: 290X)

ASPHaltenes Dispersion Test

Within the Aromatic 70% vs Aliphatic 30% components.

Containing: 0.5% asphaltenes
Test By: CRIQ
File: 640-PE2646
Year: 2000-2018-2020

Figure 3: Shell Asphaltenes precipitated with heptane from a solution containing 0.5% Asphaltene and no ADERCO 2055G in benzene (magnification: 4140X)

Figure 4: Shell Asphaltenes precipitated with heptane from a solution containing 0.5% Asphaltene and ADERCO 2055G in benzene (magnification: 4140X)
Key Characteristics:

- 100% vegetal-organic, ashless, solvent-free and metal-free
- Classified as Non-Hazardous
- No transport restriction (flash point: ≥ 146°C)
- Compatible with HFO, HSFO, VLSFO, MGO/LSGO/ULSGO
- REACH Compliant, BV Attested, DNV-GL Statement of Fact, EPA Registered.
Overcome these challenges by using ADERCO Technology

Thank You!
Fuel Additives & Fuel Blending Webinar

Energy lives here™
Key dimensions to quality fuels

Development that goes beyond ISO 8217: 2017

- Stability: The potential for a fuel to change condition
- Compatibility: The tendency of fuels to produce sediment when mixed
- Quality Fuel
- Viscosity
- Combustion: Poor combustion yields a number of issues
- Catalytic Fines: ‘Good is not good enough’

ISO 8217 stipulates max viscosity for residual fuels
It is all about the “know”

Supplier, Fuel(s), Onboard handling, Lubricants

- “Know” your supplier
  - Question the Quality, Reliability & Integrity
  - Innovation

- “Know” your fuel
  - ISO 8217: 2017
  - Fit for Use

- “Know” your onboard handling
  - Best practices
  - Technical support

- “Know” your lubricants
  - Best practices
VLSFO FUEL GUIDE

HOW ADERCO 2055G IMPROVES THE FIVE KEY FUEL OIL ISSUES

SLUDGE
STABILITY
COMPATIBILITY
CAT FINES
ASPHALTENE
**VLSFO FUEL CATEGORIES AND THEIR RELATED ISSUES**

**CATEGORY 1**
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- High pour point – fuel handling issues
- High sediment value – TSP
- Chemical contaminants
- Commingling risk with Category 2 and Category 3

**DROP TESTS WITHOUT ADERCO**

**Category 1**
- VLSFO Category 1 Drop Test 33.64cSt

**DROP TESTS WITH ADERCO 2055G**

**Category 1**
- VLSFO Category 1 Drop Test 33cSt

**CATEGORY 2**
Viscosity: From 61cSt to 120cSt
- A mix of paraffinic – light and heavy aromatic fractions
- Moderate stability issues
- Sediments value – TSP
- Compatibility issues
- Commingling risk with Category 1
- Chemical contaminants

**DROP TESTS WITHOUT ADERCO**

**Category 2**
- VLSFO Category 2 Drop Test 109cSt

**DROP TESTS WITH ADERCO 2055G**

**Category 2**
- VLSFO Category 2 Drop Test 109cSt

**CATEGORY 3**
Viscosity: From 121cSt to 300cSt
- Mostly a mix of light and heavy aromatic fractions
- Possible stability issues
- TSP usually better
- Paraffinic fractions can cause issues
- Commingling risk with Category 1

**DROP TESTS WITHOUT ADERCO**

**Category 3**
- VLSFO Category 3 Drop Test 278cSt

**DROP TESTS WITH ADERCO 2055G**

**Category 3**
- VLSFO Category 3 Drop Test 278cSt

**THE FIVE KEY OIL ISSUES**
- Sludge
- Stability
- Cat fines
- Asphaltene
- Compatibility

Our technical department has tested the efficiency of Aderco 2055G for each VLSFO Category. Test date 12 March 2020.
COMPARATIVE FUEL TESTS WITH AND WITHOUT ADERCO 2055G

COMPATIBILITY TEST
After testing the efficiency of Adero 2055G for each category of VLSFO, a Compatibility Blending Test (ASTM D4740) has been implemented.

Tests By: Aderco Marine
Year: 2020

STABILITY TEST
Asphaltene stability within the Aromatic 70% vs Aliphatic 30% components.

Containing: 2% asphaltene
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File: 640-PE2646
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Within the Aromatic 70% vs Aliphatic 30% components.

Containing: 0.5% asphaltene
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File: 640-PE2646
Year: 2000-2018-2020

SLUDGE TEST
VLSFO tanks deposit free.

Test by: Aderco Marine
Year: 2019-2020
File: 2020 ship tanks cleanliness follow-up

CAT FINES TEST
Settle down effect of Adero.

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Product: Adero 2055G
Test By: CRIQ
File: PE48844
Year: 2019

*60% - 70% of the cat fines are rejected during the water draining at the settling tank.
ADERCO 2055G 4IN1 FUEL CONDITIONER

A PROVEN SOLUTION FOR REDUCING OPEX, IMPROVING OPERATIONAL RELIABILITY AND LOWERING EMISSIONS

Aderco’s proprietary surfactant-based technology with a detergent action is at the core of the latest-generation fuel treatment developed for the shipping industry. 100% vegetal-organic, ashless as well as solvent-free and metal-free, it is not only more environmentally responsible but also extremely concentrated for the lowest cost per tonne treated.

ADERCO 2055G 4in1 Fuel Conditioner addresses the three fundamental priorities of today’s shipping industry: maximise Efficiency, ensure Economy, and respect the Environment.

The environmentally responsible way to protect your fuel investment and your engine while delivering key benefits to ensure smooth operations:

- Prevents risks linked to fuel incompatibility, instability, commingling, change-over operations
- Prevents asphaltene agglomeration and sludge precipitation
- Regenerates sludge into usable fuel
- Facilitates water separation for effective drainage
- Inhibits microbial growth and prevents pH degradation (distillates)
- Prevents clogged filters and strainers
- Eases purifier workload and prevents fouling
- Facilitates Al/Si catalytic fines (“catfines”) ejection
- Optimises fuel atomisation and prevents ignition delays
- Prevents deposits (combustion chamber, piston tops, ring lands)
- Prevents vanadium corrosion
- Lowers exhaust gas temperatures
- Prevents exhaust system fouling (turbocharger, economiser)
- Reduces particulate matter (PM) emissions

For 2-stroke & 4-stroke engines

1 litre treats 55 metric tonnes of fuel

www.aderco.com
ADDERCO 2055G 4IN1 FUEL CONDITIONER

Surfactant-based detergent action delivers benefits from tank to funnel

Once blended with the fuel (product fed directly into the storage tanks), Aderco’s surfactant formula and detergent properties keep the fuel matrix of hydrocarbon molecules (aliphatic & aromatic) stable and optimally dispersed. The surfactant action is purely physical: there is no risk of a chemical reaction.

ADDERCO 4in1 2055G Fuel Conditioner prevents the formation of sludge and gradually reduces existing sludge to molecular structures, regenerating it into usable fuel.

Treating with Aderco improves efficiency, reduces component wear and lowers emissions, delivering benefits before, during and after combustion.

- Stabilises/homogenises fuel
- Regenerates sludge into fuel and prevents new sludge formation
- Prevents fuel incompatibilities
- Breaks down water emulsion
- Stops microbial growth
- Keeps tanks and lines clean
- Eases stress on filters & purifiers
- Optimises fuel atomisation
- Cleaner, improved combustion
- Reduces wear of critical engine system components (e.g. injection)
- Prevents carbon deposit build-up
- Overall smoother engine operation
- Ensures smoother, more efficient operation
- Lowers exhaust temperatures, reducing both engine stress and noxious gas emissions
- Reduces particulate matter (PM) emissions & smoke opacity
- Prevents deposit formation in exhaust system (turbocharger, economiser)

BEFORE

DURING

AFTER

Easy application – no special dosing or mixing equipment required

Simply pour into storage tank prior to bunkering.

Recommended dosage: **1 litre of Aderco 2055G per 55 metric tonnes.**

Important: To condition the fuel tank and achieve optimum results, initial dosage is 2 litres of Aderco 2055G per 55 metric tonnes. The same applies when resuming treatment after an extended period.

Key characteristics

- 100% vegetal-organic, ashless, solvent-free and metal-free
- Classified as Non-Hazardous - no transport restrictions (flash point: ≥146°C)
- Compatible with HFO, HSFO, Hybrids, MGO/LSGO/ULSGO and ADERCO L1050 Lubricity Improver for LSGO/ULSGO
- REACH Compliant, BV Attested, DNV-GL Statement of Fact, EPA Registered