

Challenges in Formulating Higher Performing HD Lubricants for Use with Biodiesel

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Challenges in Formulating Higher Performing Heavy Duty Lubricants for Use with Biodiesel



- **Biodiesel Trends**
- **Testing and Proof of Performance**
- **Higher Value HD Lubricants Examples**
- **Summary**

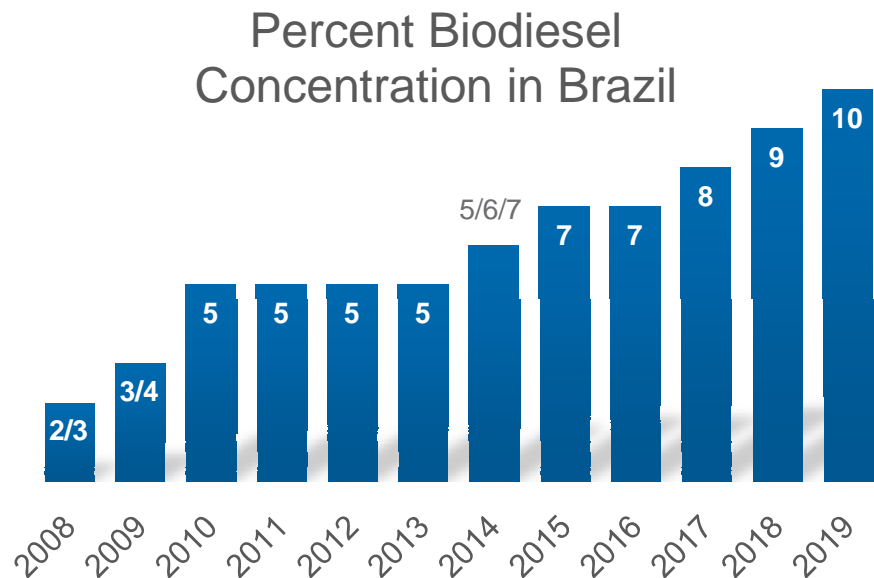


Biodiesel Trends

The Evolution of Biodiesel in Brazil



- Official Brazilian B100 production today is capable of covering the needs for up to B10
- The Brazilian plan for biodiesel content increased from 7% to 10% in March 2016, as follows:
 - 8% in 2017
 - 9% in 2018
 - 10% in 2019
- Main reason for increased biodiesel use in Brazil: less dependence of imported diesel



Biodiesel concentration will continue to rise in Brazil

Source: ANP, 2016

Slide 4

MAEA1

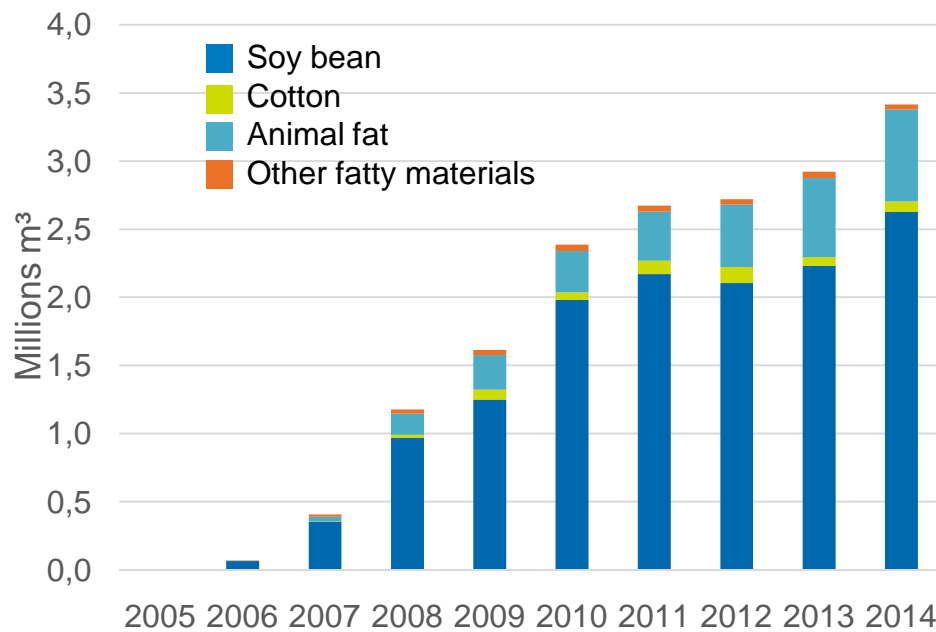
Note from Legal: If it's 10% in 2016, why is 8% in 2017. Unclear.

Abreo, Marcos; 09/10/2016

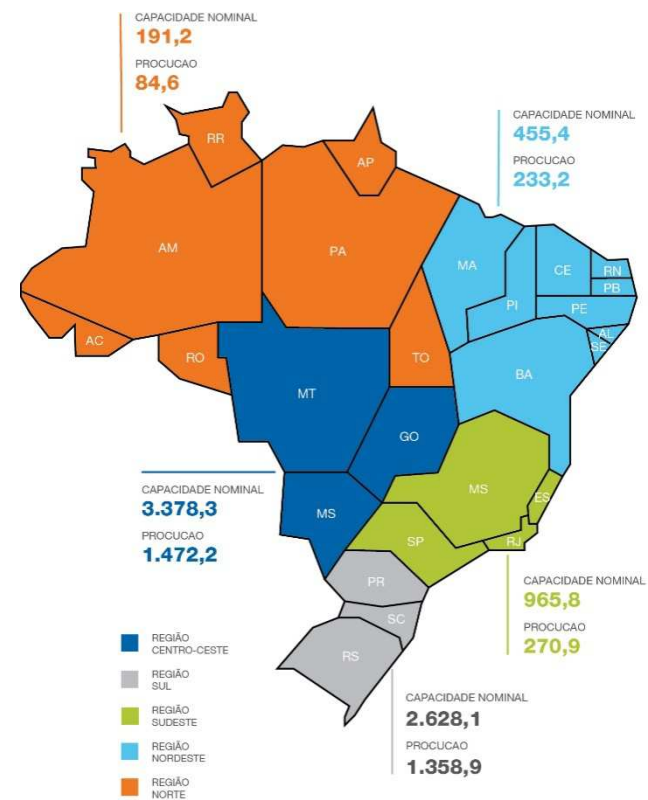
Evolution of Biodiesel in Brazilian Energy Matrix



Raw material used for Biodiesel production (B100) – 2005-2014



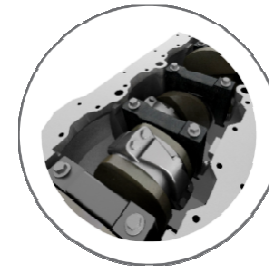
Installed Capacity of Biodiesel Production



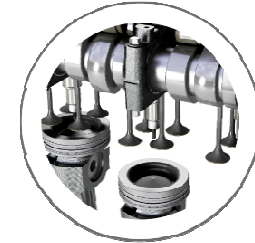
Source: ANP, 2014



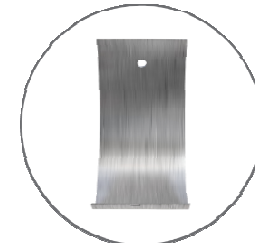
Oil Flow in an Engine



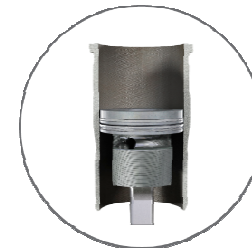
Crankcase



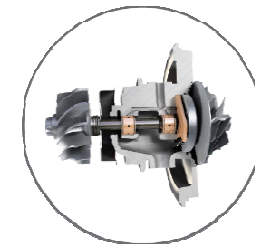
Valve train



Bearings




Pistons and liners



Turbo charger

Oil flow to key areas of the engine is essential to avoid catastrophic failure



Testing & Proof of Performance

European Biodiesel Testing



Engine Tests

B15 Fuel L-104 OM646 LA Bio-Diesel

- Piston cleanliness
- Piston ring sticking
- Sludge

B05 Fuel L-106 DV6C

- Viscosity Increase
- Piston deposits

B05 Fuel L-101 OM501 LA

- Viscosity Increase
- Piston Deposits

5% B100 Daimler Oxidation Test

- Viscosity increase
- Oxidation

B15 Fuel L-105 Bench Test

- Low temperature pumpability

7% B100 L-109 Bio-Diesel Test

- Viscosity increase
- Oxidation

Bench Tests

B15 Fuel L-104: OM646 LA Bio-Diesel Engine Test



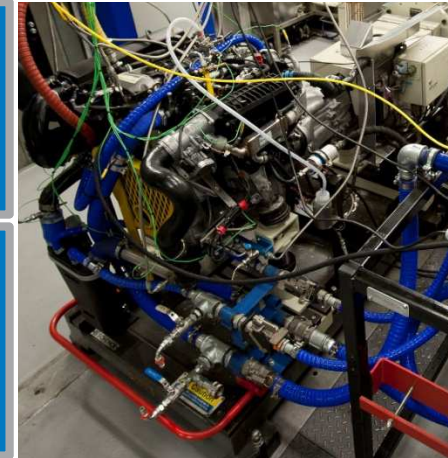
SUCCESS
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PURPOSE

Protection against biodiesel related oil degradation and deposits in modern light duty diesel engines

ENGINE

- Mercedes Benz OM646, 2.2 liter turbocharged common-rail diesel
- 110 kW maximum power



TEST CYCLE

- 120 hours, repeats a 3 hour cycle which includes both hot & cold operation
- B15 fuel used – 15% biodiesel content, mixed source
- Small quantities of B100 are injected directly into the engine's oil pan (sump) at regular intervals, simulating fuel dilution from post-injection

PROPOSED LIMITS

- ACEA has proposed limits for all categories except E4, E7, and A3/B3
- Industry is working on final limits for all categories

7% B100: L-109 Bio-Diesel Test Bench Test



PURPOSE

Glassware test to assess oxidation resistance of engine oils in the presence of biodiesel



TEST PROCEDURE

- Test oil is diluted with 7% B100
- Sample is aged for 168 hours at 150° C
- A sample is taken regularly and checked for viscosity increase & oxidation level
- CEC SG has agreed on a single candidate test run

TEST LIMITS HAVE BEEN AGREED

- ACEA have identified limits for all categories
- For both oxidation and viscosity increase @ 168 hours and 216 hours test duration

5% B100: Daimler Oxidation Test Bench Test



PURPOSE

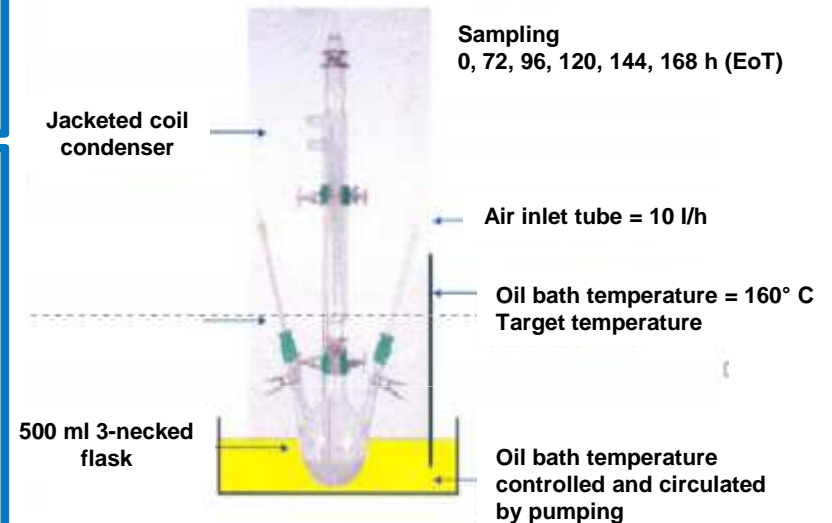
- Improved biodiesel compatibility
- Less oil oxidation & viscosity increase with increased amount of biodiesel in oil

TEST REQUIREMENTS

- Test hardware: 500 ml necked flask
- Return condenser: with intensive cooler
- Catalyst: 100 mg Fe-III-acetylacetonate
- Oil amount: 250 g
- Oil temperature: 160° C (oil bath)
- Air flow: 10 l/h
- Test length: 168 hrs

TEST PARAMETERS

- Viscosity increase (kinematic viscosity at 100° C), Oxidation (DIN 51453, IR)
- Test 1: fresh oil (candidate or reference oil)
- Test 2: fresh oil + biodiesel 5% B100 FAME **MAEA2**
- No. of tests: 3 times each
- Test laboratories: APL Landau & ISP Salzbergen




Slide 11

MAEA2

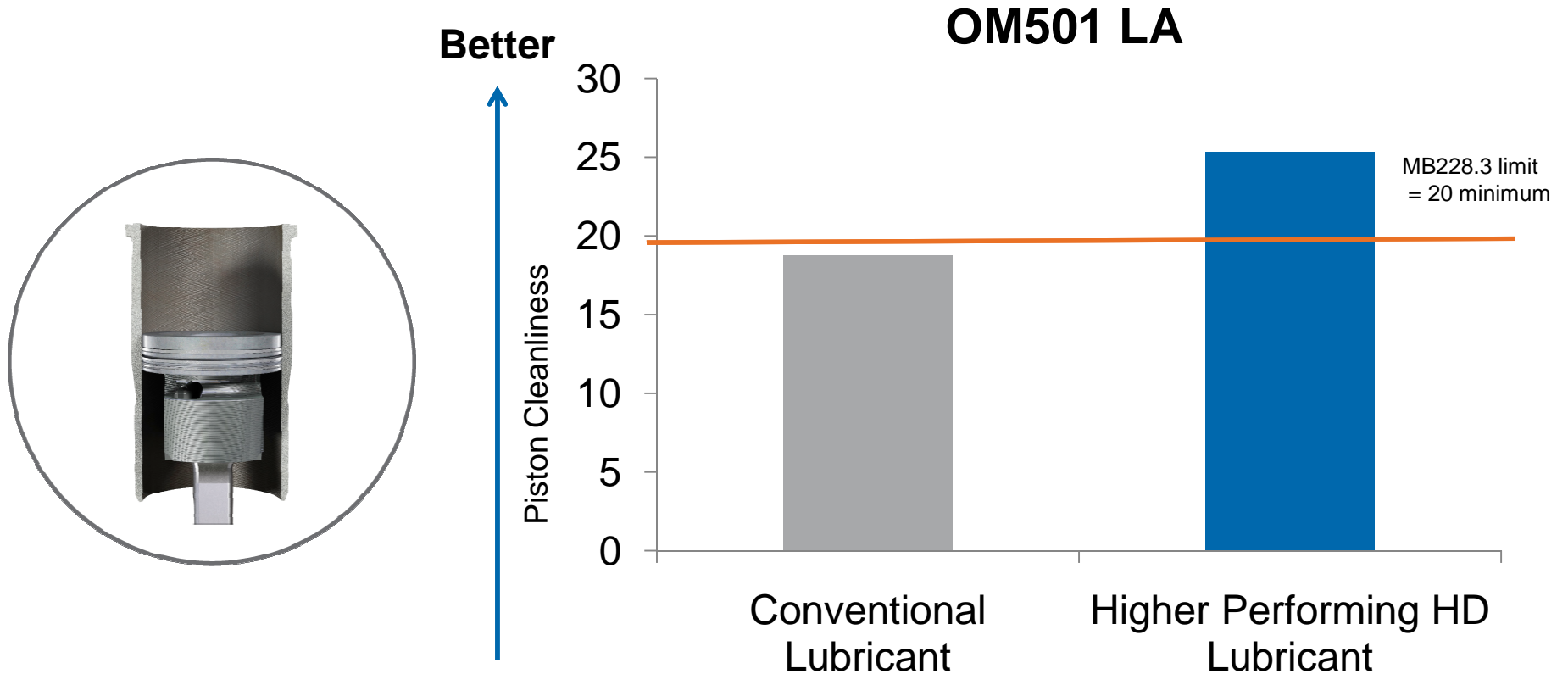
Note from Specialties: Assum the audience knows what "FAME" stands for?

Abreo, Marcos; 09/10/2016



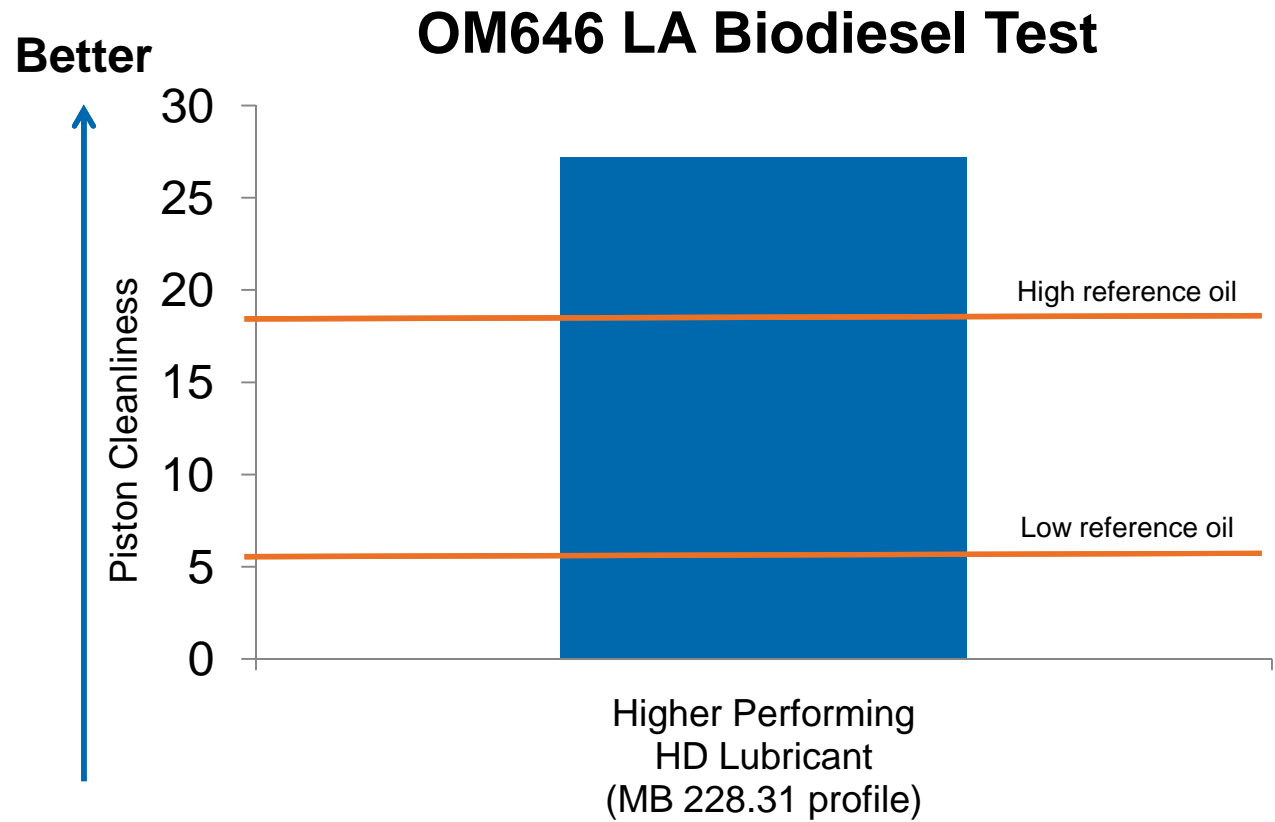
Higher Performing HD Lubricants Examples

Piston and Liner Protection



Higher performing HD lubricants exceed performance specifications, as well as cater to Brazilian biodiesel requirements

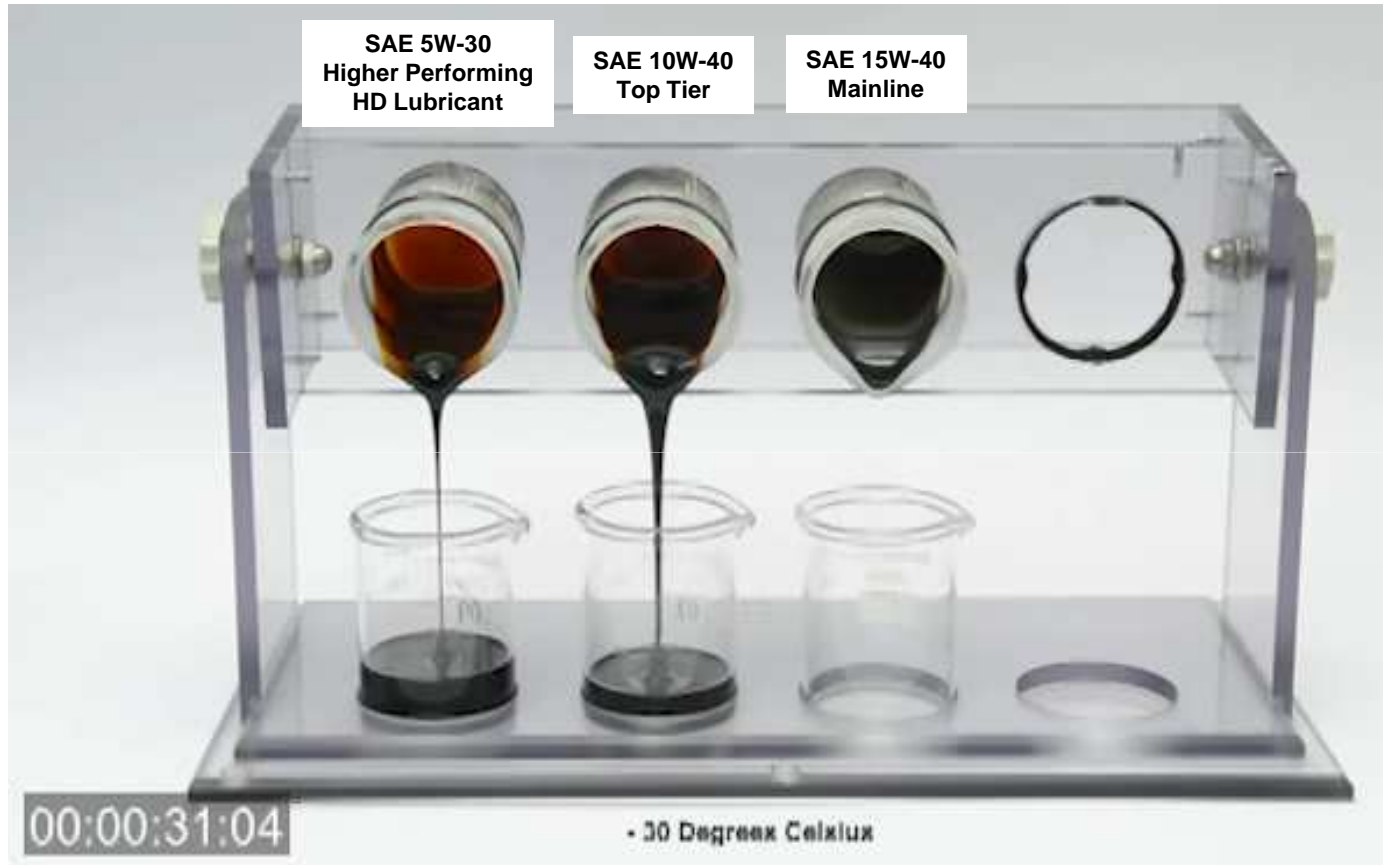
Piston Cleanliness



Higher performing HD lubricants exceed industry and more stringent OEM deposit limitations, providing increased engine life even with biodiesel presence



Cold Flow Demonstration – with Biodiesel



All 3 oils were tested the same method as before using the Low Temperature Pumpability bench test CEC-L-105.

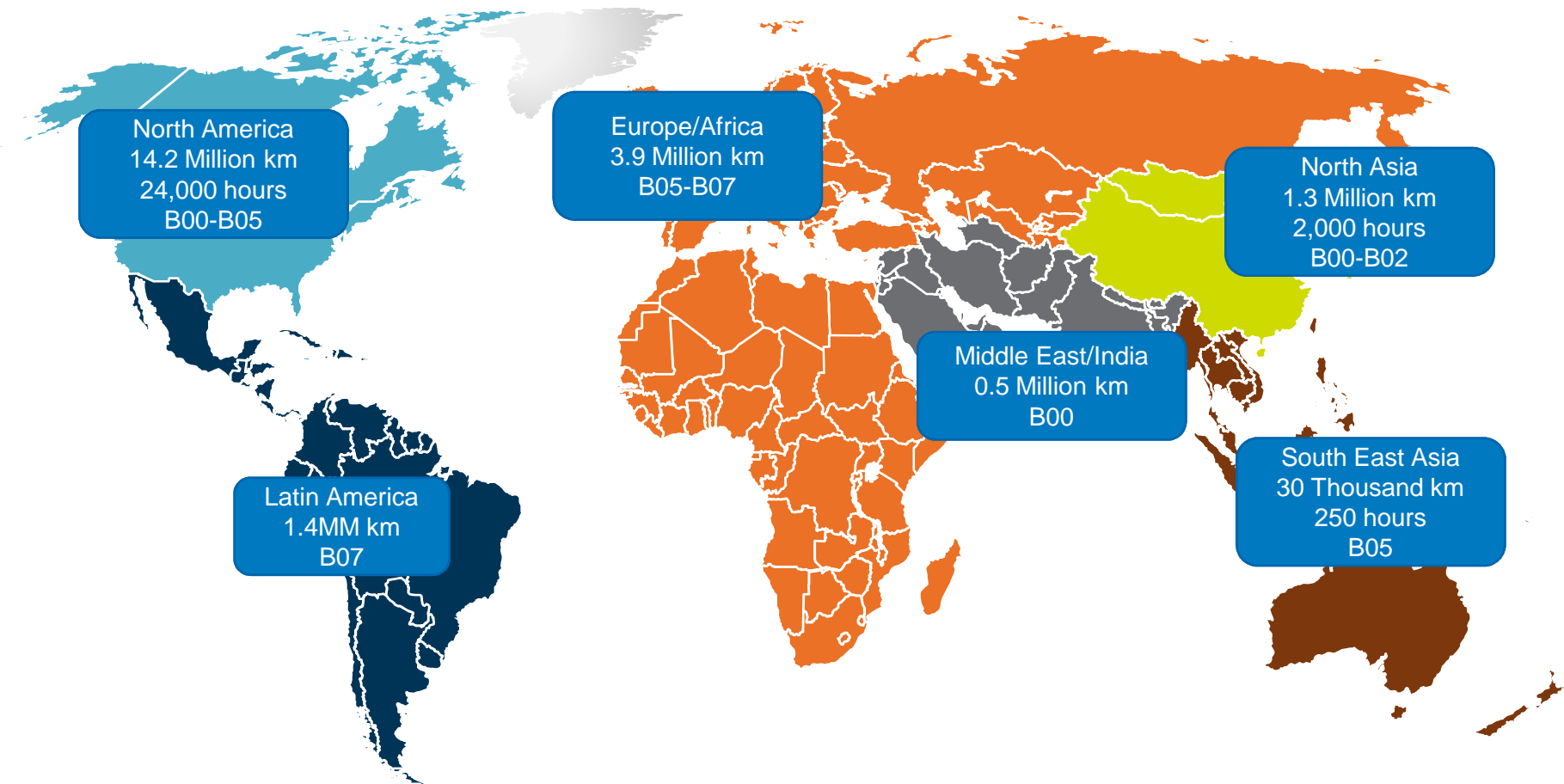
The oil was contaminated with 5% of B100 (bio-diesel) to replicate fuel dilution within an engine.

This video compares a higher performing lubricant to market available SAE 10W-40 and SAE 15W-40 lubricants with Biodiesel contamination

Performance Where it Counts... ...in the Field...in Many Vehicle Types



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Global Totals |

**On-road: 21 million km or 500 times around the world!
Off-road: 26,000 hours or 13 working years!**

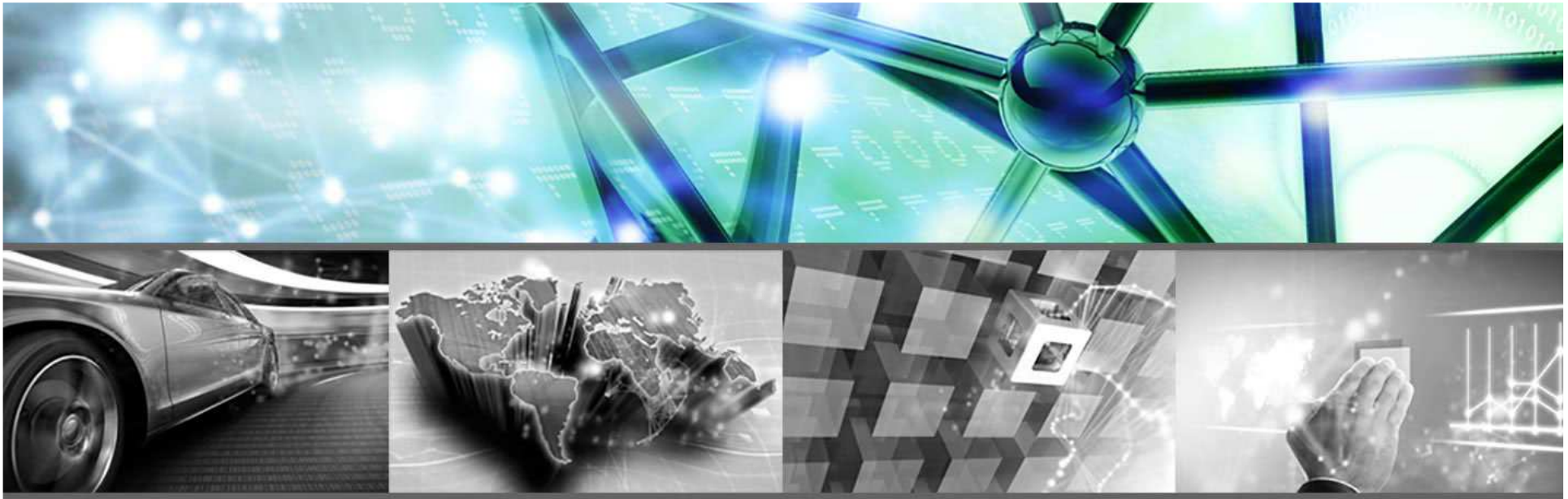


Summary



- Biodiesel is becoming more prevalent in many areas of the world, and Brazil is leading the way
- The harmful effects of biodiesel use can obstruct oil flow in modern engines, shortening the engine's life
- Bench, engine, and field tests prove the performance of higher performing lubricants in a variety of biodiesel uses and applications
- Higher performing lubricants protect engines from the harmful effects of biodiesel use





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When your company and ours combine energies, great things can happen. You bring ideas, challenges and opportunities. We'll bring powerful additive and market expertise, unmatched testing capabilities, integrated global supply and an independent approach to help you differentiate and succeed.