

HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL
OF
ASTM D02.B0.02
December 9, 2008
Tampa Marriott Waterside, Tampa, FL

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ACTION ITEMS

1. Recommendation to declare CF-2 obsolete

MINUTES

1.0 Call to order

- 1.1 The Heavy Duty Engine Oil Classification Panel (HDEOCP) was called to order by Chairman Jim McGeehan at 1:30 p.m. on Tuesday, December 9, 2008, in the Florida Salon V of the Tampa Marriot Waterside Hotel, Tampa, FL.
- 1.2 There were 10 members present and 47 guests present. The attendance list is shown as Attachment **2**.

2.0 Agenda

- 2.1 The agenda shown (included as Attachment **1**) was reviewed by Chairman McGeehan.

3.0 Minutes

- 3.1 The minutes from June 17, 2008 were approved as written.

4.0 Membership

- 4.1 Jim Linden replaces Bob Olree from GM.

5.0 EMA Update

- 5.1 Heather Debaun presented an update from the EMA. See Attachment **3**. The EMA supports the task force investigation of the emulsion situation. The EMA has not heard from the EOAT Surveillance Panel regarding a possible severity shift. The Surveillance Panel has discussed the topic. There seems to be some changes in severity. Ryan Johnson is the new chair of the EOAT Surveillance Panel. Some CJ-4 oils are shearing out of grade and data is being collected. If data exists and can be shared, submit it to Greg Shank or Roger Gault. The Biodiesel Bench Test Task Force met and is forming a scope and objectives. The 1M-PC supply of parts will stop in January of 2009.

6.0 Water-Oil Emulsion Task Force

- 6.1 Hind Abi-Akar presented an overview and update of the emulsion task force. See Attachment **4**. Slide 11 was inadvertently omitted. CAT is seeing an oil-water emulsion formation increase throughout a line up of engine applications. Older category oils

separated the oil and water, but newer category oils resulted in a stable emulsion. There is a range of temperature and humidity under which the emulsion forms. An engine was run to evaluate. A "passing" oil lets the water separate from the oil. Field data from CAT engines suggests that most brands and additive packages result in emulsion formation. The emulsion is made up of 70-90% water. Often, rust is present under the emulsion. Both the rust and emulsion are concerns.

- 6.2 A bench test has been developed at CAT named the Oil-Water Emulsion Stability Test (O-WEST). Multiple runs have been made. CJ-4 oils separate about 3.3% water and a mild fail separates about 9.2% and a passing oil separates about 19.8% water. The task force met at CAT and witnessed an O-WEST demonstration. CAT will be running a field test for evaluation of CJ-4 oils and passing oils that should last a few months.
- 6.3 CAT will evaluate the passing oil in the Passenger Car Emulsification test and work with ILSAC to maintain universal oils. Also, existing tests will be identified that will be needed to validate the impact of any formulation changes.
- 6.4 Members of the task force have contributed knowledge about the mechanism of emulsion formation relating to thin film composition. Water in the blowby is very acidic. The hand shaking screening test is not sufficient to predict the O-WEST.

7.0 Test Status of Single Cylinder tests

- 7.1 Hind also gave an indication of CAT's support of industry engine tests. See Attachment 5.
- 7.2 1K, 1R, and 1N support will continue. CAT has a dedicated parts person to monitor.
- 7.3 The 1P will be supported and currently have enough liners from the current batch to last through 2009. The 1Y3860 core assembly is out of stock, but will be in stock.
- 7.4 The 1M-PC has parts availability issues. CAT had previously announced stopping support in 2009. The 1Y7943 cylinder head is only available on a MTO (made to order) basis with a several month lead time and very high cost. The 1Y7514 RACK and 1Y0469 BUSHING are out of stock. CAT will no longer support the 1M-PC after January 2009. There are some low usage rate parts available that will be kept for 6 months, but will be discarded after that.

8.0 Test Status of 6V92

- 8.1 Patrick Lai gave an update on the status of the 6V92 test. Last June, an update was promised by December. Two organizations that had considered setting up a stand will not set up a stand. This makes the test unavailable.
- 8.2 Since the 1M-PC and 6V92 will not be available, then CF-2 is not available. The HDEOCP will recommend to B that parts are no longer available and that CF-2 be declared obsolete. A motion was made and seconded by many to recommend that CF-2 be declared obsolete. This was approved with unanimous approval. Also, the 6V92 Surveillance Panel can be disbanded.
- 8.3 Also, the next version of MIL Spec 2104H will not include the 6V92.

9.0 Bio Diesel Bench Test Task Force

- 9.1 Joe Franklin presented an update on the biodiesel task forces. See Attachment 6. The two task forces have been combined into one and have had 2 meetings. A scope has been developed. The target date for bench tests and methods is end of 2010.
- 9.2 One test will be to identify the amount of bio in used oil separate from oxidation.

10.0 Next meetings

- 10.1 The next meeting is planned for June 2009.

11.0 The meeting was adjourned at 2:30 pm.

Final Agenda
ASTMSECTION D.02.BO.02
HEAVY-DUTY ENGINE OIL CLASSIFICATION PANELS

Tampa Marriott Waterside, Tampa, FL

December 9, 2008

1:30-4:00 pm

Chairman/ Secretary:

Jim Mc Geehan/Jim Moritz

Purpose:

Support API HDMO categories

Desired Outcomes:

Preparing for next oil category.

TOPIC	PROCESS	WHO	TIME
Agenda Review	<ul style="list-style-type: none"> • Desired Outcomes & Agenda 	Group	1:30-1:40
Minutes Approval	<ul style="list-style-type: none"> • June 17th , 2008 	Group	1:40-1:45
Membership	<ul style="list-style-type: none"> • Changes: Additions 	Jim Mc Geehan	1:45-1:50
EMA Report	<ul style="list-style-type: none"> • Number of general topic's 	Heather Debaun	1:50-2:15
Water—Oil Emulsion Task-Force	<ul style="list-style-type: none"> • Caterpillar emulsion issues • Task-Force Report • Discussion 	Hind Abi-Akar Group	2:15-3:15
Bio Diesel	<ul style="list-style-type: none"> • Up-date on bio diesel effects on engine oil task-group. 	Joe Franklin	3:15-:30
Test Status	<ul style="list-style-type: none"> • Status of : IM-PC; IN; IK, IR, IP • Status of DD6V92TA 	Hind Abi-Akar Patrick Lai	3:30-4:00
New/ Old business			

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EMA Report

- **Emulsion Task Force – EMA members support investigation**
- **EOAT – Request Surveillance Panel support: Status?**
- **Shear Stability of CJ-4 Oils – collecting data**
- **Biodiesel Bench Test Task Force**
- **IM-PC – Supply of parts to stop in January 2009**

Oil-Water Emulsion in API CJ-4 Engine Oil

ASTM Section D.02
Heavy-Duty Engine Oil Classification Panel
December 2008, Tampa, Florida

Caterpillar Inc.
H. Abi-Akar
J. Katinas

- ☀ Background of Emulsion Issue
- ☀ Cat O-WEST emulsion bench test
- ☀ Emulsion Task Force Updates

Request to HDEOAP & EMA in August, 2008:

Modify the water emulsification properties of engine oils to reduce the potential of emulsion formation and/or diminish emulsion stability

Identification & Impacts



- ☀ Oil-Water emulsion found with many engine technologies:
 - ☀ Pre-2004 Off-Highway
 - ☀ 2007 EGR
 - ☀ 2007 CGI

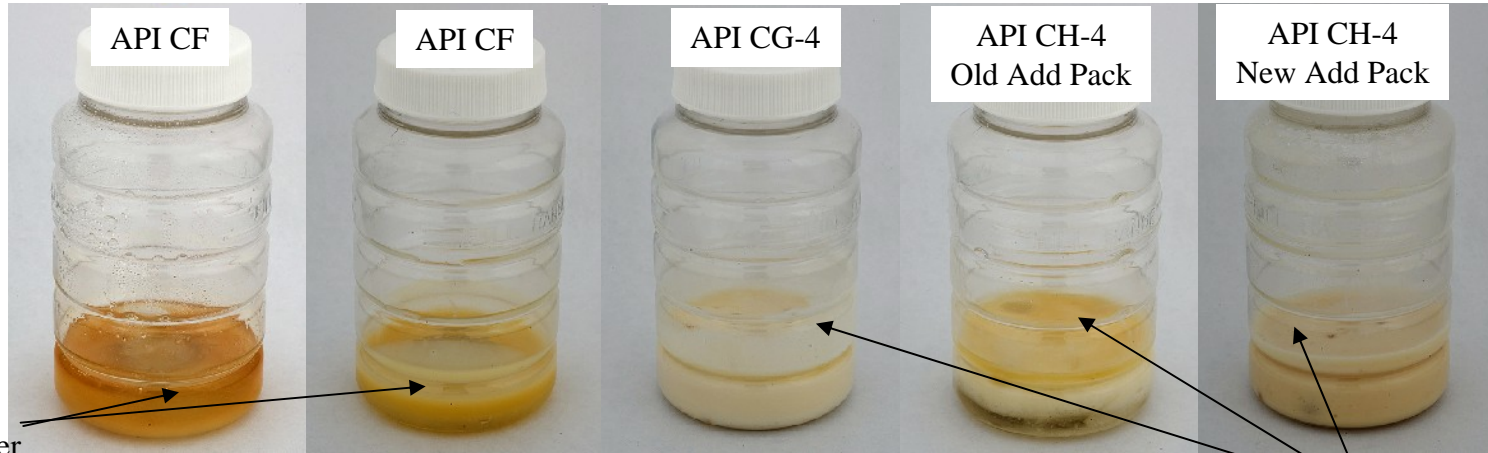
- ☀ Emulsion can cause metal components to rust
- ☀ Customer may perceive emulsion as head gasket failure
- ☀ Emulsion formation may negatively impact customer perception
 - ☀ Unnecessary downtime
 - ☀ Excessive diagnostic costs
 - ☀ Concern about engine durability



Tier 3 Machines were found with emulsion after being shipped from factory

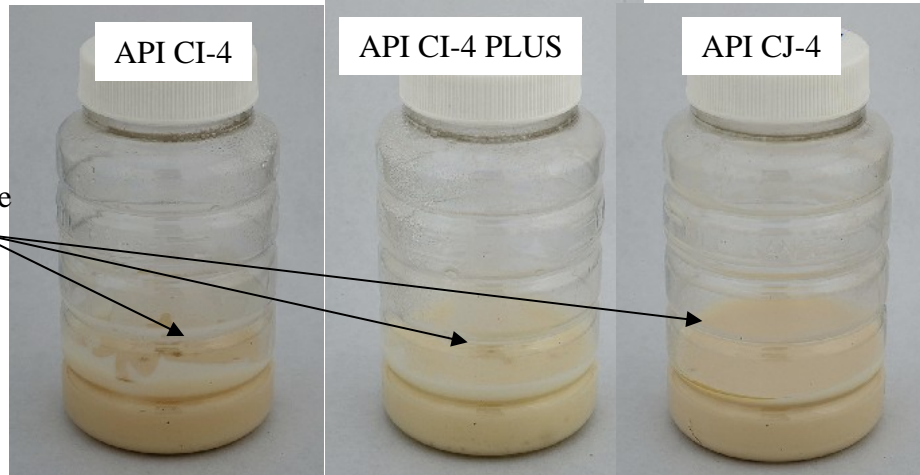
- ✿ No design changes of the engines
- ✿ Engines had <100hrs when emulsion found
- ✿ Multiple starts and stops at the factory and during the shipping process contributed to emulsion formation

API Oil Category Emulsion Effects



Oil and water
clearly separated

Oil and water clearly
separated with layer of
emulsion still visible



No oil-water layer visible
Solid emulsion

Emulsion Formation Engine Test Confirmation/Proof of Concept



**Pre-Baseline
No Emulsion**

Baseline – CJ-4 Oil

No water on valve cover – even after sitting for several min.

“Mild Fail” oil

Little water separation in valve cover after sitting for ~5min.

“Pass” Oil

Large amounts of water separated in valve cover after sitting for ~5min

Engine Test Simulating Field Emulsion Conditions

“Pass” and “Mild Fail”: API CJ-4 oil modified to reduce emulsion

“Pass” & “Mild Fail” Oil Proof of Concept



Engine Test Parts

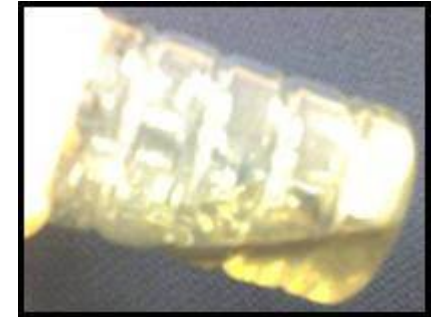


**Water began separating from emulsion
<5 minutes after test stopped**

Engine Test Simulating Field
Emulsion Conditions

Non-Emulsifying “Pass” oil successfully passed
Caterpillar Proprietary Engine testing

Emulsion Samples

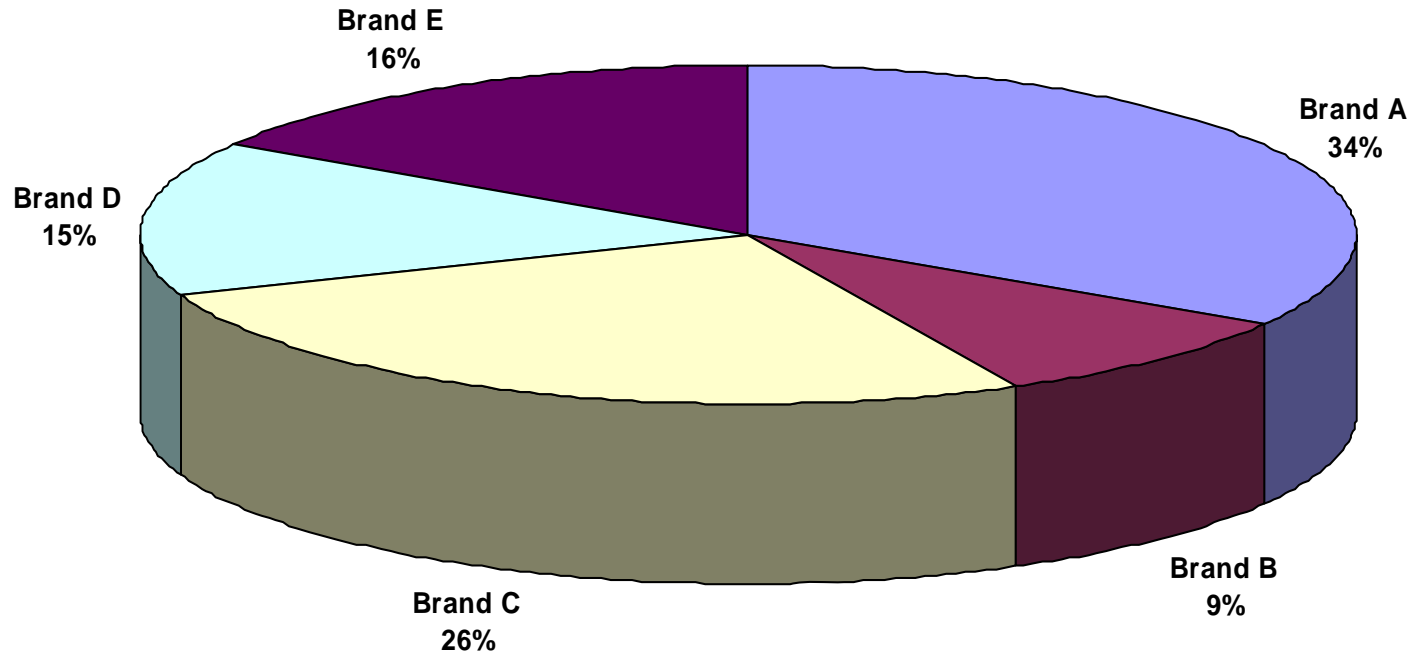


2hrs after sample taken
Oil and water separated
Considered a “Passing” Oil



(Photo at 2hrs after sample taken)
Water separated after 4 days
Considered a “Mild Fail” Oil

Field Data - Reported Oil Emulsion



Note: All values are percentages of a sample size

Oil-water emulsion forms when water becomes dispersed in oil

Two methods can be used to create thick emulsions (70-90% water)

1. Slowly adding water to oil while mixing
2. Condensing water into thin oil film layer

Condensation of water onto oil layer is believed to be cause of engine emulsion

O-WEST Bench test was developed to simulate emulsion formation as seen in engines

Bench Capabilities:

- ✿ Controlled environmental factors
- ✿ Controlled fluid supply
- ✿ Automated runs

Test Procedure:

- ✿ Form emulsion
- ✿ Centrifuge sample for set amount of time
- ✿ Evaluate water separation

Pass/Fail Criteria:

- ✿ Based on emulsion stability over time
- ✿ Amount of water separated

Emulsion Formation Test Parameter Development



Test Parameters Development: % Water with Karl-Fischer Titration

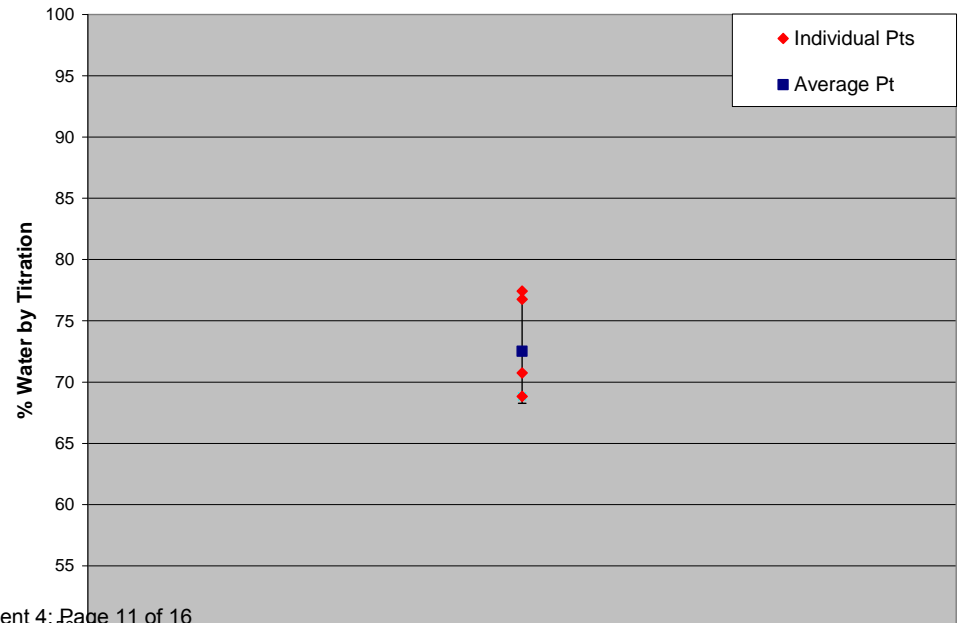
Field Data - Emulsion Characterization			
Maximum Range		Minimum Range	
85%	water	69%	water
15%	oil/fuel	31%	oil/fuel

Average water in emulsion is ~77%

Oil data from field engines included API CI-4, CI-4 PLUS, and CJ-4 oils

Test bench settings were developed to create emulsion with a range of water

API CJ-4 oil showed consistent water between 68-78%



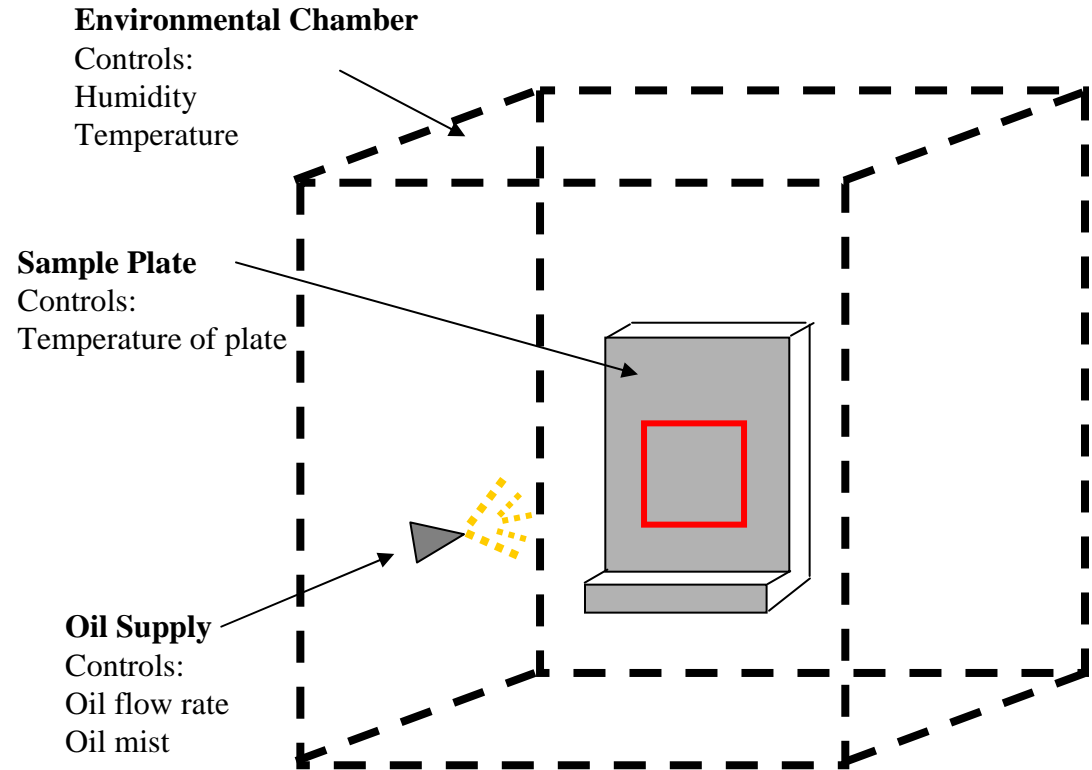
Oil-Water Emulsion Stability Test (O-WEST)



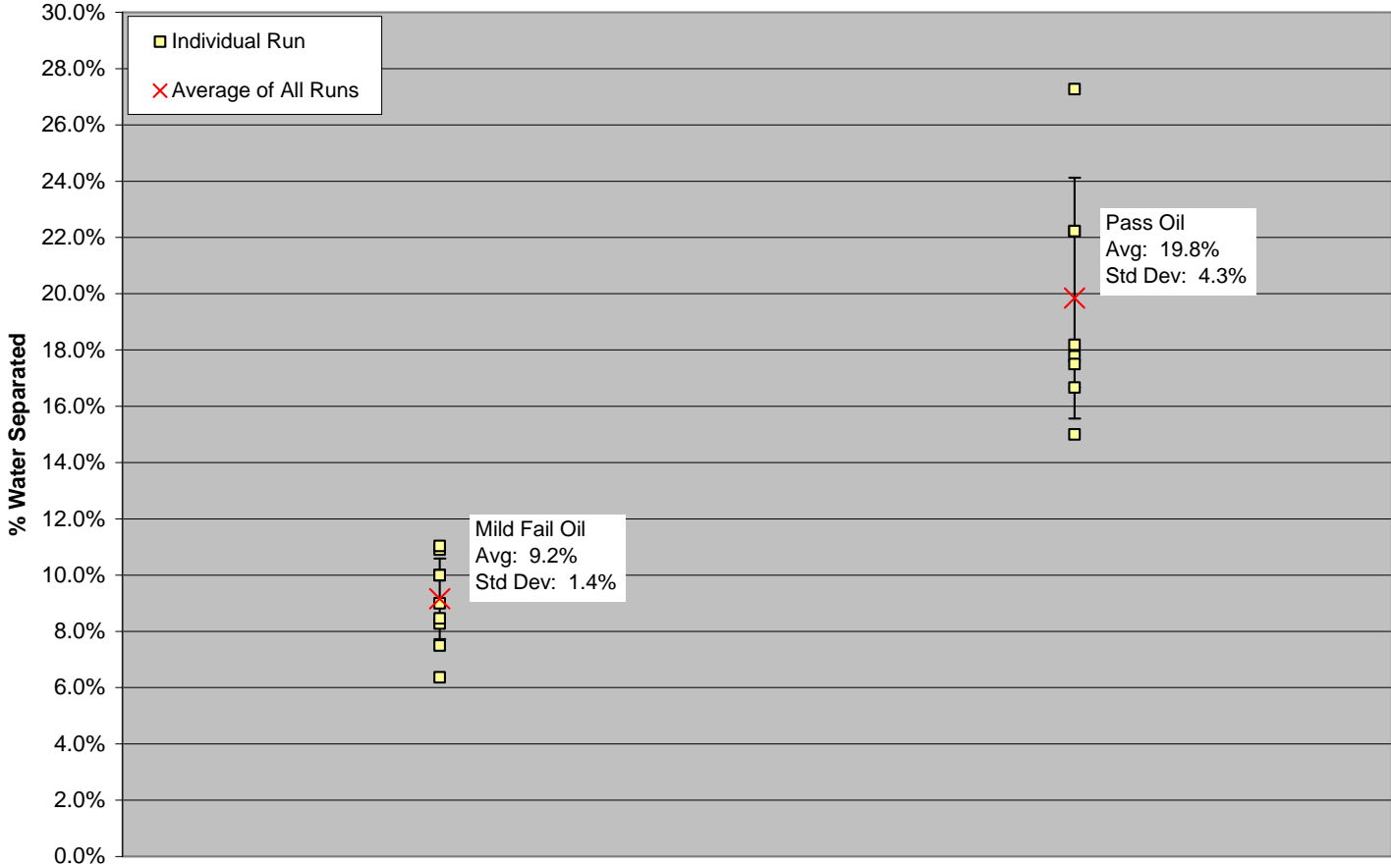
Emulsion Formation:

All aspects of the test bench are controlled by a common computer and a single program

- ✿ Environmental chamber is held at a specific temperature and humidity
- ✿ Oil is sprayed onto the sample plate
- ✿ Sample plate temperature is controlled to condense water onto the surface



"Pass" & "Mild Fail" O-WEST Data



O-WEST Data – Different Brands



	Avg Water Separated	Std Dev
API CJ-4	3.30%	1.10%
"Mild Fail" oil	9.20%	1.40%
"Pass" oil	19.80%	4.30%

	Avg Water
Brand A	1.11%
Brand B	0%
Brand C	3.20%

Emulsion formation is NOT dependent on Brand or Viscosity Grade

Commercially available oils

Emulsion Task Force Update



An Emulsion Task Force has been formed

Members include representatives from:

- ☀ Afton Chemical
- ☀ BP
- ☀ Caterpillar
- ☀ Chevron Oronite
- ☀ ExxonMobil
- ☀ Infineum
- ☀ Intertek
- ☀ John Deere
- ☀ Lubrizol
- ☀ Shell
- ☀ Southwest Research Institute
- ☀ Volvo

- ☀ Members of the Task Force have visited Caterpillar for an O-WEST Bench demonstration
- ☀ Caterpillar shared test details with the Task Force, including O-WEST parameters and emulsion formation information
- ☀ Oil and additive companies have supplied samples for testing, which includes a by-hand screening and/or O-WEST evaluation
- ☀ Caterpillar is planning a field evaluation of the “pass” engine oil that is expected to be complete by Spring, 2009

Emulsion Task Force Update



Task Force Concerns/Future Work:

- ☀ **Effects of water separation on engine** – Caterpillar is planning to run a field test to evaluate water separation with the “pass” engine oil
- ☀ **Passenger car oils requirements** – Caterpillar will evaluate the “pass” oil in the auto Emulsification test. Caterpillar will also contact ILSAC to better understand the needs and help determine a way to maintain universal oils.
- ☀ **Continued improvement and refinement of O-WEST** – Caterpillar will evaluate additional parameters such as emulsion viscosity or total percent water in emulsion as part of test data requirements. Cat will analyze separated water to determine composition.
- ☀ **Identify tests needed to validate impact on performance characteristic of the oil** - Task Force will need to review individual solutions and determine what tests would be needed.
- ☀ **O-WEST data will be shared with the Industry** – EMA will support data presentation to ensure anonymity.



Caterpillar Support of Industry Engine Tests

Heavy-Duty Engine Oil
Classification Panel

ASTM Meeting, Dec 2008

Tampa, Florida

Cat 1K, 1R and 1N Support



Support API CH-4, CI-4/CI-4 PLUS, CJ-4
(CF-4 and CG-4)

Caterpillar will continue to support 1K, 1R
and 1N test engines

Parts are available/made available for all three
test engines

Cat 1P Support



1P supports API CH-4 category

Caterpillar will continue to support 1P test

Currently:

1Y-3997 Cylinder Liners are available and
may cover the demand till end of 2009

1Y-3860, Core Assembly is not in stock

Working on restocking these parts

Cat 1M-PC – Parts Availability



- ❑ 2004: Cat proposed supporting 1M-PC for 5 years
 - Support period ends 2009
 - ❑ 2007: Cat proposed to stop supporting 1M-PC Jan 2009
 - ❑ 2007: Issues with availability of 1M-PC Head, P/N 1Y-7943
 - The Head was available on an MTO basis (made to order) – 2 months lead time and about double the cost
 - ❑ Other parts that are currently not available:
 - 1Y-7514 RACK AS-RGLT
 - 1Y-0469 BUSHING-VALVE
- Lead time to stock the parts

Cat 1M-PC Status



Effective Jan 2009, Caterpillar is no longer able to support 1M-PC engine test

Parts that are still available will remain in stock for 6 months



Questions?

Task Group on Bio-Diesel effects on Engine Oil

Joe Franklin

12/09/08

Progress Report

- Combined Analytical and Bench TG's
- 2 meetings held (Second yesterday)
- Developed a scope statement based on review of needs from HDEOCP/EMA/NBB input.
- Set basic target date

Scope

Based on a SME (without anti-oxidants Rancimat/OSI from 3-5hr) initial focus with subsequent application to other feedstocks:

- Develop Bench test(s) to evaluate:
 - TAN production, Corrosion (Pb/Cu/etc.)
 - Deposit formation and Oxidation stability of oil diluted with Bio-diesel.
 - High and low temperature viscometric properties of Used oil.
- Develop or enhance test methods to measure:
 - Oxidation and Fuel dilution in the presence of Bio-diesel.

Target date

- Usable bench tests and methods by end of 2010
 - We have a basic list of existing tests to begin to develop data
 - Planning to have a conference call in 1-2 months to continue based on data availability.