

# 2008 B20 Survey Results



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# Acknowledgments

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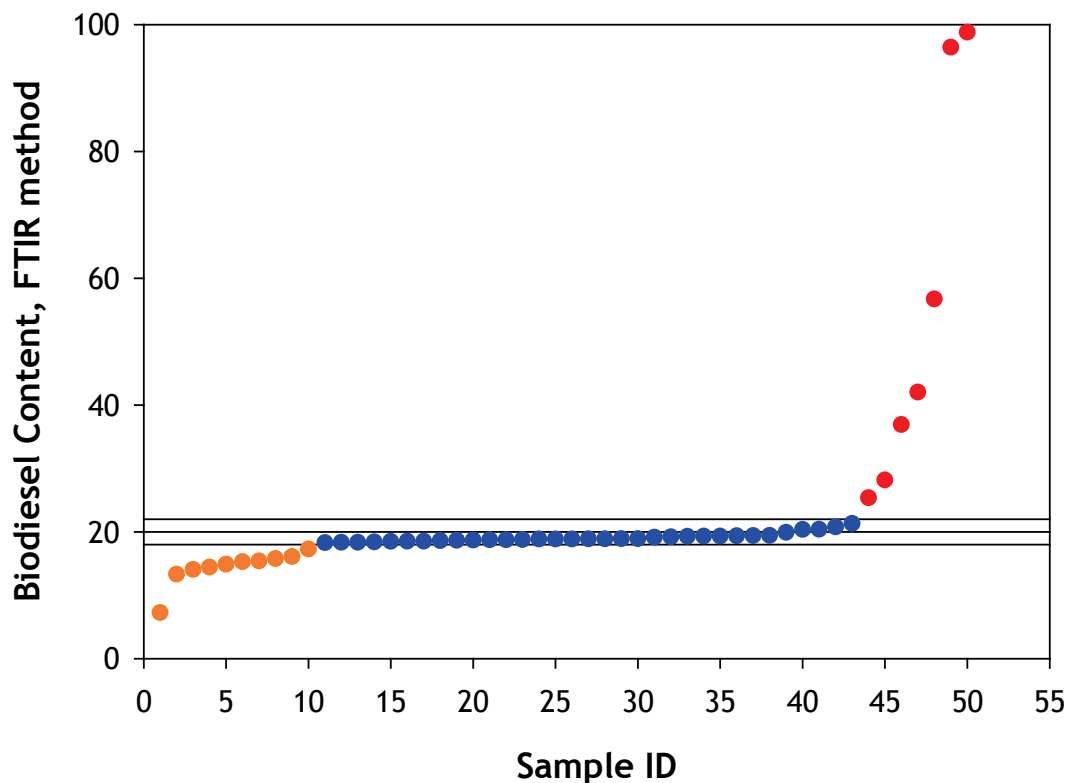
- Department of Energy
- National Biodiesel Board
- Engine Manufacturers Association

# 2004 B20 Quality Survey Results

- 22 producers in the marketplace (25 M gallons)
- Samples obtained nationwide from biodiesel blenders (27 samples)



# Biodiesel Content from 2004 Survey



- 18 samples (36%) fall outside the 18-22% range
- Likely cause: poor mixing during splash blending

# B20 Survey and D7467

- This B20 survey was taken as part of a cooperative effort between NREL, the National Biodiesel Board (NBB), and the Engine Manufacturers Association (EMA) to gain further information on B20 in the market (Biodiesel Blend Evaluation Team, BBET).
- ASTM D7467 (ASTM spec for B6 to B20 blends) was not released for use until October 2008.
- B20 samples were taken prior to release of D7467.
- Parameters, in addition to those proposed in D7467, were analyzed for additional information to provide data to ongoing NREL, NBB, and EMA technical efforts on biodiesel.
- D7467 was designed so B6 to B20 would always be in-spec if in-spec diesel and in-spec biodiesel were used to meet the blend.
- Recent B100 survey indicated 90% of biodiesel volume meets D6751.

# Pump Labeling

- There were no pump labeling regulations in effect when the samples were taken.
- Only pumps that were labeled 'B20' were sampled.
- Only fleets that identified that they were purchasing and using B20 were sampled.
- As part of EISA 2007, the Federal Trade Commission (FTC) issued federal regulations requiring pump labels for biodiesel pumps, which took effect in Dec. 2008:
  - Less than 5% biodiesel content does not require a label.
  - Pumps with biodiesel content between 6% and 20% must be labeled with wording such as 'contains between B6 and B20.'
  - Pumps over B20 must be labeled with the exact percentage of biodiesel.
- NCWM is adopting the FTC pump labeling language for biodiesel blends as part of NIST Handbook 130.

# 2008 B6-B20 Property Testing

## D7467 Specification

<u>Property</u>	<u>Test Method</u>	<u>S15 Limits</u>
Acid number, mgKOH/g	D664	0.3 max
Viscosity at 40°C	D445	1.9-4.1
Flash point, °C	D93	52
Cloud point, °C or LTFT/CFPP, °C	D2500 or D4539/D6371	Report
Sulfur, ppm	D5453	15 max
T90, °C	D86	343 max
Carbon residue, mass%	D524	0.25 max
Cetane number	D613	40 min
Cetane index	D976	40 min
Aromatics, vol%	D1319	35 max
Ash, mass%	D482	0.01 max
Water and sediment, vol%	D2709	0.05 max
Copper corrosion, 3 hours at 50°C	D130	No. 3 max
Biodiesel content, vol%	D7371	6-20
Oxidation stability, hrs	EN14112	6 min
Lubricity, µm	D6079	520 max

## Tests Performed

<u>Property</u>	<u>Test Method</u>
Acid number, mgKOH/g	D664
Flash point, °C	D93
Cloud point	D2500
Sulfur, ppm	D5453
Group I and II metals, ppm	D7111
Karl Fisher, ppm	D6304
Cetane number	D6890
Particulate contamination, ppm	D6217 or D7321
Interfacial tension, mN/m	D971
Ash, mass%	D482
Free glycerin, mass%	In-house method
Total glycerin, mass%	In-house method
Biodiesel content, vol%	D7371
Oxidation stability, hrs	EN14112





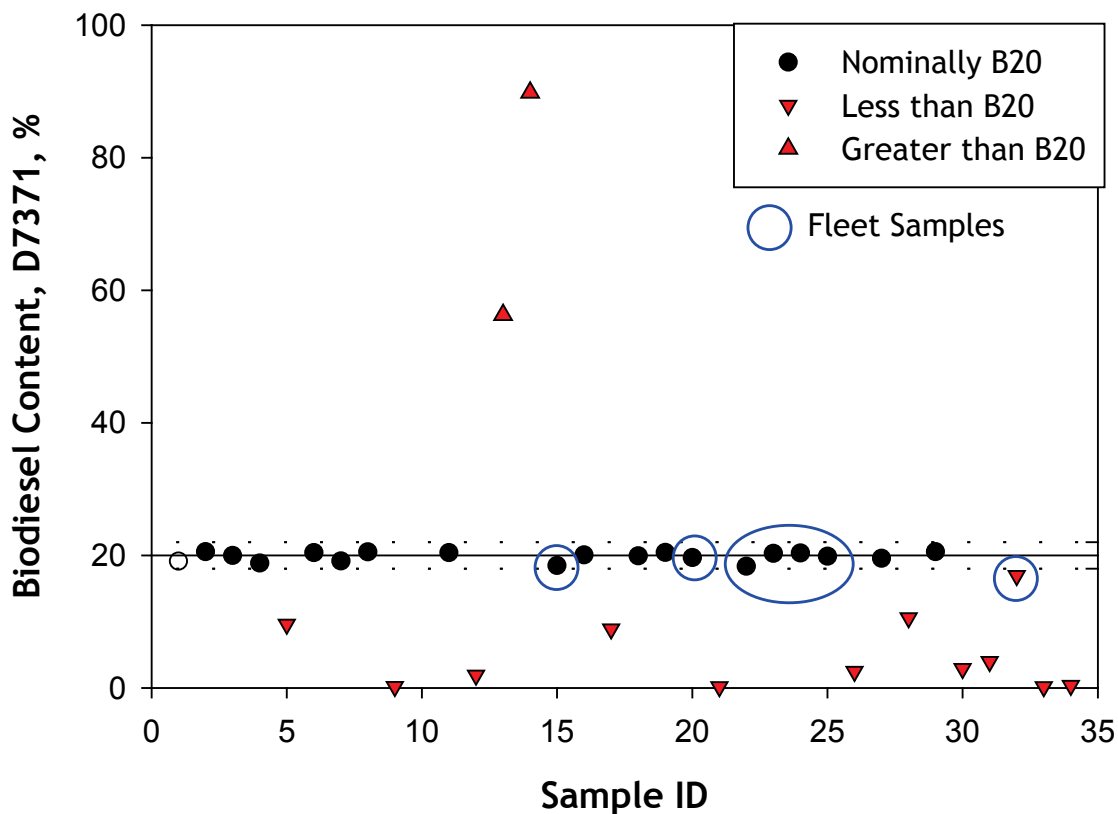


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# Results

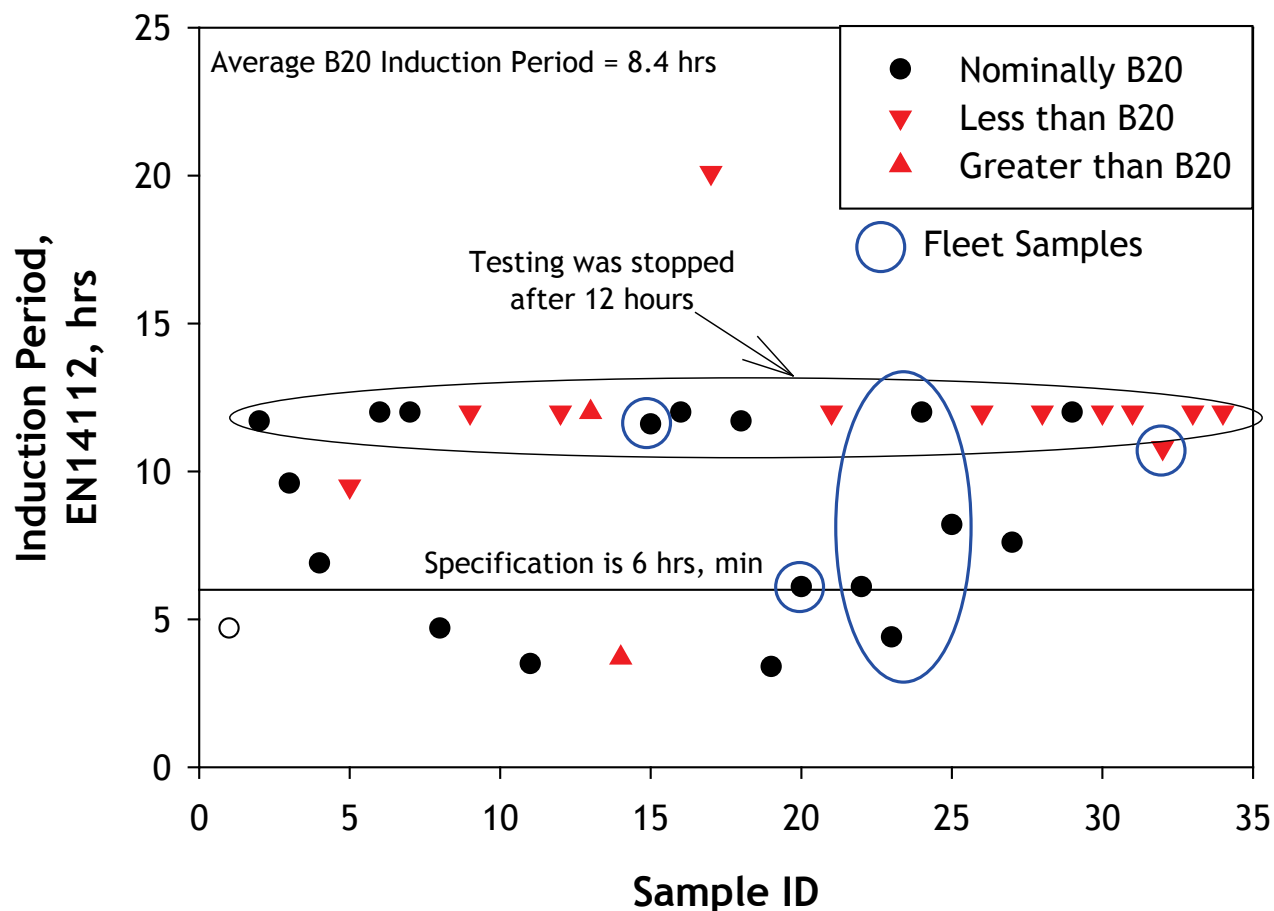
**(Note: D7467 was not in effect when samples were collected.)**

# Blend Percentage Results



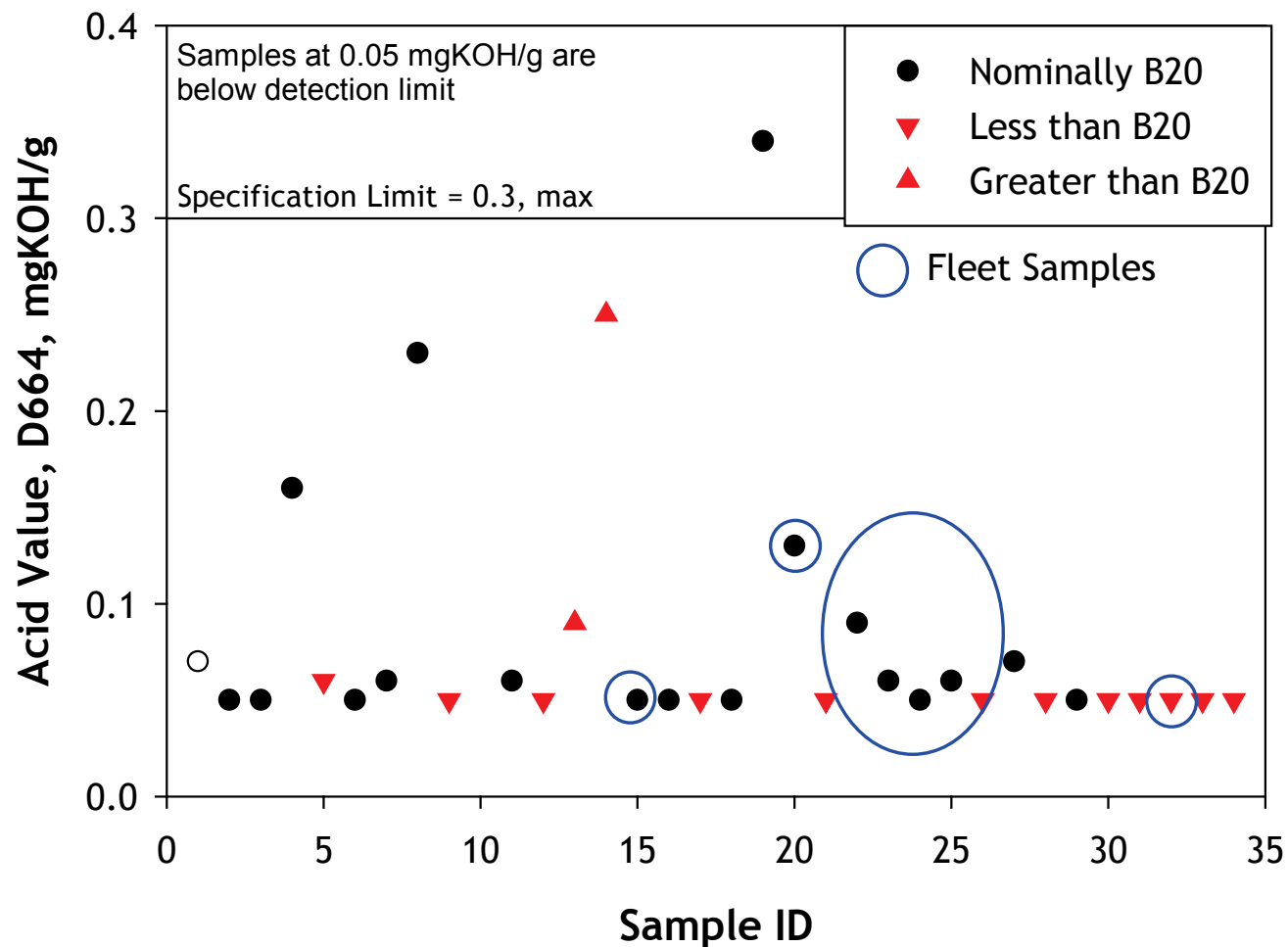
- 60% of samples were nominally B20
- Sample distribution much different than for 2004 results
  - All fleet samples were nominally B20
- Much fewer samples above B20
- Most off-spec samples were less than B20
  - Typically B11, B5, and B2

# Induction Period Stability



- D7467 not required when samples were collected
- 74% within D7467 for B20 Induction Period

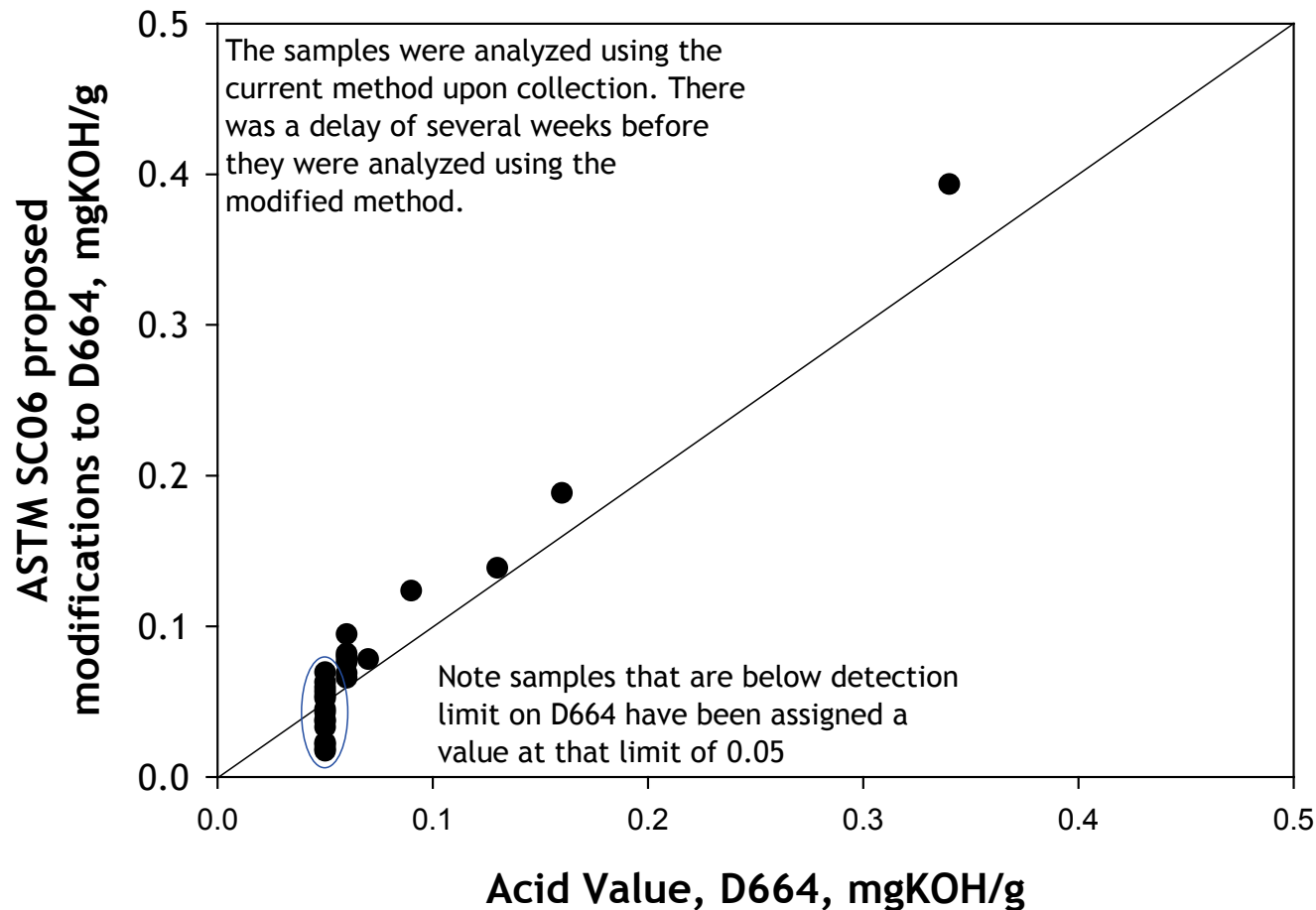
# Acid Value Results



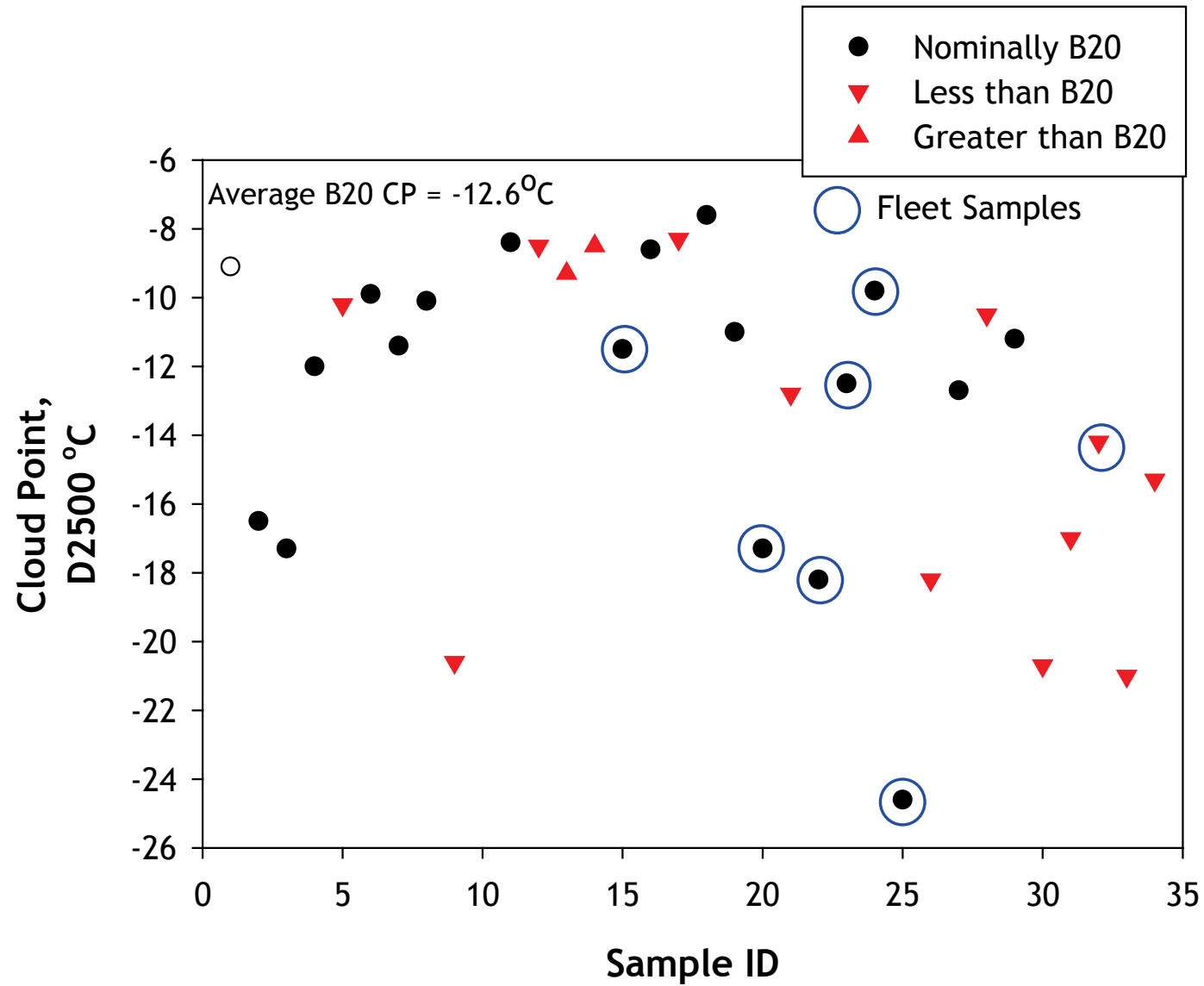
•97% within D7467 for B20

# ASTM SC06 Modifications to D664

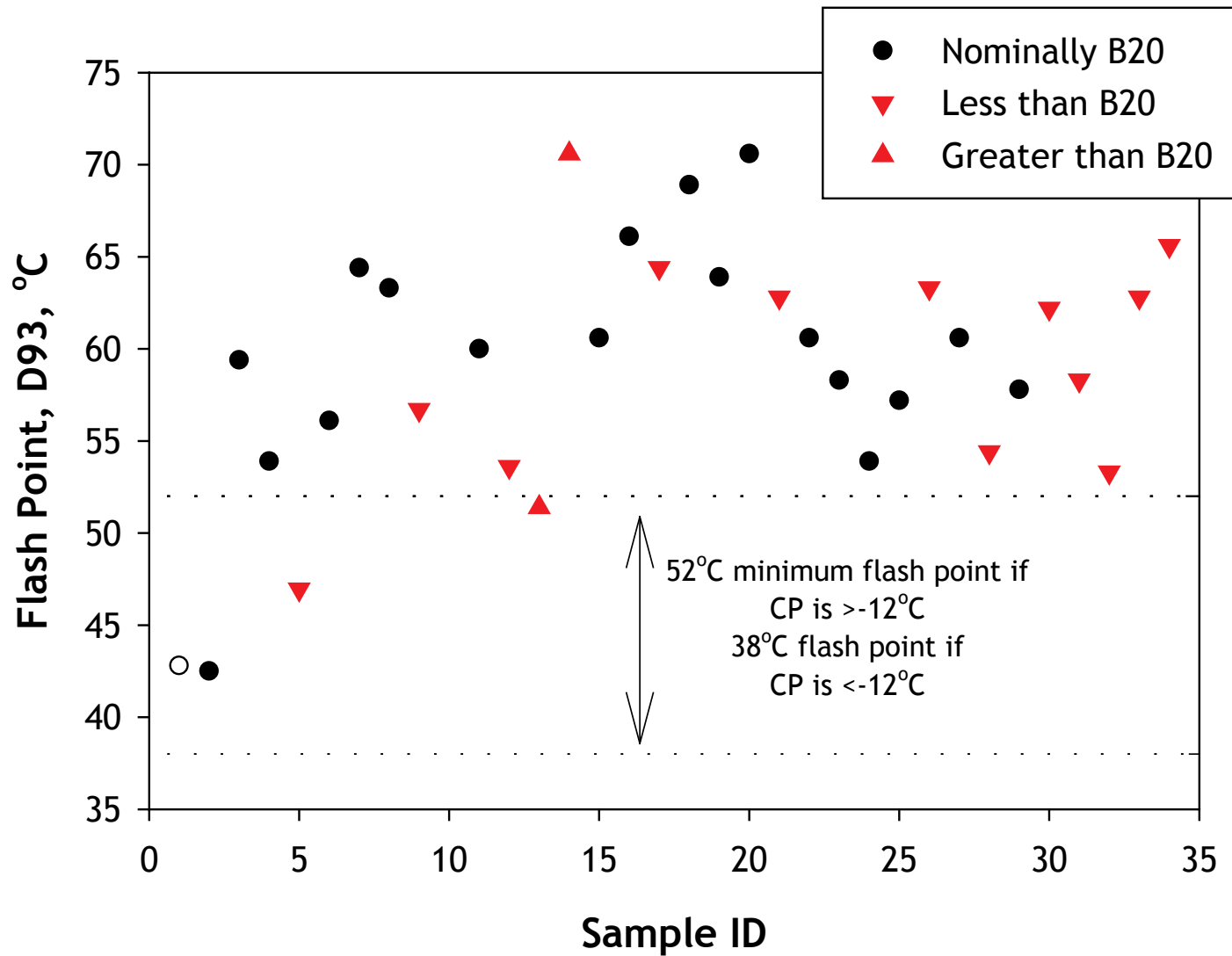
- Modifications are being balloted at ASTM
- Allows better discrimination at lower acid values



# Cloud Point



# Flash Point





# Other D7467 Properties

Property	ASTM Method	Range, Average
Sulfur, ppm	D5453	3.7-16.2, 7.3
Derived cetane number	D6890	45-56, 49
Ash, mass%	D482	BDL, BDL

\* BDL: below detection limit

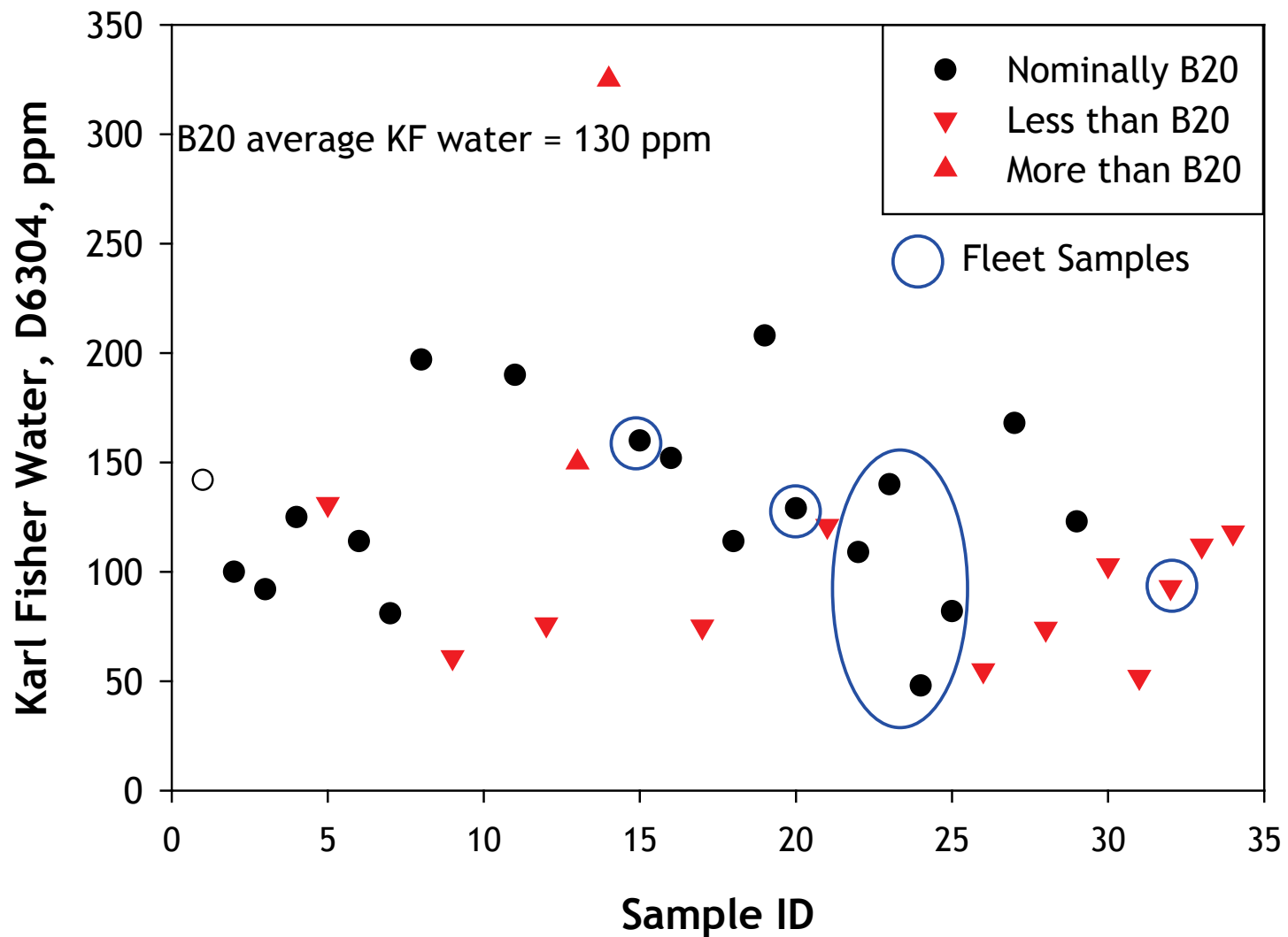
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# Results – Non-D7467 Properties

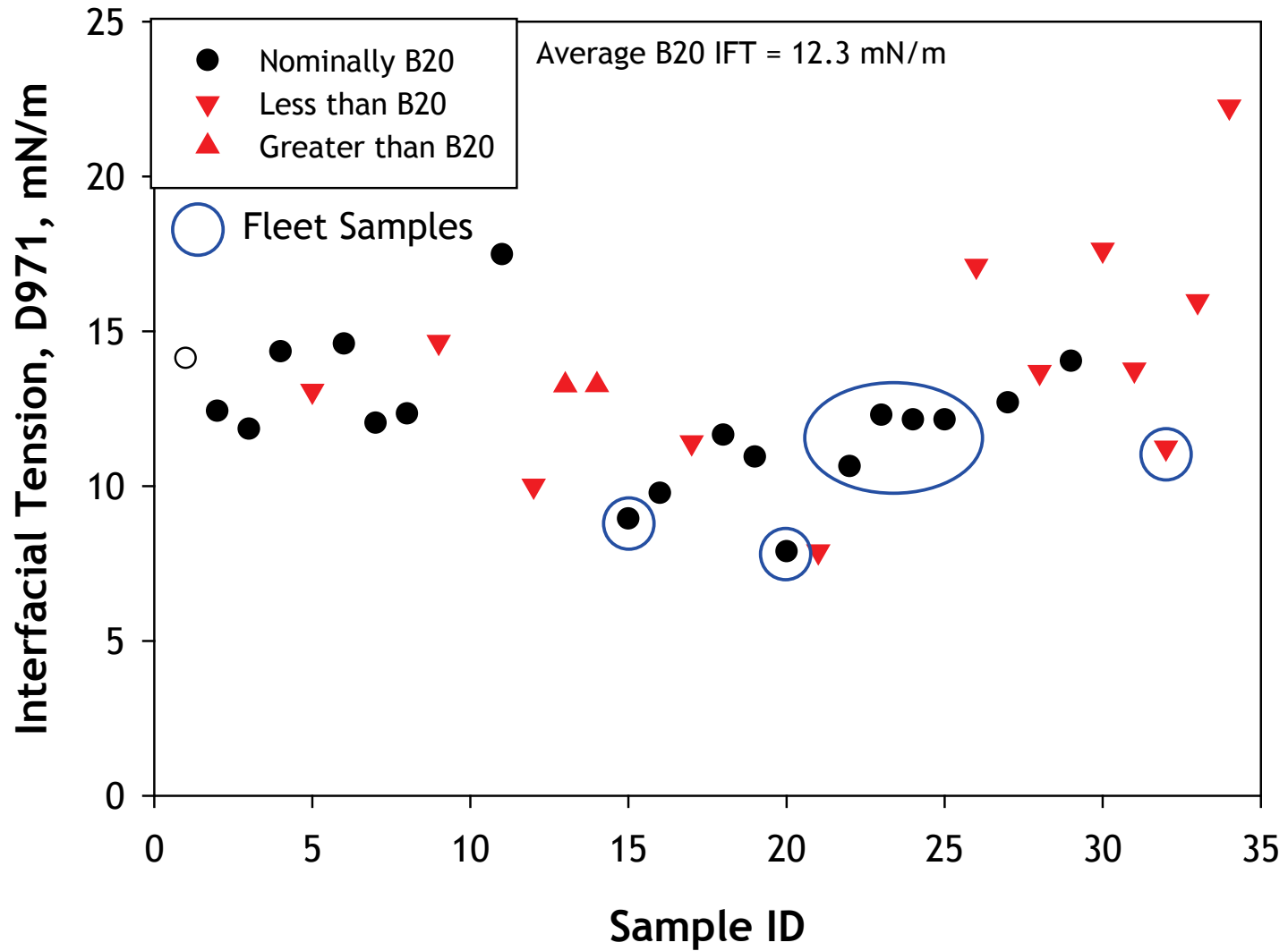
# Karl Fisher Moisture

- Current biodiesel and diesel specifications measure ‘free water’ using a centrifuge method for ‘water and sediment.’
  - D6751, D7467, D975
  - Free water is the property of most concern as this can increase water-related issues.
- EMA members desired information on both the free water and the entrained/soluble water.
- Karl Fisher moisture measures both the free water AND any entrained/soluble water (not part of the current specifications for biodiesel, biodiesel blends, or petrodiesel).
- B100 can hold slightly more water in solution than most petrodiesel.
- There is an ongoing working group within the ASTM Biodiesel Task Force looking into replacing the current water and sediment test method with a separate measure for KF moisture and a separate measure for fuel particulates.

# Karl Fisher Moisture



# Interfacial Tension



# Group I and II Metals

- Group I and II metals are controlled at the B100 level:
  - Sulfated ash of 0.02%
  - 5 ppm maximum of combined Na/K
  - 5 ppm maximum of combined Ca/Mg
- Method not approved for biodiesel used to measure these metals in the low concentrations expected in the blends

Property, ASTM D7111	Range, Average
Mg, ppb K, ppb	<100 (detection limit for all samples)
Ca, ppb	<100 to 652, 219
Na, ppb	<500 to 2000*, 606

\* 1 sample would be off-spec at B100 for Na.

# Conclusions – D7467 Properties

- B20 samples were collected from around the United States, from public pumps and fleets as part of joint effort of NREL, NBB, and Engine Manufacturers Association.
- D7467 was not enacted when these samples were taken.
- 60% of blends were nominally B20.
  - Distribution of non-B20 samples was different from that in last survey, with much less fuel above 20%; indicates less splash blending type issues but still room for improvement.
  - High percentage below B20 indicates need for improvement in pump label management and enforcement.
- Average cloud point (CP) =  $-12.6^{\circ}\text{C}$  ( $9^{\circ}\text{F}$ ).
  - No CP specification ; determined by geography, time of year, customer.
- Average flash point =  $59^{\circ}\text{C}$  ( $138^{\circ}\text{F}$ ); none outside D7467.
- 74% of samples met D7467 induction period stability requirements for B20.
- Only 1 sample off-spec for D7467 acid value.
  - Indicates fuel had not degraded to the point of being problematic even though the induction period was below current D 7467 specification level.



# Conclusions – Non-D7467 Properties

- Interfacial tension average was 12.3 mN/m.
- Average Karl Fischer moisture was 130 ppm.
  - ULSD can average 50-150 ppm.
- Elevated Na content was observed in 1 sample, indicating the B100 was not on-spec (blend was off-spec for other parameters as well).
- Ca, Mg, and K were extremely low and near detection limits.

# Recommendations

- ASTM has issued the new D7467 specifications for B6 to B20 blends, and FTC has issued nationwide pump labeling requirements for biodiesel blends.
- Fuel enforcement agencies now have specifications to help enforce quality of biodiesel blends.
- Improvement is needed to ensure that the amount of biodiesel being advertised is what is really being provided to the customer (although this seems to have improved since the last survey).