Biodiesel

What You Need to Know Now -

An Industry & Technical Overview

Agenda

- Top Ten Reasons to Use Biodiesel
- Industry Status – Incentives and Production
- OEM Support of Biodiesel
- Underground Storage of Biodiesel

Top 10 Reasons Why Smart Customers Are Using Biodiesel

#1 – America's Advanced Biofuel

- Biodiesel is America's first domestically produced, commercially available Advanced Biofuel and meets EPA requirements for inclusion and use under the new Renewable Fuels Standard (RFS-2).
- RFS-2 mandates 36 billion gallons of renewable fuel be used by obligated parties (i.e. refiners) by 2022
  - 1 billion gallons biomass based diesel,
  - 4 billion gallons un-differentiated advanced biofuel
- 2011 Volume Requirement = 800 Million Gallons
- 2012 = 1 Billion Gallons

#2 – Lower Emissions

- U.S. biodiesel reduces lifecycle carbon emissions by over 50% compared to petrodiesel, qualifying it as an Advanced Biofuel under RFS-2 and making it the best carbon reduction tool of any liquid fuel commercially available.

#3 – High Energy Balance

- Biodiesel has the highest energy balance (5.54 : 1) of any commercially available fuel, returning 5.54 units of renewable energy for every 1 unit of fossil energy needed to produce it.
- Compression Ignition Platform (i.e. diesel engine system) is 30% More Fuel Efficient Than Spark Ignition (i.e. gasoline, CNG, propane)

#4 – Sustainability

- Biodiesel is produced from a variety of renewable resources, such as plant oils, animal fats, recycled grease, and even algae, making it one of the most sustainable fuels on the planet.

- With biodiesel, you don't sacrifice food for fuel. Oils and fats for biodiesel are a minor by-product of producing food for humans and animals.
  – Soybeans are 80% protein, 20% oil
  – No one grows livestock for its fat content
  – No one cooks more fried food to get used oil for biodiesel

#5 – Energy Security

- Biodiesel production reduces our dependence on foreign oil from unstable parts of the world, while expanding and diversifying our domestic refinery capacity.
- Biodiesel is a low cost option for turning oils and fats into usable fuel diesel applications.
- Biodiesel produced in the U.S. in 2008 displaced 38.1 million barrels of crude oil.

#6 – Better For Your Health

- **Biodiesel is:**
  - **Biodegradable**
  - **Nontoxic**:
    - LD50 =17.4 g/Kg - less toxic than table salt
    - Skin irritation less than that of 4% soap and water solution
  - **Safer to handle:** Flash point above 200 Degrees F, Non-Reactive, Non-Corrosive
- Compared to petrodiesel, biodiesel reduces black smoke (particulates), Carbon Monoxide, and harmful unburned hydrocarbons that cause smog.

#7 – Economic Benefits

- Biodiesel helps our U.S. economy and improves our balance of trade.
- Using biodiesel creates added outlets for farm based products and high paid manufacturing jobs in rural parts of our country.
- The 800 million gallons of biodiesel being produced in the U.S. in 2011 has also created nearly 31,300 U.S. jobs.

#8 – Ease of Use & Performance

- Using Biodiesel is easy!
- B20 and lower blends are a drop-in replacement for diesel fuel
- Can be used in any diesel engine / vehicle without modification, according to OEM's recommendations
  - Visit www.biodiesel.org/resources/oems for OEM positions
    - Similar in terms of engine performance, fuel economy, horsepower, torque – same as diesel
- Dispensed through existing fueling stations

Distribution Infrastructure

- Biodiesel and biodiesel blends are now available nationwide from more than:
  - 1,495 Distributors
  - 1,330 Retailers
  - 775 Truck Stops
  - 3,600 Public Locations Total

- Visit the NBB website at: www.biodiesel.org/buyingbiodiesel/ or www.biotrucker.com to view biodiesel retailers near you, by state, or along a route

9 – ASTM Specifications & Technical Credibility

- Biodiesel production is guided by stringent ASTM fuel specifications, developed through years of testing.
- The biodiesel industry works closely with OEMs and Petroleum companies to identify needed technical information
  - Brainstorming and prioritization each year
- Over $100MM in testing and R&D over last 20 years, primarily sponsored by soybean farmers
- Continued investment to answer technical questions that arise is something that sets the biodiesel industry apart from other new fuels
- ASTM specs are continually being evaluated & improved

Biodiesel Specifications

- **ASTM D6751** is the approved standard for B100 for blending up to B20, in effect since 2001
  - Performance-based standard: Feedstock and Process Neutral
  - 48 states have now legislatively adopted the ASTM D6751 specifications for biodiesel
- **D975** – Covers petrodiesel and blends up to 5% biodiesel maximum for on/off road engines
- **D7467** – Covers blends containing 6% to 20% biodiesel for on/off road engines

ASTM INTERNATIONAL
Standards Worldwide

10 – Marketing Advantage

- Companies using biodiesel feel good about flaunting their reduced carbon footprint.
- Using biodiesel differentiates your organization with a "green" competitive advantage
- Examples: Restaurant services providers, municipalities, trash/recycling
- Employment recruiting

Federal Biodiesel Support

Renewable Fuel Standard (RFS2)

- RFS-2 mandates 36 billion gallons of renewable fuel be used by obligated parties (i.e. refiners) by 2022
- 1 billion gallons biomass based diesel,
- 4 billion gallons un-differentiated advanced biofuel
- 2012 Volume Requirement = 1 Billion Gallons

EPACT Credits –

- Incentive for Fleets for B20+ use; most economical option for EPACT Compliance.

CAFÉ Credits –

- Incentive for Automakers for B20+ approval

California LCFS: Brief Summary

- **Established by Assembly Bill 32 in 2006.**
  - Requires a reduction of at least 10% in the carbon intensity for all transportation fuels sold in California by 2020.
  - Required carbon intensity reductions began January 1, 2011.
  - December, 2011 court decision issues injunction suspending enforcement.
  - April 2012, 9th Circuit issues stay of injunction, allowing CARB to resume enforcement.
  - Appeal being heard by 9th District Circuit Court of Appeals this month.
- **Purpose: Reduce carbon by:**
  - Decreasing use of petroleum and high-carbon biofuels (corn ethanol).
  - Increasing use of biodiesel, renewable diesel, electricity,

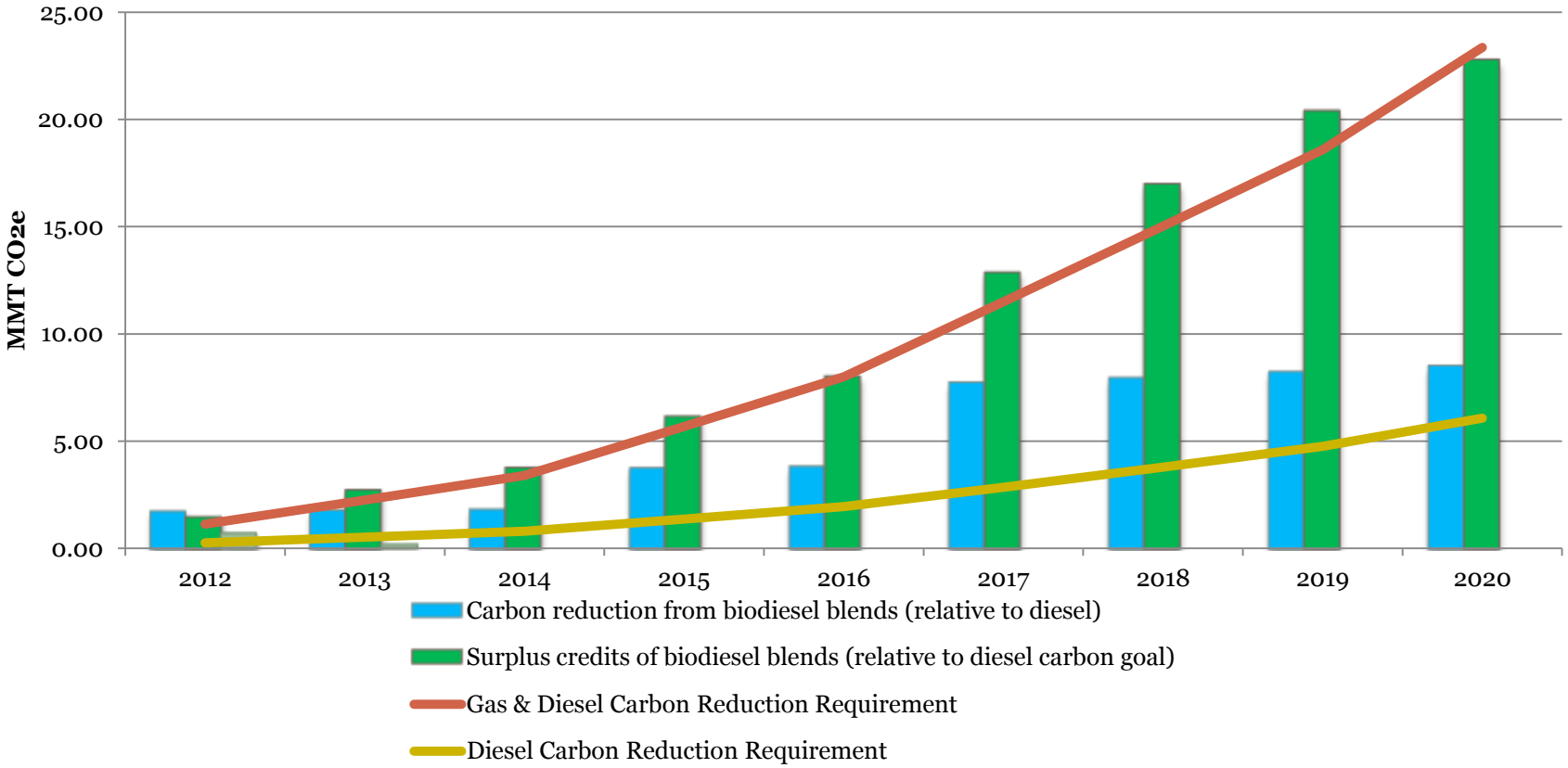
California LCFS:
Implementation Schedule

Year	% Reduction Required	Biodiesel Blend Required (UCO)
2011	.25	B.3
2012	.50	B.6
2013	1.0	B1.2
2014	1.5	B1.8
2015	2.5	B3.0
2016	3.5	B4.2
2017	5.0	B6.0
2018	6.5	B7.8
2019	8.0	B9.6
2020	10.0	B12

California LCFS:
Impact of B5-B20 Phase-In

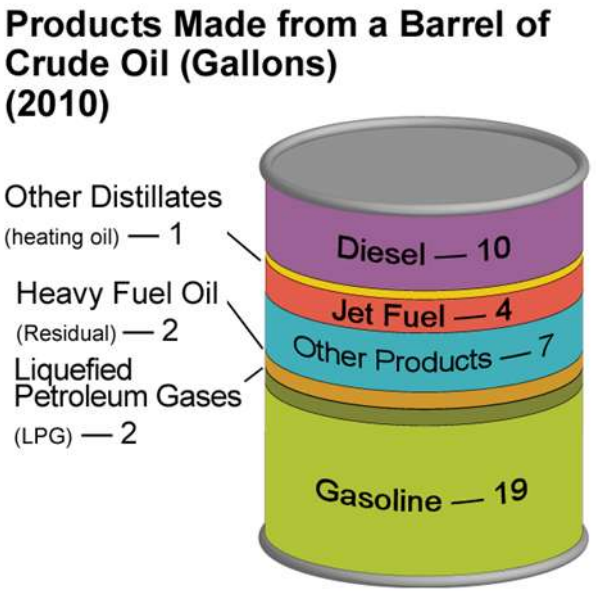
Carbon Reduction Through the Use of Biodiesel Blends in California [B5 in 2012-14; B10 in 2015-16; B20 in 2017-20]

*50% soy/50% UCO blend

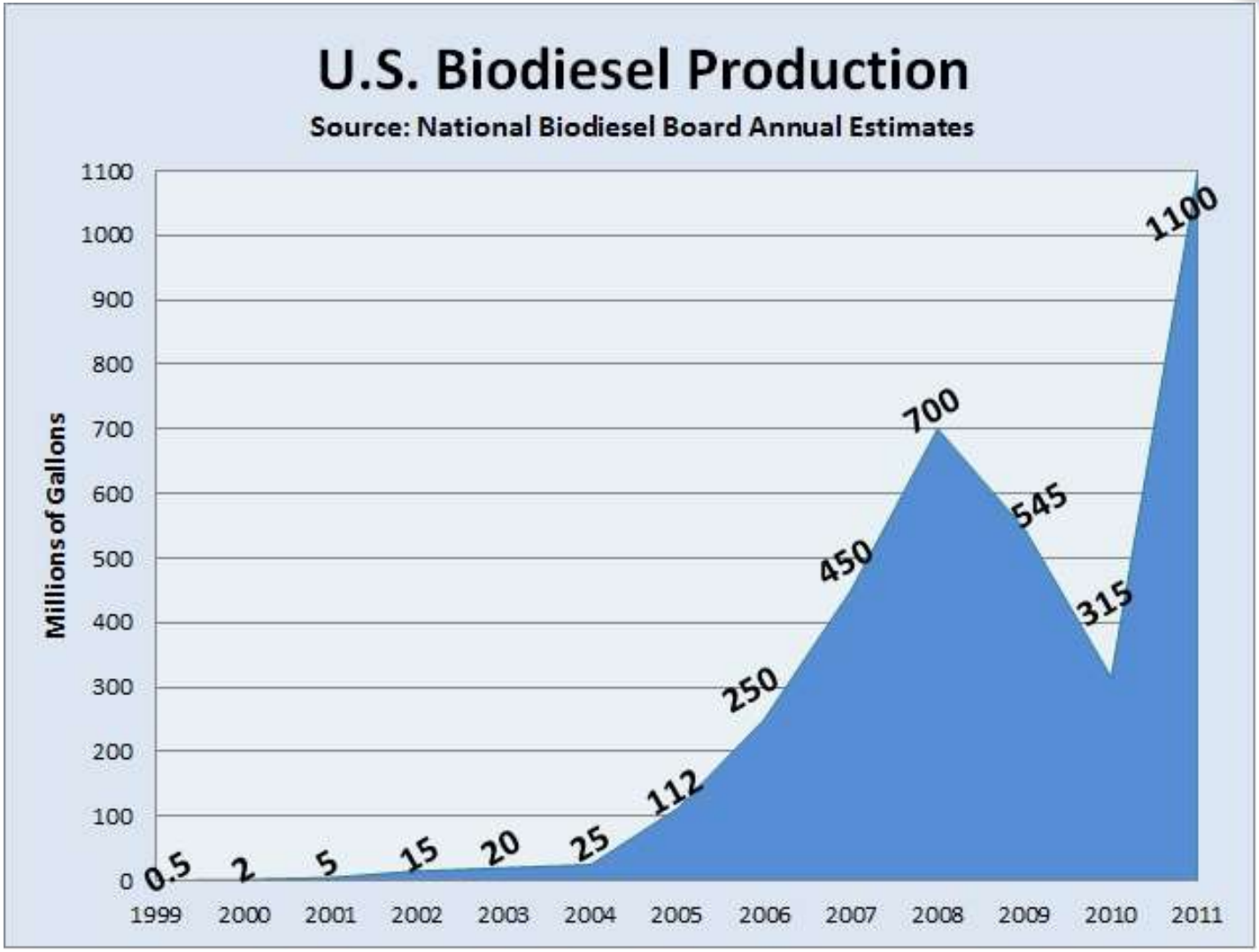


Is 5% Significant?

- Five year average of on-highway diesel fuel demand in the U.S. is 37.8 billion gallons
  - Replacing 5% with biodiesel = 1.88 billion gallons of biodiesel
- In 2010, the United States imported 1.93 billion gallons of ULSD from other countries
- In 2010, the United States imported the equivalent of 1.52 billion gallons of diesel from Iraq crude oil and 3.6 billion gallons from Venezuela crude



Biodiesel Production History



Biodiesel Feedstocks and Production Forecasts

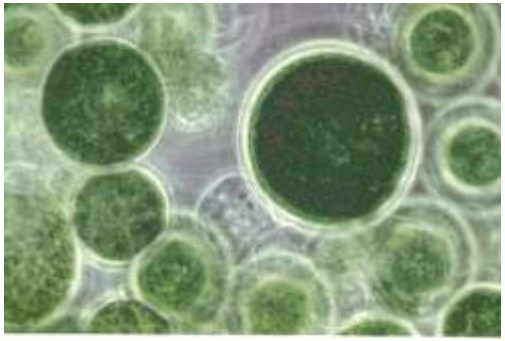
Global Insight:

- "By using demonstrated yield technologies available to farmers today in combination with consistent biofuels policies and the DOE/EIA crude oil price forecast, biodiesel production can reach 2.5 billion gallons by 2017. This can be reached with growing global food demand for vegetable oils without dramatic increases in vegetable oil prices."

- This represents B6.5 in all on-road fuel in the US

- Note: This work only evaluated feedstocks that have approved pathways or were under review by EPA; over next 5 years, additional feedstocks may contribute to the overall supply, potentially reaching 3.3 BGPY by 2022.

Future Feedstocks



Algae

Jatropha

Halophytes

Pennycress

Brown Grease

Photo by: Joel Rose

Low Ricin Castor

Biodiesel Use & OEM Acceptance

OEM Warranty Statements & Biodiesel

- All major OEMs selling diesel equipment in the U.S. support at least B5 and lower blends, provided they are made with biodiesel meeting ASTM D 6751
- More than 65% of U.S. manufacturers now support B20 or higher blends in at least some of their equipment;
- More than 95% of medium-duty truck market supports B20
- Several more OEMs are completing testing and progressing toward support for B20
- For a complete listing of **OEM position statements on biodiesel**, as well as the **current**

New in 2012: Volvo Trucks & Mack Support B20

Volvo & Mack B20 warranty statements:

"Use of biodiesel up to a maximum of 20% (B20) in and of itself, will not affect the manufacturer's mechanical warranty as to engine and emissions system related components, provided the bio fuel used in the blend conforms to ASTM D6751, B1 to B5 blends conform to ASTM D975, and B6 to B20 blends conform to ASTM D7467.

Engine and after treatment emissions system component warranties are valid providing the B20 blend meets the respective ASTM standard. Customers will need to utilize oil sampling to establish appropriate drain interval(s) for their specific application(s)."

NEW in 2011: B20

ISUZU
Commercial Truck of America, Inc.

Isuzu Commercial Truck approves B20 for all of its 2011+ MY diesel engines, including N-Series t models and new Isuzu Reach commercial van.

- Isuzu holds 75% market share of low cab-forward medium duty truck market in U.S.
- First Asian manufacturer to announce B20 support in U.S.

NEW in 2011: B2[illegible]

Hino Trucks approves B20 for its complete product line of 2011+ MY class 4 and 5 cab-over and class 6 and 7 conventional trucks.

B20 is also approved for Hino's new 2012 diesel-electric hybrid truck entering the market in early 2012.

- Hino Trucks is the world's 3rd largest mfr. of light and medium duty trucks, and now the fastest growing truck mfr. in the U.S.

B20 Approved

Ford approves B20 in all its 2011 MY and beyond

Class 2 - 5 Super Duty &

Class 6,7 Medium Duty Trucks

B20 Approved

All 2011 MY and beyond GM Heavy Duty Products are approved for B20:

Chevrolet Silverado, GMC Sierra, Chevrolet Express, GMC Savana

B20 Approved for Fleets

Chrysler supports the use of B20 in the Dodge Ram for government, military and commercial fleets, and is considering full B20 support for all customers.

OEMs Supporting B20+

B100 Approval

- The following companies approve biodiesel use up to B100:
  - Case IH (approx. 50% of models)
  - New Holland
  - Fairbanks Morse

B5 Approvals

Approve B5:

- Audi
- BMW
- Mercedes
- Mitsubishi **
- Volkswagen **

Approve B5*:

- Daimler / Detroit Diesel **
- Freightliner
- Thomas Built Buses
- Kubota
- PACCAR – Peterbilt/Kenworth

* Exceptions have been made for B20 use by fleets

** Actively researching B20

Biodiesel Use in Today's New Clean Diesel Engines & Aftertreatment Systems

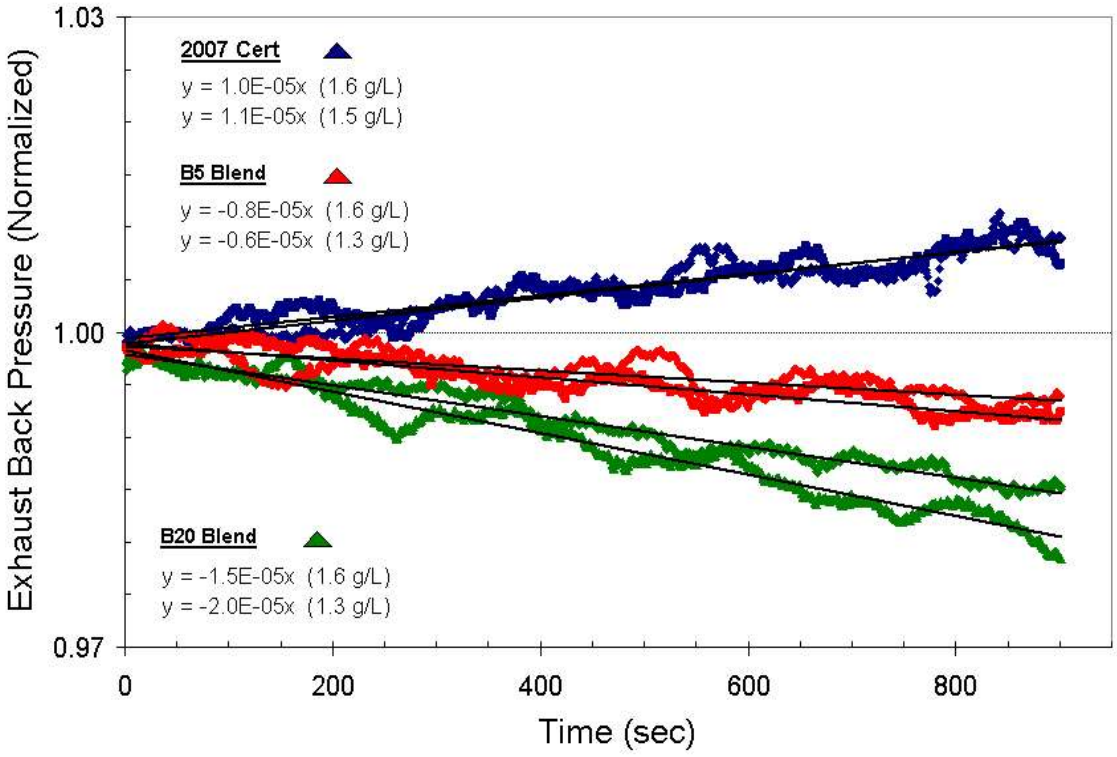
Biodiesel & Aftertreatment Systems

Biodiesel is compatible with Diesel Particulate Filters in today's new clean diesel technology, and has some distinct advantages:

- Lowers regeneration temperatures
- Less engine out particulate matter
- May provide increased performance and decreased maintenance vs. ULSD alone
- May provide increased fuel economy

Superb Results

- Regeneration rate increases with increasing biodiesel content
- Even at 5%, biodiesel PM measurably oxidizes more quickly

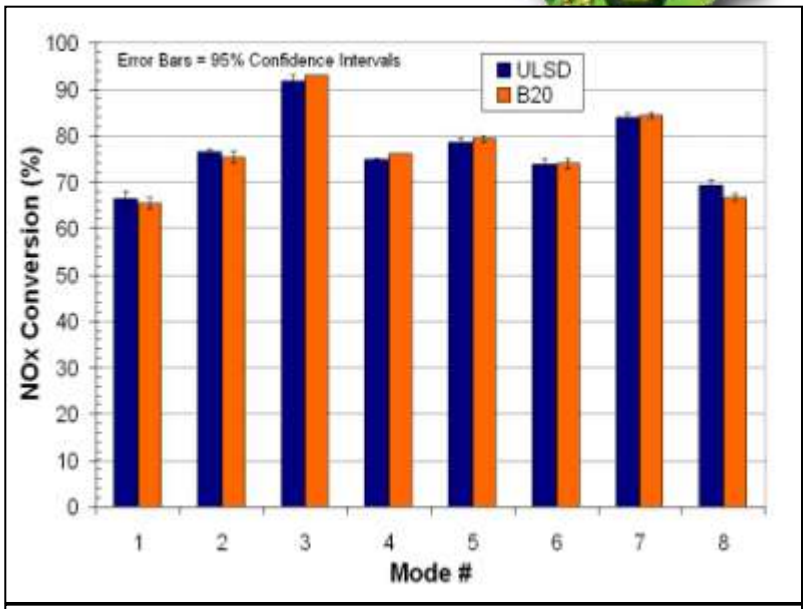


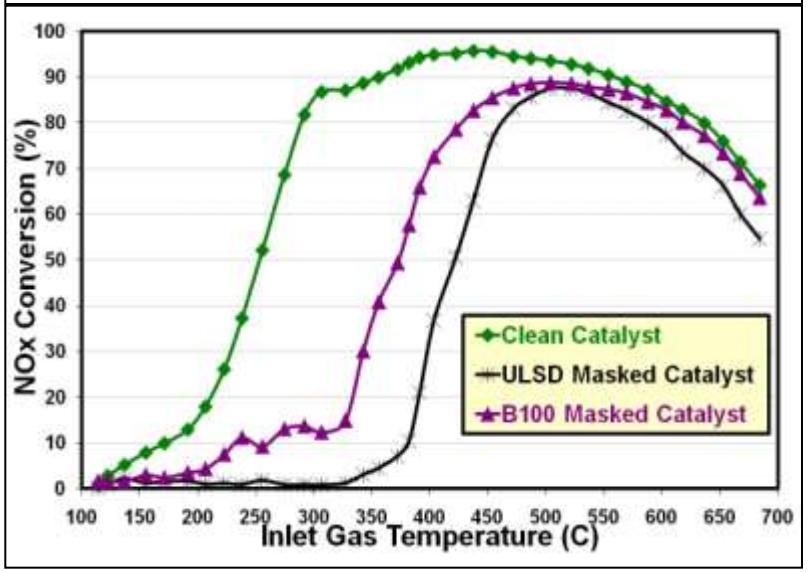
- BPT is 40ºC lower for B20
- Soot is more easily burned off of filter
- B20 can be used for lower temperature duty cycle

Balance Point Temp	
ULSD	360ºC
B20	320ºC
B100	250ºC

Biodiesel Impact on SCR Catalyst Systems

- All on-road diesel engines require SCR systems starting with MY2010
- Engine studies on a Cummins ISB show no change in NOx reduction performance of SCR with B20
- Certain types of SCR catalysts are susceptible to HC inhibition
- Studies show that SCR catalysts recover more quickly from HC inhibition when fueling with biodiesel





B20 vs. Diesel: In the shop

- With in-spec B20 and lower blends, the issues you can expect to see in your shop are the same as you will see with petrodiesel
- Except:
  - Expect to see fewer lubricity related issues
  - Expect to see fewer problems with after-treatment
  - Filter related issues may be related to cleaning effect upon first use, or are likely normal diesel issues or out of spec or imposter biodiesel
  - Less black smoke from exhaust!

USTs: The Need for Approvals

- Authorities having jurisdiction (AHJs) with legal authority to regulate/approve fueling infrastructure and equipment:
  - OSHA (personnel/worker safety)
  - Fire Marshal (fire/explosion hazard)
  - Local Water Board/Environmental (spills/leaks)
- Equipment that is generally regulated includes:
  - Dispensing Equipment
  - Underground Storage Tanks
  - Leak Detection and Vapor Recovery Equipment
  - Piping, fittings, flanges, etc.

Legacy vs. New Equipment

- UL and other third party listing organizations do not normally retroactively list equipment in the field for new fuels or products, and do not have protocols for testing new fuels.

Solution?

- Use options other than 3rd party for legacy acceptance and new equipment where 3rd party protocols have not been developed. The most common are independent white papers or manufacturer warranty/approval/guarantee.
- Work with 3rd party listing organizations to develop protocols
- Encourage private industry to conduct certification testing with new equipment using the new protocols once developed
- Consider partnering (i.e. Cost share) testing costs for new equipment where manufactures cannot justify testing.

Leak Detection Equipment

- Ken Wilcox Associations (KWA) published a white paper in 2011 which evaluated the effects for leak detection systems with biodiesel blends.

- The data in the KWA white paper showed that leak detection equipment will work with either biodiesel or biodiesel blends as long as materials are compatible.

- The National Working Group on Leak Detection Evaluation (NWGLDE) has provided approvals for B20 and lower blends for all leak detection equipment listed for petrodiesel

NREL White Paper

- Covers equipment other than leak detection equipment, similar to the white paper developed by KWA for leak detection equipment.
- NREL has reviewed existing literature, and approached manufacturers on existing data on the compatibility of existing and current fuel dispensing infrastructure.
- NREL White Paper documents material compatibility information and manufacturer warranty statements for biodiesel and biodiesel blends.
- The goal of this white paper is to give AHJs a technically credible document to reference if questions regarding fuel dispensing equipment arise.

Thank you!

Questions?

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