National Biodiesel Board

South Dakota Energy Conference

May 13, 2009

Biodiesel…Revitalizing America's Future & Fuel Needs

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South Dakota Soybean

Association/National Biodiesel Board

Syllabus

- Biodiesel 101
- Benefits of Using Biodiesel
- Biodiesel Industry Trends
- Using Biodiesel in Diesel Engines
- Handling and Storage
- Biodiesel Standards and Fuel Quality
- National Fuel Quality Survey
- Original Equipment Manufacturers
- Educational Resources

BIODIESEL

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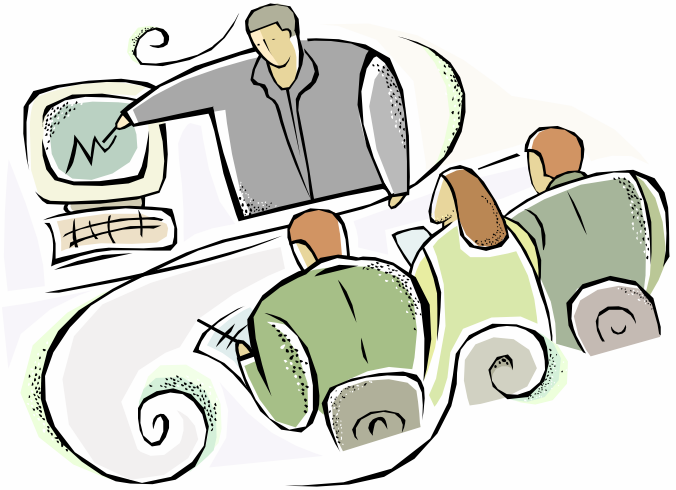
“Biodiesel 101”



What is Biodiesel?

- A clean burning alternative fuel, produced from domestic, renewable resources such as soybean oil
- Contains no petroleum, but can be blended at any level with petroleum diesel to create a biodiesel blend
- Can be used in compression-ignition (diesel) engines with little or no modifications
- Simple to use, biodegradable, nontoxic, free of sulfur and aromatics

Biodiesel Defined

- Biodiesel, n. -- a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100, and meeting the requirements of ASTM D 6751.
- Biodiesel blend, n. -- a blend of biodiesel fuel meeting ASTM D 6751 with petroleum-based diesel fuel designated BXX, where XX is the volume percent of biodiesel (e.g. B20)

Industry Status: USA

- Biodiesel fully registered with the US EPA
  - Clean Air Act 211(b) Tier 1 and Tier 2 testing complete
- ASTM Specification for B100 for Blending: D 6751
  - B20 blended specification in progress and moving fast
  - Incorporation of B5 into petrodiesel spec: D 975
  - D 6751 being modified
    - Address lingering stability concerns of OEMs
    - Insure compatibility with 2007/2010 diesel technology
- National Quality Program (BQ-9000) Launched for Biodiesel Marketers and Producers

US Biodiesel Industry Direction

- **B2** as the preferred lubricity component for 2006 Ultra Low Sulfur Diesel fuel
- **B5** generally accepted blend level among the major automakers / engine manufacturers; moving toward B20
- **B20** in niche markets and for fleet use – over 600 fleets using B20 nationwide
  - Government / Military / Municipal Fleets
  - School Buses / City Transit
  - Garbage Trucks
  - Home Heating Fuel
  - Agriculture

Making Biodiesel

Transesterification

(Catalyst)

100 pounds Triglyceride	+	10 pounds Alcohol	=	10 pounds Glycerine	+	100 pounds Mono-Alkyl Esters
Soy oil		***Methanol***		***Soap***		***Biodiesel***

- Raw Vegetable Oil is NOT Biodiesel!
- Other ‘biomass’ products aren’t Biodiesel
- Must meet ASTM D 6751

Biodiesel Raw Materials

Oil or Fat

- Soybean
- Corn
- Canola (rapeseed)
- Cottonseed
- Sunflower
- Beef tallow
- Pork lard
- Used cooking oils

Alcohol

- Methanol
- Ethanol

Catalyst

- Sodium hydroxide
- Potassium hydroxide

Biodiesel Credentials

- B100 has a full ASTM standard (D 6751) in place
- ASTM standard setting is currently in process for B20
- The biodiesel industry has implemented a voluntary quality control program – BQ9000 – for biodiesel producers and marketers
- Designated as an alternative fuel by the Department of Energy (DOE) & US Department of Transportation (DOT)
- Energy Policy Act (EPAct) regulations allow fleets to earn EPAct credits by using biodiesel – the least cost option for EPACT compliance
- Registered as a fuel & fuel additive with the Environmental Protection Agency (EPA)
- Biodiesel is the only alternative fuel to have fully completed the health effects testing requirements of the 1990 Clean Air Act Amendments

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Benefits of Using Biodiesel

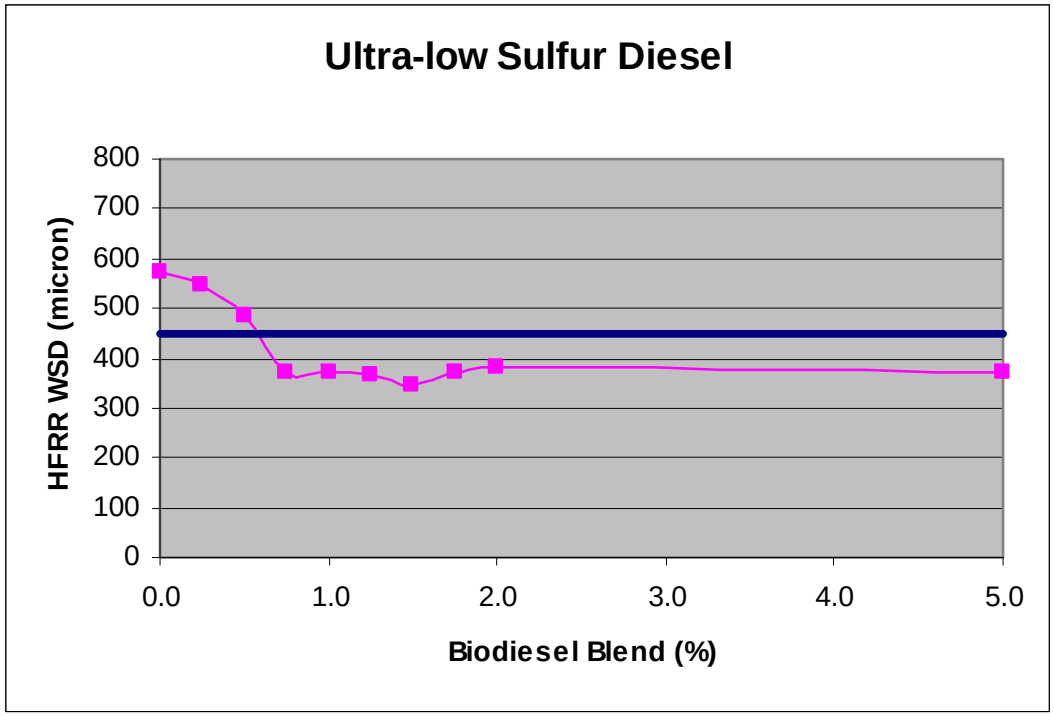
Biodiesel

- High Cetane (avg. over 50)
- Ultra Low Sulfur (avg ~ 2 ppm)
- High Lubricity, even in blends as low at 1-2%
- High Energy Balance (3.24 to 1)
- Low Agriculture Inputs: Soybeans
- 78% Life Cycle C02 Reduction
- Renewable, Sustainable
- Domestically Produced
- Reduces HC, PM, CO in existing diesel engines
- And reduces NOx in boilers and home heating

EPA HD Emissions Averages

Emission Type	B100	B20	B2
Total Unburned Hydrocarbons	-67%	-20%	-2.2%
Carbon Monoxide	-48%	-12%	-1.3%
Particulate Matter	-47%	-12%	-1.3%
Oxides of Nitrogen (NO_X)	+10%	+2%	+.2%

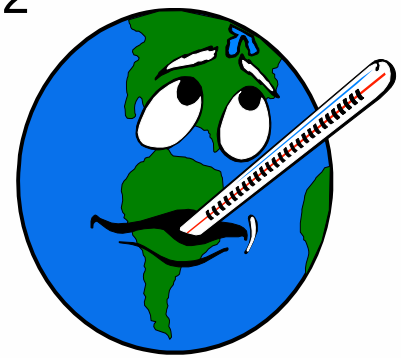
Enhanced Lubricity



- Equipment benefits
  - Superior lubricity
  - B2 has up to 66% more lubricity than #2 Diesel
- EPA requires sulfur reduction in 2006
- No overdosing concerns

Biodiesel and Global Warming

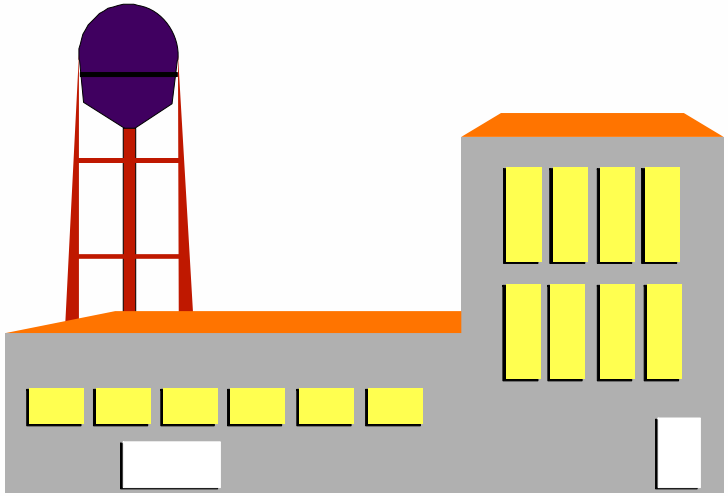
- Closed Carbon Cycle: CO_2 Used to Grow Feedstock is Put Back Into Air
  - 78% Life Cycle Decrease In CO_2



- Energy Balance 3.24 to 1
- Compression Ignition Platform 30% to 40% More Efficient Than Spark Ignition

Economic Development--Biodiesel

- Creates Manufacturing Jobs
- Reduces Energy Imports
- Improves Balance of Trade
- Creates Expanded Markets for Agriculture



Benefits of Using Biodiesel

- Renewable, domestic resource that helps support American agriculture industry and decreases our dependence on foreign oil
- Biodiesel has the highest energy balance of any fuel, further increasing its value in our energy portfolio; every unit of fossil fuel it takes to make biodiesel results in 3.24 units of energy gain
- Tax incentive helps close the gap between the cost of biodiesel and regular diesel

Benefits of Using Biodiesel

- Safer, Cleaner Alternative to Petroleum
  - Exhaust has less harmful impact on human health
  - Reduces emissions of lifecycle CO^2 by 78%
  - Reduces emissions of unburned hydrocarbons, carbon monoxide and particulate matter
- Simple to use, biodegradable, nontoxic, free of sulfur and aromatics
  - Less toxic than table salt and biodegrades as fast as sugar
  - Biodiesel exhaust comparable to the smell of French fries

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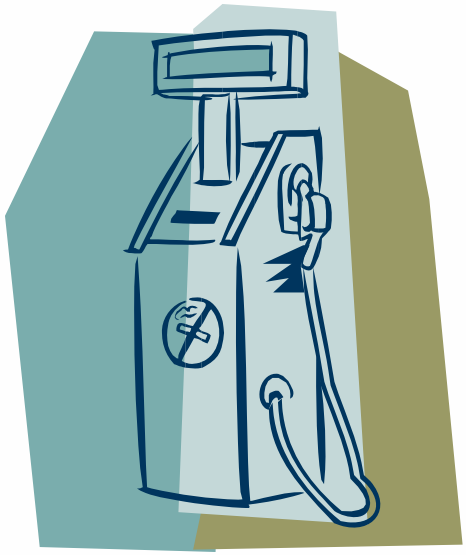
Biodiesel Industry Trends



Current Market Drivers

- Environmental Benefits
- Energy Independence
  - Biodiesel Tax Incentives / Legislation
  - Energy Policy Act of 1992 (EPACT)
  - Executive Order 13149 (20% reduction in Fed fleet fuel usage compared to 1999 levels)
- Enhanced Lubricity
  - Premium Diesel Market Grows as Consumers Demand More From the Fuel They Use
- Market Competition Among OEMs
  - Biodiesel announcements from GM, DaimlerChrysler, VW, and John Deere; more in the works

Biodiesel Legislation

- Federal Excise Tax Credit
  - Signed into law on 10/22/04 as part of H.R. 4520, the American JOBS Creation Act of 2004
  - Tax incentive effective as of 1/1/05 (*expires 12/31/08)*
  - One penny per percentage of biodiesel per gallon for "agri-biodiesel" made from first-use veg oils and animal fats, and ½ penny per percentage of biodiesel made from recycled oil feedstocks
  - Lowers cost of biodiesel to consumers in taxable and tax exempt markets

Biodiesel Tax Incentive

- The benefits are available to fuel blenders / distributors and other diesel excise tax payers, who carry an excise tax liability
- The incentive is applied toward road tax or income tax liability of the blending company
- The incentive applies to any blend of biodiesel

2005 Energy Bill

- Extends the Federal Tax Incentives to 12/31/08
- Establishes a Renewable Fuel Standard (RFS)
  - Doubles the use of biodiesel and ethanol by 2012
  - Mandates a 7.5 billion gallon RFS by 2012

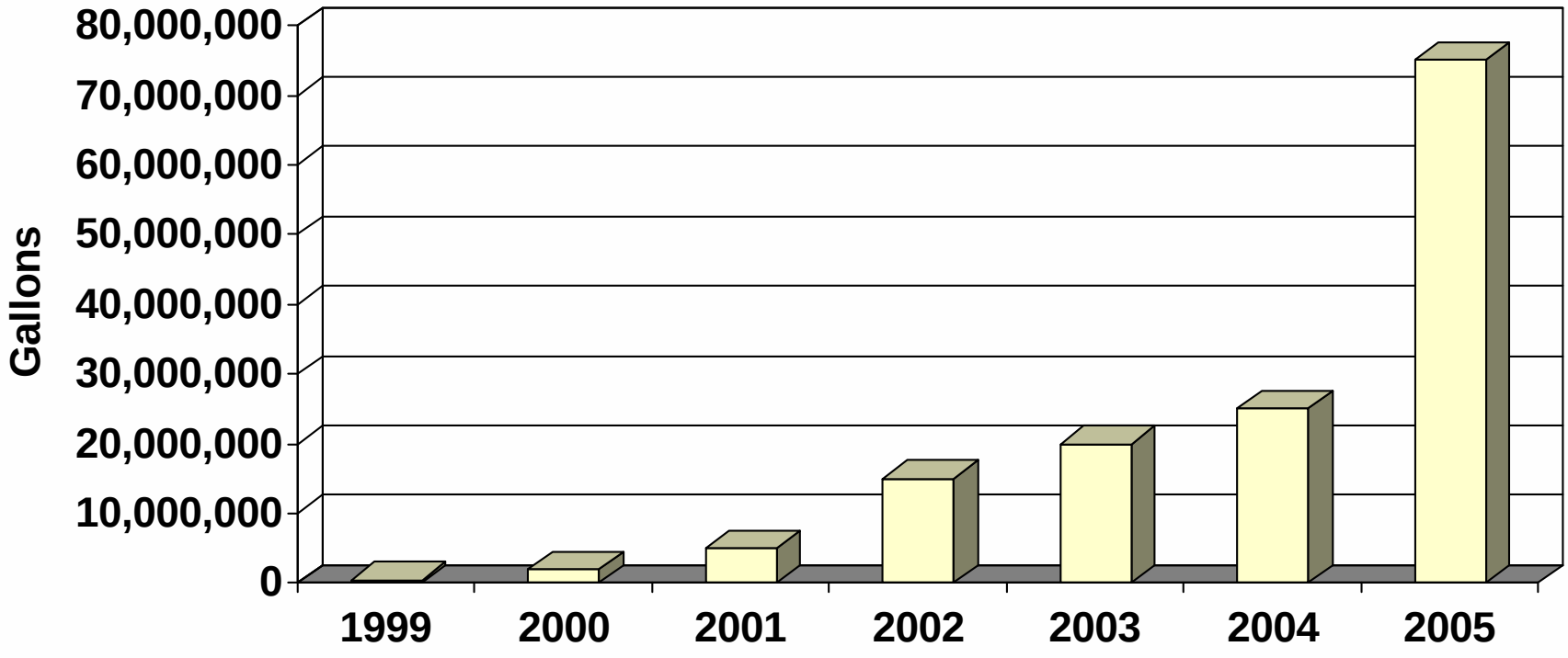
Federal Biodiesel Legislation

- EPACT
  - 75% of light-duty vehicle purchases must be alternative fuel vehicles (AFV)
  - 50% of light duty AFV purchase requirements can be met with biodiesel
  - Can earn 1 AFV purchase credit for each 2,250 gallons of B20 used or for each 450 gallons of B100 used

Infrastructure

- Fuel available through direct shipment or from over 1,000 petroleum distributors nationwide
- About 400 public retail filling stations nationwide
- Movement towards biodiesel at the terminal

Biodiesel Demand / Production



150 Million Gallons+ projected sales of B100 for 2006

Biodiesel Production Capacity

- 86 active plants currently –
  - 552.1 million gallons capacity
- 65 plants under construction plus 13 expansions –
  - 1.29 billion gallons capacity
- Potentially over 1.6 billion gallons capacity inside 2 years

Biodiesel Feedstock Supplies

- There is enough to make a difference
  - 1.7 billion annual gallons resource of feedstock supplies currently
  - 3.6 billion annual gallons feedstock supplies by 2020
  - Long-term potential: 10 billion annual gallons by 2030
  - U.S. On-Road Market: 40 billion annual gallons

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Using Biodiesel In Diesel Engines

Kansas farmer Harold Kraus fuels up with B20

Using B20 and Lower Blends

- B20 operates in conventional engines, just like petroleum diesel
- Few or no modifications needed to engine or fuel system
  - Most common measures include initial fuel storage tank cleaning or fuel filter replacement
- Higher cetane and lubricity than diesel
- Similar horsepower, torque and mileage as diesel

Using B20 and Lower Blends

- B20 can be stored and distributed using existing petroleum diesel tanks and fueling stations
- "Start today, stop tomorrow" technology
- Biodiesel the least cost, best alternative to diesel
  - New Tax Incentive brings cost of biodiesel blends in line with or sometimes lower than #2 Diesel
  - No special equipment or modifications to vehicle
  - Using B20 results in lower total annual costs than other alternative fuels

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Handling and Storage


From the National Biodiesel Board

BIODIESEL Education Network News

summer 2006

10 steps for successful biodiesel handling and storage

In this Issue:

(888) BIODIESEL (773) 835-7913 fax www.biodiesel.org

BQ 9000 Accreditation Mark

BQ-9000 Status

- BQ-9000 is a unique combination of the ASTM standard for biodiesel, ASTM D-6751, and a comprehensive quality control system that includes storage, sampling, testing, blending, shipping, distribution, and fuel management practices.
- To receive accreditation, companies must develop a quality control manual and pass a rigorous review of their quality control processes by an independent auditor.
- 3 BQ-9000 certified biodiesel marketers
- 14 certified biodiesel producers
- Together these producers account for more than 40 percent of the biodiesel produced in the U.S.

Accredited Producers

- Peter Cremer
- SoyMor Biodiesel
- Dow Haltermann Custom Processing
- Eastman Chemical Company
- Imperial Western Products
- Cargill Inc.
- AGP
- Huish Detergents
- Organic Fuels
- World Energy
- Griffin Industries
- FUMPA Biofuels
- Minnesota Soybean Processors
- Renewable Energy Group

Certified Marketers

- Peter Cremer
- Sprague Energy
- Metro Fuel Corp.

BQ-9000 Audits in Process

- Accredited Producers
  - Bioenergy of Colorado
  - Peach State Labs
  - Stepan
  - Carolina Biofuels
  - Eastern Biofuels
  - Xenerga
- Certified Marketers
  - TransMontaigne
  - Western States Petroleum
  - Pro Petroleum
  - FUMPA Biofuels
  - Xenerga

www.BQ-9000.org

Fuel Filters and Solvency

B100

- Monitor filters closely
- Strong cleaning effect
- Storage tanks may need to be cleaned, or keep extra filters on hand at start up
- Wipe painted surfaces immediately

B20 & Under

- Monitor filters, less than 2% need to be changed
- Mild cleaning effect
- Storage tanks may need to be cleaned, or keep extra filters on hand at start up
- Housekeeping protocols for generic diesel equally important prior to blending

Material Compatibility-Hoses

- B100 may adversely affect some elastomers such as natural or nitrile rubbers over time
- Many elastomers used after 1993 are compatible with B100 (Viton, etc.)
- Blends (B20) effect is less, or non-existent
  - Normal monitoring of hoses and gaskets for leaks appears sufficient with B20
- No special precautions needed for B2 – B5

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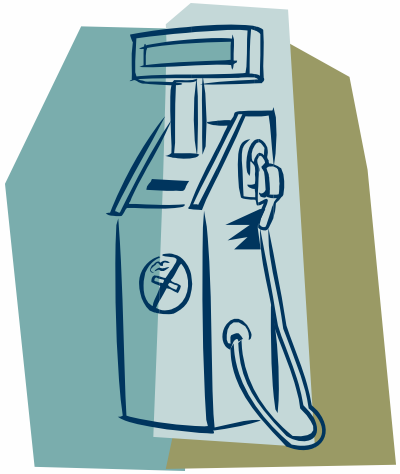
Biodiesel Standards and Fuel Quality



ASTM D 6751 for B100

Property	ASTM Method	Limits	Units
Flash Point	93	130 min.	degree C
Water & Sediment	2709	0.05 max.	vol.%
Carbon Residue (100% sample)	4530	0.05 max.	wt. %
Sulfated Ash	874	0.02 max.	wt. %
Kin. Viscosity, 40C	445	1.9 - 6.0	$mm^2/sec.$
Sulfur	5453	0.05 max.	wt. %
Cetane	613	47 min.	
Cloud Point	2500	By Customer	degree C
Copper Corrosion	130	No. 3 max.	
Acid Number	664	0.80 max.	mg KOH/g
Free Glycerin	6854	0.020	wt. %
Total Glycerin	6854	0.240	wt. %
Phosphorous	4951	10 max	ppm
Distillation, T90 AET	1160	360 max	degree C

Biodiesel Specifications Status

- **ASTM Specifications**
  - The existing **ASTM D6751 standard for B100** is being modified with new oxidation stability parameters and other updates.
    - B5 ballot passed at Subcommittee vote in December 2006
    - New working groups established for cold flow & sterol glucosides
  - Concurrently, a **new ASTM specification for B20 blends** is being revised for balloting in mid-January 2007
- **Engine Manufacturers Association (EMA)** has approved test specifications for B20 biodiesel
  - Helping to pave the way toward acceptance of the ASTM B20 standard
  - To view the EMA press release and test specifications, visit: http://www.biodiesel.org/pdf_files/fuelfactsheets/EMA_Biodiesel_Blend_PR&Statement.pdf

Biodiesel Standards & Quality

- Fuel quality is of the **utmost concern and importance** to the biodiesel industry
- ASTM D 6751 is the quality specification for **biodiesel** fuels irrespective of the feedstock source and/or processing method
- National Quality Program (**BQ-9000**) Launched for Biodiesel Marketers and Producers
  - Ensures that biodiesel is produced according to ASTM specifications, and that contamination or degradation does not occur during distribution, storage or blending

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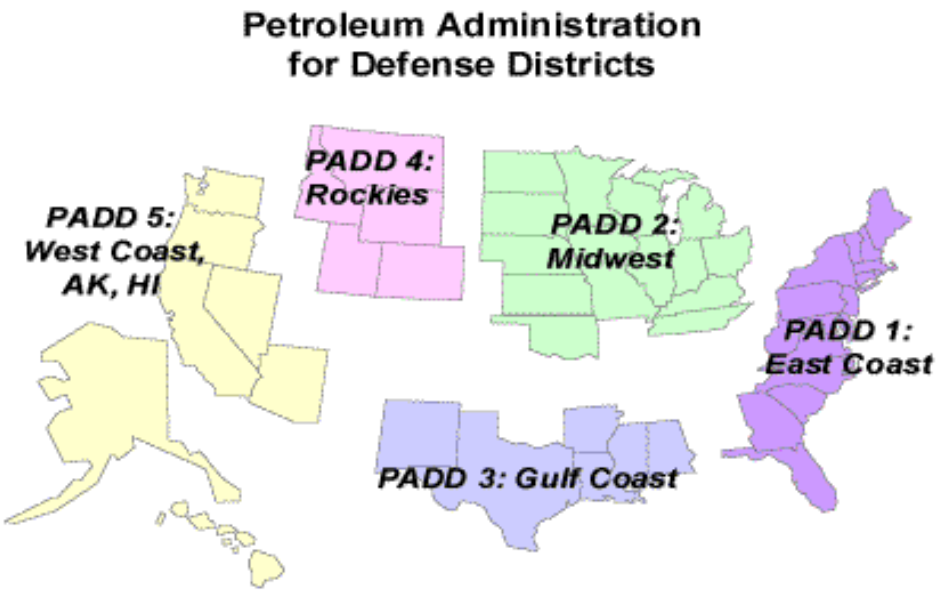
National Fuel Quality Survey

Performed by National Renewable Energy Lab
November 2005 – July 2006

2006 Quality Survey Sample Collection

- Samples were collected randomly in several campaigns by PADD
- A subcontractor visited the site of a biodiesel blender, usually a terminal operator or jobber to collect the B100 sample
- 32 B100s, 6 B99s, and 1 B50



- PADD 1
  - 6 samples
  - FL, GA, MA, PA(2), RI
- PADD 2
  - 18 samples
  - IA(3), IL(2) IN, MI(2), MN(3), MO(3), NC, ND, TN, WI
- PADD 3
  - 5 samples
  - LA(2), TX(3), VA
- PADD 4
  - 1 sample
  - CO
- PADD 5
  - 4 samples
  - CA (2), WA (2)

B100 Quality vs. Specifications

- A national fuel quality testing project, co-funded by NBB and the National Renewable Energy Laboratory, found that 50 percent of biodiesel samples pulled between Nov. 2005 and July 2006 were out of spec on at least one parameter.
  - Typically failing for total glycerin or flash point

- One-third of all the samples were out of spec for total glycerin, the same property that caused issues in Minnesota last year.

- A combination of challenges with Ultra Low Sulfur Diesel (ULSD) and these biodiesel fuel sampling results make conditions right for caution when blending and using biodiesel this winter.

Ultra Low Sulfur Diesel (ULSD)

- Some Petroleum Marketers Association (PMAA) members have expressed concerns about the cold flow performance of ULSD when blended with cold flow additives
  - Some are noting no differences in cold flow performance, others are noting approx. 10ºF increase in CFPP
  - Problem can be exacerbated when ULSD is blended with biodiesel
  - ULSD now on market has some different properties than the ULSD test fuels that were previously available
- NBB is addressing this issue by:
  - Working with the biodiesel and petroleum communities to share data they have with biodiesel/ULSD blends
  - Contracting with laboratories to test and confirm blended fuel properties with ULSD and biodiesel

Industry Response

- The NBB and PMAA released a **Biodiesel Winter Weather Advisory** in response to the fuel quality testing results and introduction of ultra low sulfur diesel.
- **The industry's response included the following actions:**
  - Stepped up a Fuel Quality Outreach Program to federal and state agencies with authority to test biodiesel at the plant / terminal levels to enforce fuel quality (IRS, EPA, USDA, state Departments of Weights & Measures)
  - Developed an online Fuel Quality Enforcement Guide, as well as posted the NBB Fuel Quality Policy at www.biodiesel.org/resources/fuelqualityguide
  - Issued recommendations to users that include buying fuel from BQ-9000 certified marketers and accredited producers

Biodiesel Winter Weather Advisory

- **The NBB and PMAA have advised their members & biodiesel users to take the following precautions:**
  - Buy fuel from BQ-9000 accredited producers or certified marketers.
  - Work with a reputable supplier who you have a good relationship with who will stand behind the product.
  - Require an actual certificate of analysis on every load.
  - Know cold flow properties of both the ULSD and biodiesel before blending.
  - Observe all proper handling and storage procedures, and carefully review the materials available online. Those materials include:
    - Fuel Quality and Performance Guide
    - Biodiesel Handling and Use Guidelines
    - Cold Weather Blending Report
    - Fuel Handling Training Video

NBB Stance on Biodiesel Fuel Quality

- Ensuring that consumers have a high level of confidence in the biodiesel they purchase is a top priority for the National Biodiesel Board and a key element for the industry's continued growth.
- As the industry ramps up to meet the vast increase in demand for biodiesel, this growth simply cannot occur at the expense of fuel quality.

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Cold Flow

Cold Weather Performance

- B100 freezes faster than most US petrodiesel
- Untreated B20 freezes about 2-10 °F higher than #2 petrodiesel
- The same precautions taken with petrodiesel can be used to insure trouble free operation with biodiesel

Cold Weather Performance

- Various options exist to insure the fuel does not gel:
  - Pour and cloud points can be addressed with kerosene blending
  - Desirable CFP results can be attained with conventional flow improver technology, although additives don't work as well on B100 as they do with B20 or petrodiesel
  - Fuel heaters or indoor vehicle storage can also be substituted for the use of kerosene or additives

Biodiesel Fuel Stability

- Fuel stabilizers generally are not needed in biodiesel blended fuel that is being used on a frequent basis
- When using biodiesel in vehicles that sit unused for 6 months or longer, a stability additive can help ensure trouble-free use:
  - NBB recommends Tenox 21, by Eastman
  - Stability additive should be mixed with B100 before blending with petro diesel

High Profile Cold Weather Users

- Glacier National Park (MT)
- Yellowstone
- Grand Teton National Park (WY)
- Salt Lake City Airport
- CO Ski Resorts
- CU Boulder
- Peterson AFB (CO)

...Fueling the Famous

- Neil Young

- Willie Nelson

- Lollapalooza

- Indigo Girls

- Bonnie Raitt

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Original Equipment Manufacturers

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OEM Support for Biodiesel

DaimlerChrysler

Volkswagen

Ford

GM

John Deere

CNH

Caterpillar

Major OEMs' Biodiesel Positions

John Deere	Accepts up to B5; B2 factory fill for all US diesels
CNH	Accepts up to B20 in both Case IH & New Holland brands for most equipment
Caterpillar	Accepts up to B30 in most equipment; B5 for remainder
DaimlerChrysler	Accepts up to B5 in most vehicles; B5 factory fill in Jeep Grand Cherokee; B20 approved for fleet use in Dodge Ram
General Motors	Accepts up to B5; B20 offered as SEO for fleets
Ford	Accepts up to B5; working toward B20
VW	Accepts up to B5; working toward B20

OEMs: What You Need To Know

- Most OEMs support up to B5, some moving toward B20 as soon as ASTM standard for B20 is in place
  - John Deere – B2 factory fill for all U.S. diesel vehicles; support up to B5; trying to implement biodiesel use across Ag industry
  - DaimlerChrysler – B5 factory fill for Jeep Liberty CRD; supports fleet use of B20; proactively support biofuels
  - VW – Covers up to B5 under warranty; researching B20 performance; some VW customers use higher blends at own risk
  - GM – Supports B20 for fleet use only in heavy trucks & vans
  - Ford – Reluctant support of up to B5; slow to adopt

OEM Warranty Statements

- All engine and vehicle manufacturers provide a material and workmanship warranty on the products they manufacture. **Such warranties do not cover damage or problems caused by external factors or elements they don't produce or control, such as the type of fuel or additives used in the engine.** Thus, if an engine experiences a failure that is caused by a fuel or a fuel additive – no matter if the fuel or additive is biodiesel, regular petroleum diesel, or an aftermarket additive - the damage generally will not be covered by the OEM's equipment and workmanship warranty.

- **Federal law, called the Magnuson Moss Act, prohibits the voiding of an OEM warranty just because an aftermarket additive—or biodiesel—was used.** The additive or biodiesel must be the cause of the failure for the issue not to be covered by the warranty.

- **Most OEM dealers and customer service departments currently tell their customers the use of up to 5% biodiesel (B5) is acceptable,** with the requirement the pure biodiesel fuel adhere to the quality standards specified by American Society of Testing and Materials standard (ASTM D 6751) prior to blending.

NBB 2007/2010 OEM Goals

- B20 will be approved by all major diesel engines and vehicles with the new 2007 and later model year engines
- Engine and vehicle companies will incorporate B20 into all future designs
- Engine and vehicle companies will help to promote and encourage B20 and lower blends

Goal of OEM Outreach Program

- Increase OEM knowledge about the benefits and use of biodiesel
- Foster enthusiastic support for biodiesel both within their organizations and externally (dealers, customers, etc.)
- Demonstrate how the use of biodiesel benefits their customers, and how the support of biodiesel benefits their company
  - Environmental stewardship & domestic energy security
  - Readily available solution to emissions reduction challenges
- Encourage current & future involvement with biodiesel
  - More positive positions / warranty statements re: B20
  - Incorporation of B20 into all short- and long-term R&D programs
  - Involvement in biodiesel promotional efforts

New Technology

- Biodiesel provides SIGNIFICANT benefits with new diesel technology
- 2% biodiesel restores the lubricity of the poorest lubricity diesel
- Although similar in size/distribution, B20 particles are different than petrodiesel particles
- Break Even Temperature of PM Traps reduced by 30 to 50 degrees F with B20
  - May increase fuel economy w/ PM traps
  - May lengthen PM trap life
- Engine out PM reduced
  - Helps EGR, reduces engine oil soot levels

New Technology

- New diesel engines in 2007/2010 w/ after-treatment and 15 ppm sulfur fuel will have over 90% less NOx and PM than today's engines
- This is much cleaner than CNG today
  - Diesel will be 'clean technology'
  - While increasing fuel economy 25-30%
- Biodiesel is already 15 ppm sulfur level
- Biodiesel is an 'implementing' technology for new diesel engines by eliminating the lubricity problems, while already being 15 ppm sulfur, zero aromatics, and high cetane

US Biodiesel Industry Direction

- B2 as the preferred lubricity component for 2006 Ultra Low Sulfur Diesel fuel
- B5 in home heating fuel
- B20 in niche markets
  - Government Fleets
  - School Buses
  - Garbage Trucks
  - Mines
  - Agriculture
  - Stationary Electricity Generation
  - Others????

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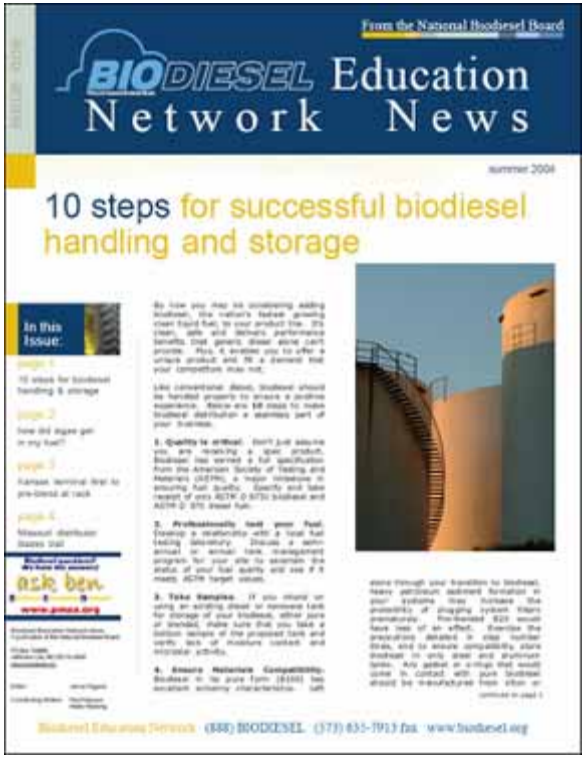
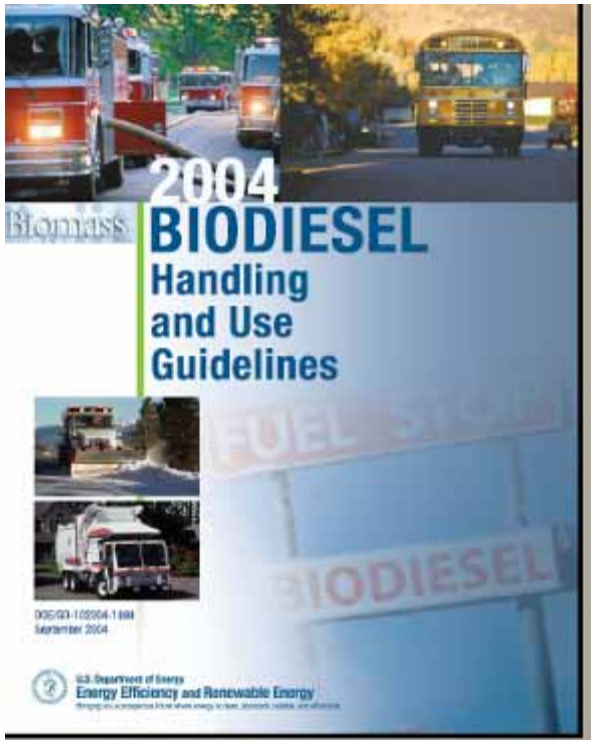
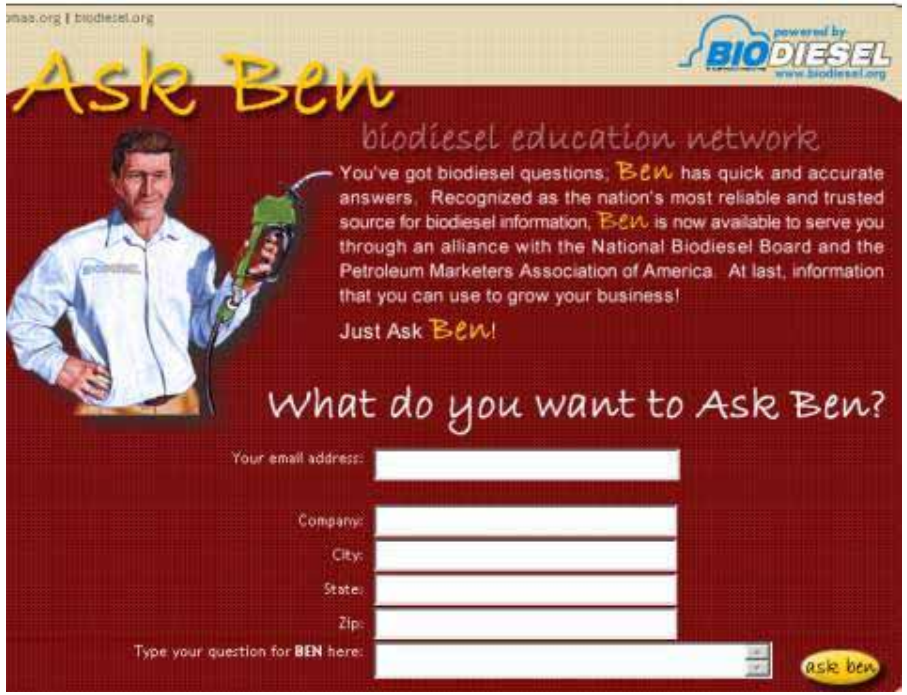
Educational Resources





Educational Resources

- BEN: Biodiesel Education Network
- Web-based resource specifically for petroleum marketers
- Partnership between NBB/PMAA
- www.pmaa.org
- www.biodiesel.org



Other Biodiesel Resources

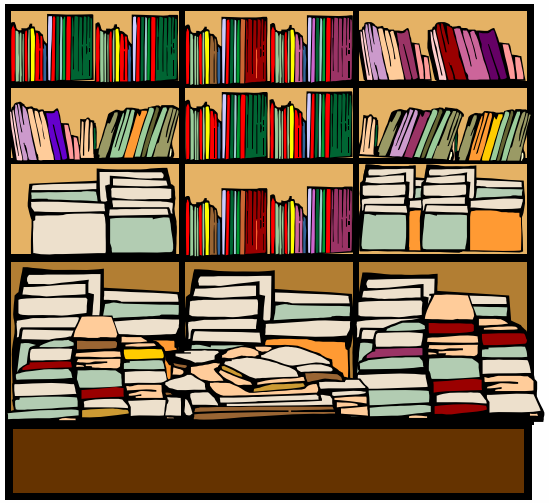
- www.bbibiofuels.com
- Biodiesel Magazine
  - A **<u>MUST HAVE'</u>** magazine
- Biodiesel Industry Directory On-Line

NBB Technical Library

National Biodiesel Board

www.biodiesel.org

1-800-841-5849



- Educational Videos Available
- Informational Resources
- Technical Resources
- On-line Database & Spec Sheets

BIODIESEL

TM by the National Biodiesel Board

USDA

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