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NBB Technical Update: Iowa Biodiesel Board

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NBB Technical Program

- **Keep Biodiesel Legal**
 - Emissions
 - ASTM Standards
 - New Engines
- **Eliminate Technical Barriers**
- **Quantify Technical Benefits**
- **Industry Wide Efforts Benefiting Everyone**
 - Do projects one entity couldn't do on their own
 - Do projects for whole industry so they don't need to be repeated by each company
- **Key Advantage to the Biodiesel Industry**

Biodiesel Technical Workshop



October 23-24, 2018; Kansas City

- Invitation only
- Best and brightest brainstorm/prioritize:
 - Petroleum/Additive Companies
 - Academia/Government Labs
 - OEMs
 - Biodiesel Producers and Test Labs
- Producers meet Thursday to give direction
- Road map: NBB technical efforts for members
- Marriott Plaza Kansas City

NBB Priority	FY19 Technical Priority Area	BTW Priority
Core	Feedstock development	1
2	B21-B100 in heating oil	2
1	New ultra-low NOx engines (metals)	3
4	Implement B20 heating oil	4
1	On/Off road B21-B100 (metals)	5
Lower	On-Road Vehicle Emission Testing	6
	Improve cold flow	7
Core	B20 in locomotives	8
Core	Long term stability	9
Core	Fuel quality enforcement	10
1	Existing aftertreatment (metals)	11
5	Multiproduct pipelines	12
	Biodiesel quality surveys	13
Lower	Biodiesel in electricity generation	14
Lower	Adjust timing to reduce Nox	
3	Fuel Economy and Maintenance on NTDE	
Lower	Marine ISO sulfur reduction	

NBB Technical Program



- Technical Efforts for B1-B20:
 - Maintain existing markets
 - Build confidence
 - Increase volumes
- Begin Research/Testing B21-B100
 - Market/application focused
 - Heating oil already underway

Technical Efforts for B1-B20



California:

- **Partnered with California Fueling on B20 NOx Additive for California**
 - This has encouraged others to complete testing
- **B20 in Underground Storage Tanks**
 - UL listings for petrodiesel also cover B20 in USTs
 - Technical Package Submitted California Water Board: Treat B20 the Same as Petrodiesel
 - 2015 EPA ruling considers B20 the same

Technical Efforts for B1-B20



- **Planned efforts to more formally document fuel economy, maintenance on NTDEs**
- **Conduct emissions durability testing to determine appropriate lower metals specifications for NTDE aftertreatment**
 - Many companies already below 1 ppm
 - Some companies may need process changes

Technical Efforts for B1-B20



- **Monitor CRC tank corrosion study**
 - Increase in diesel tank corrosion at filling stations
 - ULSD? Water? Microbes? Lubricity Additives?
Ethanol Contamination? Biodiesel? Glycerin?
- **Monitor field issues/problems and take appropriate action**
 - Diesel continues to change
 - Cold flow with more paraffinic diesel
 - Potential new diesel for low sulfur marine fuel

Technical Efforts for B1-B20



- Fully implement B20 in heating oil
 - B20 shelf life increase to over 1 year
 - Guidance for storage longer than 1 year
 - Better equipment company support
- Railroads requesting minimum aromatic, maximum cetane specifications....
- BQ-9000 and Fuel Quality Enforcement
 - Build consumer confidence

Efforts With Blends Over B20

Why B20? Mid 1990's

- **Cold Flow—only 2-10 F increase in Cloud Point**
- **Cost—B20 was only 20 cents more per gallon**
- **25% Opacity reduction for urban buses**

Plus:

- **B20 has similar physical properties as petrodiesel**
- **EPACT—Gov. Fleets and Alt. Fuel Providers: Using 450 gallons of B100 in B20 or higher = purchase of one AFV**
- **Reduces dependence on foreign oil, helps farm economy, creates manufacturing jobs**
- **NOx was similar for B20**
- **Other air toxics were lower**
- **Material compatibility (gaskets, elastomers) was OK**

What Has Changed...2018



- **Carbon Footprint is major driving force now**
- **RFS and Blenders Credit allow B100 to sell at prices similar to diesel**
- **State Credits or Requirement Programs**
- **Diesel technology has changed dramatically**
 - **Emissions are very low with ULDS or Biodiesel**
 - **NOx after-treatment**
 - **Diesel particulate filters**

Planned Approach, Blends Over B20



- Use driving forces to target markets and blend levels
 - On/Off Road Diesel
 - Home Heating Oil
 - Electricity Generation?
 - Marine Diesel?
- Use Technical Workshop input to guide efforts
- Get with equipment companies and users: What are the detailed technical needs and challenges?
- Mesh with existing technical projects and efforts
- Piggy back on users/fleets who are willing to be early adopters and guinea pigs for higher blends

Blends Over B20 On/Off Road Diesel



Major Driving Force: Lowering Carbon to Combat Climate Change

Secondary Driving Force:

- Zero Petroleum Movements**
- Incentives Reduce Cost to Below Petroleum**
- Low cost option to meet mandatory regulation**

Other Driving Forces:

- Environmental Spill Less Harardous**
- Early Adopter Mentality**

Blends Over B20

On/Off Road Diesel



- Initial meetings completed with Case New Holland, Caterpillar, John Deere, Cummins, GM
- Injector Performance
 - Deposits?
- After-treatment
 - Confirm NO_x OK
 - Biodiesel metals values
 - Positive Impacts on Diesel Particulate Filter?
- Material compatibility—seals/gaskets
- Lab Scale Durability
- Field Trials
 - Document durability, fuel economy, maintenance

Blends Over B20

On/Off Road Diesel



Piggybacking on Existing Projects—NBB funded

- **Case New Holland Off Road—Confirm lower spec levels for metals for NOx aftertreatment for B20: NREL**
 - Add CARB, EPA diesel with B40/B50 and B100 emissions
- **Cummins Engine On Road at Purdue University**
 - Run B40/B50 and B100 emissions
- **Investigate ‘Optimizing’: Capitalize on lower B100 PM**
- **Do all this in such a way that it sets the metals specifications needed for B100 used as B20, or used as higher blend**

Blends Over B20 Home Heating Oil



Major Driving Force: Lowering Carbon to Combat Climate Change

Secondary Driving Force:

- **Oilheat Dealers Competing Against Natural Gas and Electricity to Save Their Business**
- **Incentives Reduce Cost to Below Petroleum**
- **Low cost option to meet mandatory regulation**

Other Driving Forces: Early Adopter Mentality

Blends Over B20

Home Heating Oil



Bioheat Technical Steering Committee

- Flame Sensors
- Modifying Air/Fuel Ratio to account for ~10% oxygen in B100
- Emissions
- Materials Compatibility
 - Copper
 - Gaskets/Seals

Blends Over B20

Home Heating Oil



Bioheat Technical Steering Committee

- Documentation of field experience
- Get equipment makers on board
- ASTM standards for blends over B20
 - Stability
 - Viscosity
 - Acid Number
 - Others?

Blends Over B20 Home Heating Oil



Cooperation with NORA–National Oilheat Research Alliance

- Babington Burner, unique 'blow hole' technology
- B0-B100 flexible burner
- Automatic adjustment of air/fuel ratio through O₂ sensor in exhaust piping
- Dial up and dial down of fueling rate, which is not possible with conventional 'on/off' type burner

Blends Over B20

Electrical Generation



- **Two Technologies: diesel electrical generation**
 - Diesel engine generator sets
 - Large (railroad size) and medium (UPS truck/semi size)
 - On-ground gas turbines
 - Low NOx and High NOx versions
- **Main driving forces:**
 - Renewable, low carbon electricity (65% of electricity is from high carbon coal, natural gas)
 - Resiliency and back-up power for peaking, and power on cloudy, windless days!
 - Low/zero capital cost—use existing equipment

Blends Over B20

Electrical Generation



Diesel engine generator sets

- **On/Off road To-Do list for blends over B20 will address most questions in this application**
- **May need to do some additional emissions and stability work**
- **Cold flow probably easier to handle with stationary applications**

Blends Over B20

Electrical Generation



On-Ground Gas Turbines:

- Emissions, particularly NO_x and CO
- Combustor deposits and/or coking
- Metals need to be below 0.5 ppm
- Material compatibility—seals/gaskets
- Lab Scale Durability
- Field Trials
 - Document durability, fuel usage rate, maintenance

Blends Over B20:

Heating Oil

On/Off Road Diesel

Electrical Generation

COLD FLOW

Cold Flow Options: Blends Over B20

- Use in warm weather
- Heat the vehicle tank and/or filter
- Use the 'right' kind of biodiesel
 - Let mother nature do the work
 - Remove/modify the high freezing components

Cold Flow Options: Blends Over B20



Heating The Fuel:

Optimus Heated Duel Tank System

- Illinois Soybean, MN Soybean with 2-5 trial units
- Washington DC Metro
- Other potential customers
- Piggyback to document fuel economy, durability, in-use experience w/ B100

Cold Flow Options: Blends Over B20



Use the Right Kind of Biodiesel

- **Optimize Fatty Acid Profile**
 - Saturates: great cetane and stability, but BAD cold flow
 - Poly-unsaturates: good cold flow, OK cetane, but BAD stability
 - Mono-unsaturates: BEST trade off between cold flow, stability, and cetane
- **HIGH OLEIC, LOW POLY, LOW SATURATE OIL WOULD BE IDEAL!**
- **Potential competitive advantage for these oils**

Pathway to Higher Biodiesel Blends

- **Do the initial technical work on blends from B21-B100**
 - Not quite starting from scratch.....but close
- **Marry up the driving forces, economics, and customer desires with technical challenges/questions on B21-B100**
 - What blend level, and why?
- **Industry Leadership: How big in 2050?**
 - B100 in heating oil: 5 billion gallons
 - B20 in on/off road engines: 8 billion
 - B100 for electrical generation: 2 billion
- **Put in place steps to develop feedstock for target volumes in 2050**

Parting Thoughts.....

- **Some customers want higher blends**
 - Low carbon, zero petroleum, made in the USA
- **Some policy makers want higher blends**
 - Jobs, global climate change, resiliency, sustainability
- **Being able to do higher blends—if and when the market dynamics play out—is a great hedge for the future regardless of how much is actually used**
- **Being an 80% carbon reducer keeps biodiesel ‘in the game’**

Thank You!
Questions...?

