National Defense Center for Energy and Environment

Demonstration of Biodiesel in Non-deployed Ground Tactical Vehicles/Equipment

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Stakeholder Team

- Joint Group on Pollution Prevention (JG-PP)
- Environmental Security Technology Certification Program (ESTCP)
- Naval Facilities Engineering Service Center (NAVFAC ESC)
- United States (U.S.) Army Tank Automotive Research, Development and Engineering Center (TARDEC)
- Air Force Petroleum Agency (AFPET)
- Naval Air Systems Command (NAVAIR)
- Navy Environmental Sustainability Development to Integration (NESDI) Program

Background and Objective

- The U.S. Navy tasked JG-PP to investigate expanding B20 use to non-deployed tactical vehicles
- The Tri-Service Petroleum, Oil, Lubricant (POL) Users Group expressed concerns with the use of B20 in tactical vehicles in their March 2006 Position Statement
  - Stability of the biodiesel
  - Accelerated deterioration in high temperature environments
  - Vehicle operation and fuel properties in low temperatures
  - Water affinity and microbial degradation
  - Material compatibility
- This effort will demonstrate tri-service operational parameters in non-deployed ground tactical vehicles
  - Determine if existing Department of Defense (DoD) fuel management infrastructure and handling procedures can satisfy user requirements
  - Recommend a minimum set of fuel quality tests for use by tactical fleet end users
  - Provide guidance for installation commanders to facilitate decisions on B20 use

Recognition of DoD Biofuel Initiatives

President Obama recognized military leadership in biofuels during March 31, 2010 speech at Andrews AFB, referencing Light Armored Vehicle (LAV) participation in this demonstration project.

Approach

- Identified four DoD sites to span climatic conditions
  - Naval Base Ventura County (NBVC) – Oxnard, CA
  - Marine Corps Air Ground Combat Center (MCAGCC) 29 Palms – Twentynine Palms, CA
  - Naval Surface Warfare Center (NSWC) Crane – Crane, IN
  - Moody Air Force Base (AFB) – Valdosta, GA
  - TBD HI Site(s) utilizing sustainable (used cooking oil) feedstock B20
- Data gathered from some or all of these sites will be compared to POL Users Group Concerns
  - Stability of the biodiesel – All sites
  - Accelerated deterioration in high temperature environments – Moody AFB (hot/humid) and MCAGCC 29 Palms (hot/dry)
  - Vehicle operation and fuel properties in low temperatures – NSWC Crane
  - Water affinity and microbial degradation – All sites
  - Material compatibility – All sites

Approach (continued)

- Fuel samples from multiple points to evaluate fuel life cycle
  - Tanker truck sample at delivery (only point at which spec is valid)
  - Nozzle sample at distribution point
  - Vehicle fuel tank sample

Fuel lab personnel at Moody AFB collect samples and perform initial acceptance testing

Nozzle and Vehicle Fuel Sample Analysis

Test Name	Test Method	Test Name	Test Method
Acid Number	ASTM D664	Color	ASTM D1500
Viscosity at 40 C	ASTM D445	Particulate Contamination	ASTM D6217
Water and Sediment	ASTM D2709	Oxidation Stability - Rancimat	EN14112
Total Water Content	ASTM E1064	Oxidation Stability	Modified ASTM D2274

Approach (continued)

- Delivery samples evaluated for adherence to ASTM D7467-08 defined properties, requiring testing in addition to nozzle and vehicle fuel sample analysis

Delivery Fuel Sample Analysis			
Test Name	**Test Method**	**Test Name**	**Test Method**
Flash Point	ASTM D93	Ash content	ASTM D482
Cloud Point	ASTM D2500	Copper strip corrosion	ASTM D130
Sulfur Content	ASTM D5453	Density	ASTM D4052
Distillation Temperature	ASTM D86	API Gravity	ASTM D1298
Carbon Residue, 10% bottoms	ASTM D524	Biodiesel Content	ASTM D7371 modified
Cetane Index	ASTM D976	Demulsification	ASTM D1401
Aromaticity	ASTM D1319	Trace Metals	ASTM D5185/D4951

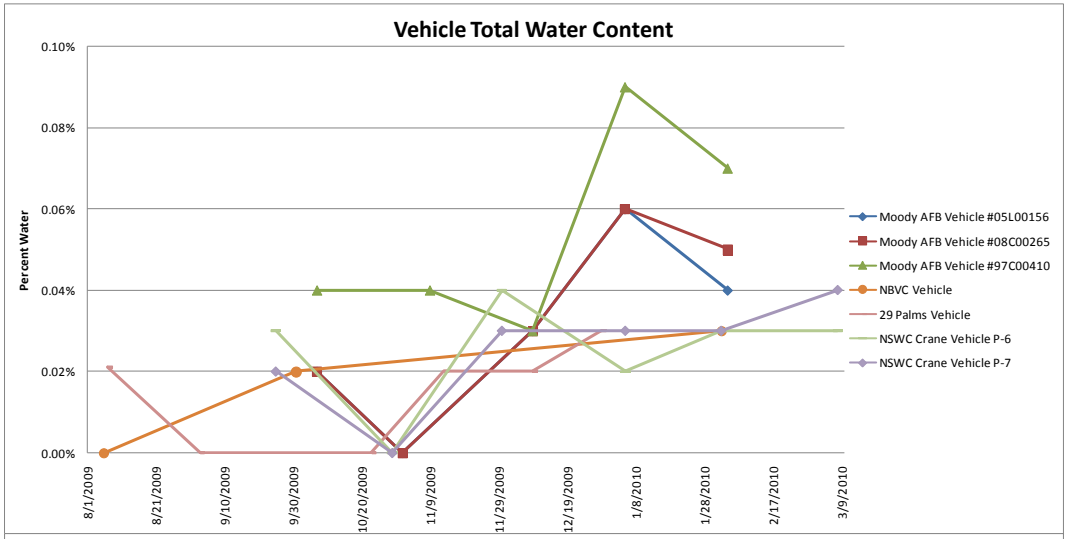
Interim Status

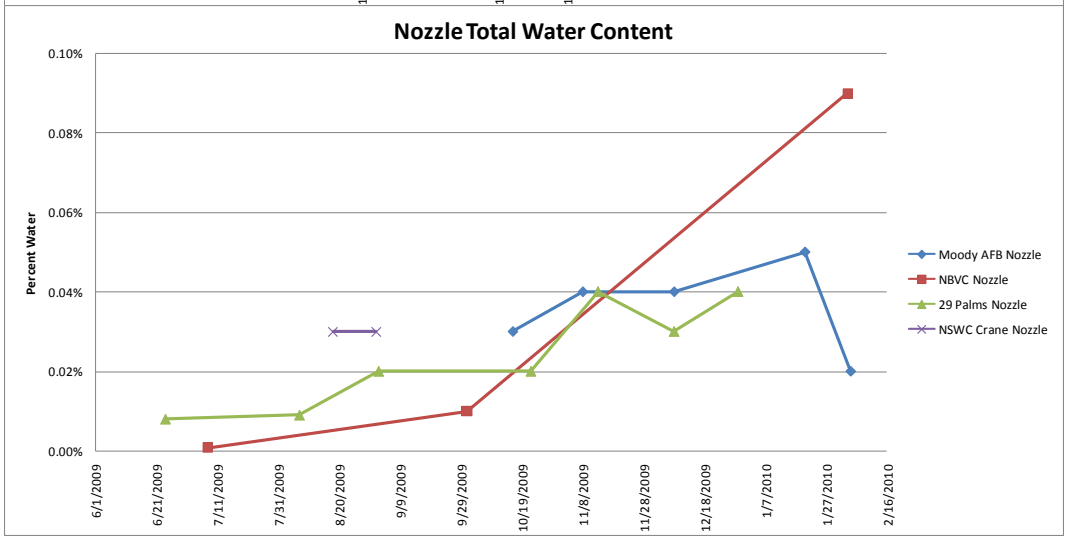
- Gradual increase noted in water content and particulate contamination versus time
- All delivery samples meet specifications
- Database developed to manage information as it is received
- Joint Oil Analysis Program (JOAP) testing is conducted to evaluate material compatibility – data analysis pending

The use of similar test and control vehicles allows valid comparison of B20 performance against baseline fuel

Analysis of Fuel Samples

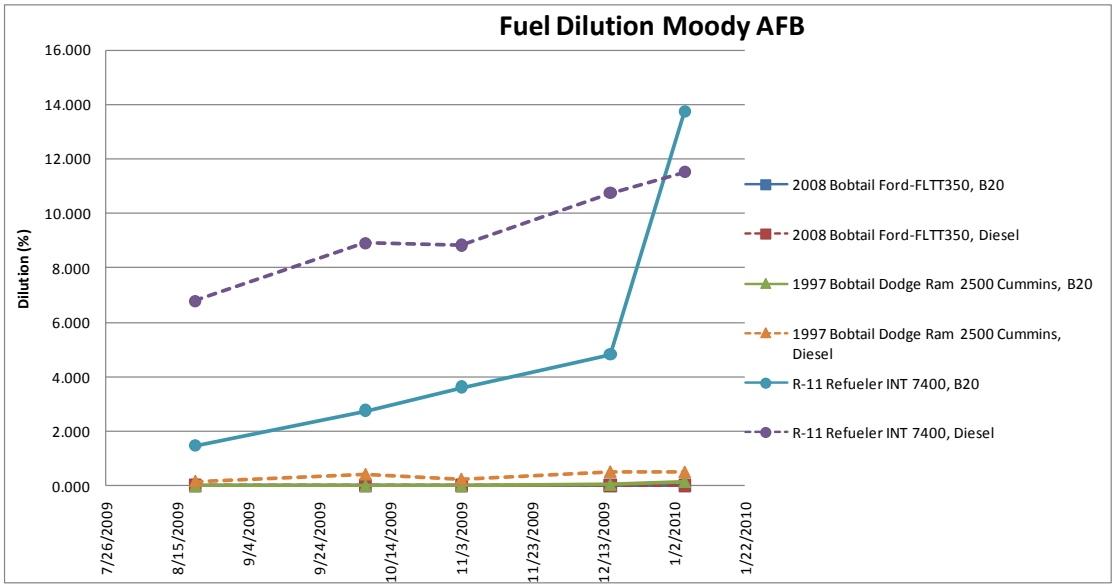
- Composite graphs show trends across test sites as well as outliers in the data
- Multiple test points (supply, nozzle, vehicle) allows causal determinations
- Fuel analysis conducted by NDCEE





JOAP Testing of Oil Samples

- Oil analysis provides insight into engine wear, including both metals and gasket materials
- Test and control vehicles allow impact of B20 use to be assessed
- JOAP oil analysis conducted by TARDEC



Path Forward

- Implement program and initiate sampling at fifth site
- Incorporate maintenance and weather data to identify causal relationships
- Identify B20 impacts on oil analysis
- Perform trend analysis to identify control points and key parameters of B20 programs
  - Temperature and humidity
  - Limited use vehicles
  - Extended B20 storage
  - Maintenance cost impacts

Path Forward (continued)

- Investigate B20 sustainability on Oahu
  - Investigate potential volumes of used cooking oil at DoD sites on Oahu
  - Determine volume of biodiesel and B20 that can be manufactured from
  - Compare to local DoD fuel needs
- Document current and future availability of local biodiesel
  - Oahu production capabilities
  - Hawaii production capabilities
  - Impacts of imported biodiesel

National Defense Center for Energy and Environment

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