

Evacuation Information

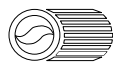
- Please look around now and identify two exits closest to you. In some cases, an exit may be behind you. In the event of a fire alarm, we are required to evacuate this room immediately. Please take your valuables with you and do not use the elevators. While staff will endeavor to assist you to the nearest exit, you should also know that you may find an exit door by following the ceiling mounted exit signs. Evacuees will exit down the stairways and possibly to a relocation site across the street. If you cannot use stairs, you will be directed to a protective vestibule inside a stairwell. Should we have to relocate out of the building, please obey all traffic signals and exercise caution crossing the street.

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Biodiesel and Renewable Diesel Research Study

September 24, 2008

California Environmental Protection Agency



Air Resources Board

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Agenda

- Introduction
- Summary of results
 - 2006 Cummins ISM engine draft report
 - Summary of results for 2007 DDC MBE4000
 - Vehicle one toxic emissions test results part I
- Biodiesel/renewable diesel multimedia evaluation
- Update on the remainder of the biodiesel/renewable diesel studies
- Open discussion

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Introductions

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Biodiesel and Renewable Diesel Research Study

- Oxides of Nitrogen (NO_x) formation and mitigation evaluation
- Biodiesel and renewable diesel emissions evaluation
- Non-road engine emissions evaluation
- Light duty vehicles
- Durability study
- Multi-Media evaluations

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On-Road Heavy-Duty Emissions Studies

Task 1: NO_x Formation and Mitigation Study

- Investigate the mechanism of NO_x formation and evaluate possible NO_x mitigation options

Task 2: Biodiesel and Renewable Diesel Emissions Evaluation Study

- Evaluate emissions and health effects
- Evaluate NO_x impact

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Task 1: NO_x Formation and Mitigation Studies

- Conducted at CE-CERT engine emissions test facility

Presentation by
Dr. Tom Durbin,
Principal Investigator

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Draft NO_x Emission Results

- Compared to CARB
- For engine tests UDDS, FTP, 50 mph highway cruise and for soy only 40 mph highway cruise
- Up to five blend levels compared B5, B10, B20, B50, and B100
- Two engines and one vehicle
- Soy and animal biodiesel feedstocks

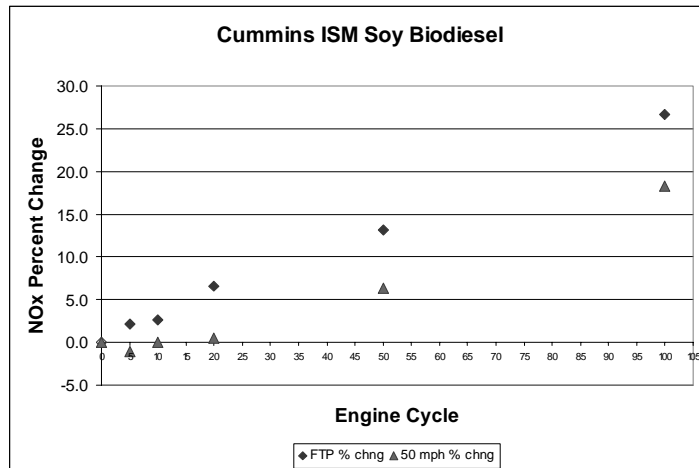
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Summary of Change in NOx from Biodiesel as Compared to CARB Diesel

	Engine Cummins ISM				Detroit MBE 4000			Chassis Cat C15	
	FTP	UDDS	40 mph	50 mph	FTP	UDDS	50mph	UDDS*	50mph
	% chng	% chng	% chng	% chng	% chng	% chng	% chng	% chng	% chng
B5-S	2.2	NA	1.7	-1.1	0.9	NA	NA		
B10-S	2.6	NA	NA	NA	2.9	NA	NA		
B20-S	6.6	4.1	3.9	0.5	6.0	2.5	6.3	-4.2	-1.9
B50-S	13.2	9.8	9.1	6.3	16.3	14.1	17.6	9.5	6.4
B100-S	26.6	17.4	20.9	18.3	40.5	37.7	46.1	20.2	17.5
B5-A	0.3	NA	NA	NA	1.3	NA	NA		
B20-A	1.5	-1.5	NA	-2.3	5.8	2.6	7.6	3.3	0.4
B50-A	6.4	0.1	NA	0.8	11.1	9.6	16.9	4.9	6.7
B100-A	14.1	1.9	NA	5.3	31.3	17.0	40.9	13.7	17.1

NA=not analyzed

Example Change in NOx



NOx Results

- Study is on going and needs to be completed before the NOx impacts, especially at low blend levels, can be fully evaluated
- What is still needed
 - Complete vehicle chassis tests
 - Test engine(s) in vehicle(s) on chassis dynamometer
 - Complete non-road testing
 - Statistical evaluation

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Task 2: Biodiesel and Renewable Diesel Emissions Evaluation Study

- Vehicle one is a truck equipped with a 2000 model year Caterpillar C15 engine
- UDDS test cycle
- In-depth exhaust emissions characterization
- Species reported to date
 - Regulated emissions (March 12, 2009)
 - Volatile organic carbon (VOCs)
 - Nitrous oxide
 - Formaldehyde and acetaldehyde
 - Total carbon, elemental carbon, and organic carbon
 - Elements
 - Ions
 - Particle associated PAHs

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Emissions Evaluation Cont.

- Results yet to be released for vehicle one
 - Gas phase PAHs
 - Nitro-PAHs
 - Additional carbonyl species
 - Ultrafines
 - Mutagenicity
 - Oxidative stress and inflammatory assays
 - DNA damage-comet assay
- Vehicle two
 - In-depth characterization on soy feedstock only
 - Carbonyls and VOCs on animal feedstock
- Vehicle three
 - Carbonyls and VOCs

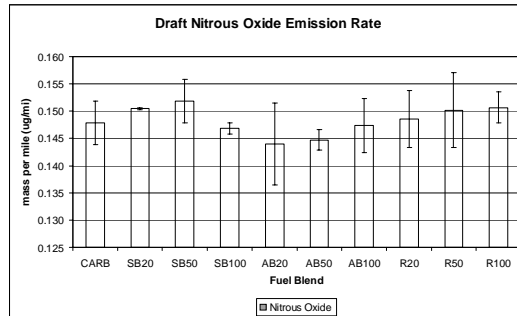
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Preliminary VOC Results

- 100% biodiesel tended to have the lowest emission rates for BTEX for both UDDS and 50 mph highway cruise cycles
- More scatter for the more reactive species, 1,3-butadiene and styrene, make comparisons more difficult

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Preliminary Nitrous Oxide Results



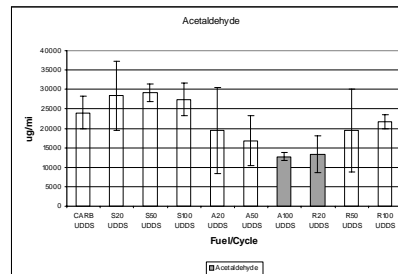
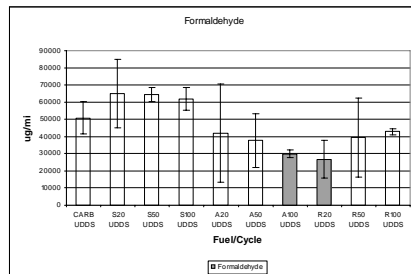
- Background corrected data
- The significance of the data is difficult to determine since the ambient levels were close to the emission levels and will require further evaluation

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Preliminary Formaldehyde and Acetaldehyde Results

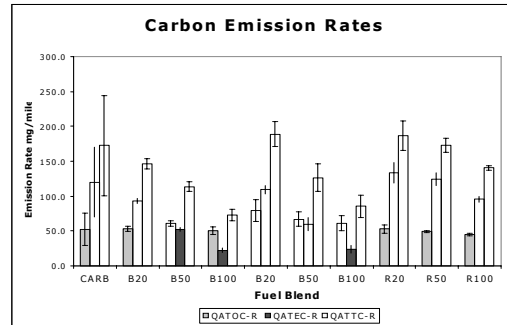
- 100% animal generally showed the lowest emission rates for formaldehyde and acetaldehyde over the UDDS and 50 mph highway cruise
- Some blends of renewable diesel had lower emission rates than CARB diesel

Emission rates for UDDS test cycle



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Preliminary Carbon Results



- Total carbon decreases with increasing blend level for biodiesel and renewable diesel
- Mainly due to a decrease in elemental carbon

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Preliminary Elements and Ion Results

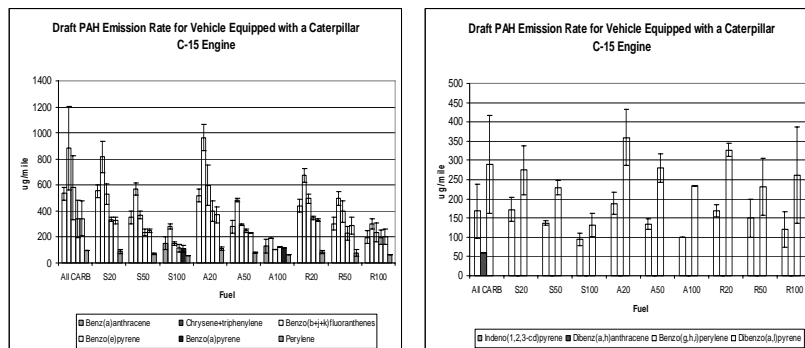
- Report the 10 elements with the highest emission rate in CARB
- Calcium ion and elemental Calcium emission rate is highest for the soy biodiesel
- Data being reviewed to evaluate for other trends

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Preliminary Particle Associated PAH Results

- Only data currently reported is for PAHs that are solely on the particles, other PAHs which are volatile or distribute between particles and gas phase will be reported when the total PAH data set is completed
- Most particle PAHs decreases with increasing blend level of biodiesel and renewable diesel

Preliminary Particle Associated PAH Results



Vehicle Tests Update

- Vehicle two-2007 MBE 4000
 - Chassis dynamometer repair is delaying the testing of vehicle two
 - Emissions from regeneration events will not be measured under this program
 - Force regeneration before sample collection
 - Proposing to characterize emissions during regeneration events under a separate study

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Discussion

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Non-Road Engine Tests

- TRU testing
 - Preliminary testing completed
 - Main test has begun
- Test preparations underway to install a John Deere PE 4045HF285 Diesel Engine on the engine dynamometer

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Discussion

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Light-Duty Diesel Vehicle Testing

- Part of a ARB Research Division study
- Planning stage

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Durability Study

- Completed, will be released in the Fall 2009

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Biodiesel Multimedia Assessment

- Principal Investigators
 - Dr. Tom McKone, University CA Berkeley
 - Dr. Tim Ginn University CA Davis
- Biodiesel and renewable diesel
 - Assesses impacts on water, soil, air, human health, and the environment
 - Compared to CARB diesel
 - Evaluation includes a range of feedstocks, blend levels, and additives

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Biodiesel Multimedia Assessment Protocol

- Draft Multimedia Guidance Document
 - Tier one: Establishes the risk assessment elements and issues (scope of work)
 - Tier two: Development of the experimental design
 - Tier three: Multimedia risk assessment submittal, review, and recommendation

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Biodiesel Multimedia Assessment Protocol

- Released
 - Comments to Biodiesel Tier one
 - Final Biodiesel Tier one
 - Comments to Biodiesel Tier two experimental plan
 - Final Biodiesel Tier two experimental plan
- Draft renewable diesel Tier one completed in October-November

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Biodiesel and Renewable Diesel Advisory Group

- Next meeting in January 2010

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