

Public Workshop on Regulatory and Non-Regulatory Fuels Activities for 2003

May 20, 2003

California Environmental Protection Agency



Air Resources Board

Public Workshop on Regulatory and Non-Regulatory Fuels Activities

- Introductions
- Amendments to the California Diesel Fuel Regs.
 - 15-ppmw Sulfur Limit
 - Procedures for Certifying Alternative Formulations
 - Flexibility Issues
 - Lubricity
 - Low Sulfur Diesel Costs
- Diesel Engine Lubricating Oils
- Fuel Properties for Diesel Engine Certification
- Presentations by Others
- Open Discussion
- Closing Remarks

Introductions

California Diesel Fuel Program

Background

California Diesel Fuel Program

- Adopted in 1988
- Implemented October 1993
- Provides flexibility by allowing certification of equivalent formulations
- On-road and off-road motor vehicles
- Emission benefits:

–NO_x 7 %

–PM 25 %

–SO_x >80 %

California Diesel Risk Reduction Plan

- Reduce diesel PM emissions and associated health risk by 85% by 2020
- Establish more stringent emission standards for new diesel engines
- Establish particulate trap retro-fit requirement
- Require 15-ppmw sulfur limit for California diesel fuel.

Low-Sulfur Diesel Fuel Programs

- U.S. EPA adopted 15-ppmw sulfur rule in 2001 for on-road diesel motor vehicles, to be implemented in 2006
- U.S. EPA considering low-sulfur regulation for off-road motor vehicles.
- South Coast adopted Rule 431.2 in 2000,
 - 15-ppmw sulfur limit for diesel fuel to be used in stationary engines, implementation is 2004
 - 15-ppmw sulfur limit for motor vehicle, implementation in 2005 unless the ARB adopts for 2006.

Draft Proposed Amendments
Under Development - California
Diesel Fuel

15-ppmw Sulfur Limit

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- Lower CARB diesel sulfur limit to 15 ppmw
- Applies to
 - On-road and off-road vehicle uses
 - Stationary sources that are subject to Air Toxics Control Measures (Air Toxic Control Measure)
- Necessary to:
 - implement diesel PM risk reduction plan
 - enable new diesel engine control technology

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- Implementation concurrent with EPA's 2006 implementation date
 - No phase-in
 - At this time, no provisions for small refiners

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- Replace ASTM D2622-94 (x-ray fluorescence) test method for determining sulfur content
 - Detection limit of 10 ppmw
 - Repeatability of +/-9 ppmw at 15 ppmw S
- With ASTM D5453-93 (UV fluorescence)
 - Detection limit of 1 ppmw
 - Repeatability of +/-2.8 ppmw at 15 ppmw S

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- No changes to aromatic hydrocarbon specifications

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Procedures for Certifying
Alternative Diesel Fuel
Formulations

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- Update certified diesel fuel formulation procedures
 - Sulfur specification of candidate fuels: <15 ppmw
 - Sulfur specification of reference fuels: 7 - 15 ppmw
 - Eliminate unused sulfate credit provision

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- Add provisions to ensure that commercial formulations and candidate fuels are equivalent
 - Candidate fuel subject to same required specifications and ranges as the reference fuel
 - Candidate fuel properties could differ from reference fuel properties by no more than half of the permitted fuel property ranges
 - Applicable to new certifications

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- Add provisions to ensure that commercial formulations and candidate fuels are equivalent (continued)
 - Exception: a candidate fuel outside of an allowable property range can still be the basis of a certified formulation if the applicant agrees that the certified formulation include additional specifications based on the candidate fuel properties

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- Applicability of additional candidate fuel requirements to previously certified diesel fuel formulations
 - the executive officer shall then identify any formulations for which the candidate fuel's aromatic hydrocarbon content was more than three times that of the reference fuel, and its cetane number was less than that of the reference fuel. The certification of any formulation that meets all of the criteria shall no longer be effective as of 90 days after the operative date of the amendments

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Flexibility Issues

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- Propose alternative equivalent set of flat limits, similar to flat limits used in the reformulated gasoline regulations.

<u>Property</u>	<u>Equivalent Limit¹</u>	<u>Test Method</u>
<u>Aromatic Content (% by wt.)</u>	<u>≤ 21.0</u>	<u>ASTM D5186-96²</u>
<u>PAH Content (% by wt.)</u>	<u>≤ 3.5</u>	<u>ASTM D5186-96</u>
<u>API Gravity</u>	<u>≥ 36.9</u>	<u>ASTM D287-82</u>
<u>Cetane Number</u>	<u>≥ 53</u>	<u>ASTM D613-84</u>
<u>Nitrogen Content (ppmw)</u>	<u>≤ 500</u>	<u>ASTM D4629-96</u>
<u>Sulfur (ppmw)</u>	<u>≤ 160</u>	<u>ASTM D2262-94</u>

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Lubricity

Draft Diesel Fuel Lubricity Concept

Lubricity Concerns Related to Low Sulfur Diesel Fuel

- Diesel fuel injection systems require adequate fuel lubricity to prevent excessive wear
- Hydrotreating process to lower sulfur can reduce level of trace components, which can reduce lubricity
- Sweden experienced fuel lubricity problems in 1991 with low sulfur diesel fuel

California Experience

- Refineries voluntarily implemented and maintain recommended lubricity level
 - 3,000 gms Scuffing Load BOCLE
- CARB monitored California diesel fuel in 1993 through 1996 and concluded lubricity levels of diesel fuel were consistently at or near the recommended level

Lubricity Concerns Related to Low Sulfur Diesel Fuel

- Current Concerns:
 - Equipment manufacturers believe lubricity standard necessary with 15 ppm diesel sulfur standard
- ASTM has attempted but not been successful to date in passing a lubricity standard

Industry Standards

- European standard EN590
 - HFRR 460 micron maximum wear scar diameter (WSD) @60 deg C
- World Wide Fuels Charter lubricity specification
 - HFRR 400 microns maximum WSD @ 60 deg C
- SAE J2265: Diesel Fuel Performance Requirement and Test Method for Assessing Fuel Lubricity
 - HFRR 450 microns maximum WSD @ 60 deg C
 - Allows additive/fuel combinations with a greater WSD that give acceptable performance as agreed between fuel supplier and purchaser

Equipment Manufacturer Recommendations

- EMA
 - Two non-equivalent standards
 - HFRR maximum WSD 450 micron
 - SLBOCLE minimum scuffing load of 3100 grams
- Alliance of Automobile Manufacturers
 - World Wide Fuels Charter HFRR maximum WSD 400 micron
- Fuel injection equipment manufacturers
 - European EN590 HFRR maximum WSD 460 micron

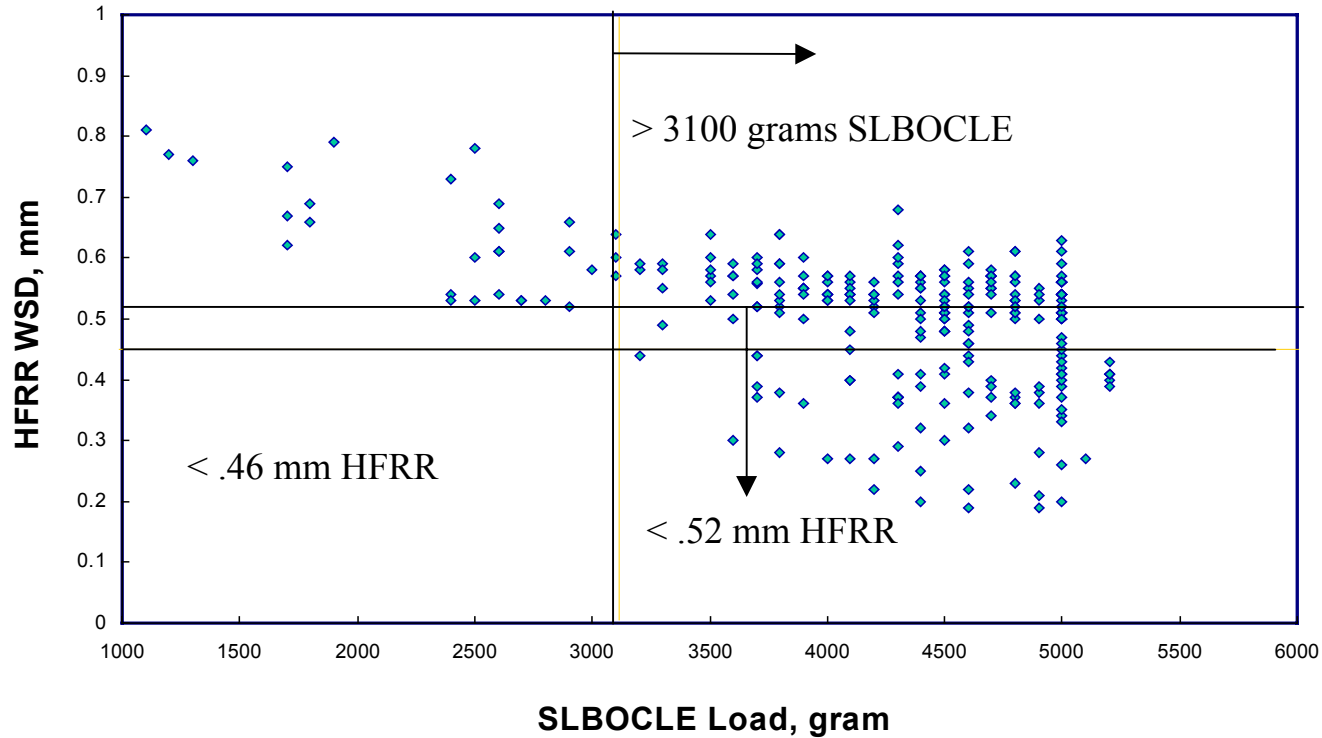
Advanced Technology High Pressure Fuel Systems In U.S. Market

- Provide improved combustion efficiency and reduce PM
- Require higher lubricity levels
- Several engine manufacturers report vehicles with new fuel system technology in U.S. market since 2001/2002
- Vehicles primarily medium duty trucks
- Vehicle must be protected against premature wear to maintain emissions benefits

Current ASTM Ballot

- Minimum lubricity limit being proposed as starting point
- Maximum 520 micron using HFRR for all grades of diesel
- CRC Diesel Fuel Lubricity Panel formed
 - Research program to determine level of lubricity required by advanced technology high pressure fuel injection systems
 - Work to be completed in 2004
 - Specify more stringent lubricity requirement for ULSD (15 ppm sulfur) if necessary

520 Micron HFRR at Least as Protective as 3100 gm SLBOCLE



ARB Draft Diesel Fuel Lubricity Concept: Two Tier Approach

- Protect existing equipment
 - 520 micron maximum WSD based on HFRR @60 deg C
 - Time frame: 90 day phase-in commencing August 1, 2004
- Protect new low emissions high pressure fuel injection systems technology
 - 460 micron maximum WSD based on HFRR @60 deg C
 - Technology assessment review
 - Re-evaluate 2006 standard
 - Consider CRC Lubricity Panel research results
 - If necessary, propose new lubricity level to Board for 2006
 - Time frame:
 - Review complete 2005
 - 2006 standard: 90 day phase-in commencing June 1, 2006

Sunset

- Consider sunsetting lubricity regulation if
 - ASTM establishes a standard that is protective of advanced technology fuel injection systems
 - Division of Measurement Standards adopts

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Low Sulfur Diesel Costs

Existing Requirements for Low Sulfur Diesel in California

- Cap of 15 ppmw
- U.S. EPA nationwide regulations apply to all on-road diesel fuel sold in California
- Requirements in South Coast apply to all diesel fuel sold in SCAB

Methodology

- Two surveys sent to refiners
 - 2001 and 2003
 - 8 of 12 large refiners reported minimal capital costs
- Estimated costs over:
 - California diesel production, and
 - Total low sulfur diesel production (California and U.S. EPA)

Costs Considered

- Refinery capital
- Increased Operating and Maintenance
- Lubricity
- Distribution (transmix) system impacts
- Fuel economy penalty
- First year market uncertainty

Refinery Capital and O&M Costs - California Production Only

- Anticipated 2007 production of 230 Mbpd
- Anticipated capital costs:
 - \$170-\$250 million
- Anticipated O&M costs:
 - \$50-\$60 million
- Anticipated refinery production cost increases:
 - 0 to 11 cents per refinery

Refinery Capital and O&M Costs - CA & U.S. EPA Production

- Anticipated 2007 production of 370 Mbpd
- Anticipated capital costs:
 - \$215-\$300 million
- Anticipated O&M costs:
 - \$60-\$70 million
- Anticipated refinery production cost increases:
 - 0 to 6 cents per refinery

Anticipated Costs of Low-Sulfur Diesel Fuel

Expenditure	1 st Year (¢/gallon)	Subsequent Years (¢/gallon)
Capital Investment (including O&M)	2.2 – 2.7	2.2 – 2.7
Distribution System	0.0 – 0.2	0.0 – 0.2
Lubricity Additives	0.2 – 0.6	0.2 – 0.6
Fuel Economy Penalty	0.0 – 0.5	0.0 – 0.5
Price Sensitivity	0.0 – 1.0	--
Overall Costs	2 – 5	2 – 4

- Likely cost estimated to be 2 to 3 cents
- Consistent with SCAQMD estimate of 1 to 3 cents
- Lower than U.S. EPA estimate of 4 -5 cents

Diesel Engine Lubricating Oils

Following Industry Efforts

- Awaiting test results:
 - Advanced Petroleum-Based Fuels - Diesel Emissions Control (APBF-DEC) Lubricants Work Group
 - Southwest Research Institute private consortium:
 - Diesel Aftertreatment Sensitivity to Lubricants (DASL) / Non-Thermal Catalyst Deactivation (N-TCD)
- ASTM Heavy Duty Engine Oil Classification Panel
 - Proposed Category 10 (PC-10)
- Industry efforts may preclude necessity for regulatory action

Draft Proposed Amendments for Fuel Properties for Diesel Engine Certification Testing

Proposed Amendments Under Development for California Certification Diesel Fuel

- Sulfur content of California certification fuel to be consistent with Title 40, Code of Federal Regulations, §86.1313-2007.
- (b)(2)...petroleum fuel for diesel engines...
- Total Sulfur, ppmw 7 - 15

Presentations by Others

Open Discussion

Closing Remarks