OFFICE OF RESEARCH & DEVELOPMENT

2012 R&D REVIEW

Alternative Fuel for Railroad Equipment Research

U.S. Department of Transportation
Federal Railroad Administration

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Overview

- Acknowledgement and Stakeholders
- Goal
- Drivers
- Program Activities
  - Amtrak Trial
  - SAE TC7 Subcommittee Biodiesel in Railroad Application
- Conclusion
- Discussion

Acknowledgement and Stakeholders

- Amtrak
- Chevron-Oronite
- GE Transportation Services
- North Carolina State University
- Oklahoma DOT
- SAE TC7 Subcommittee Biodiesel in Railroad Applications

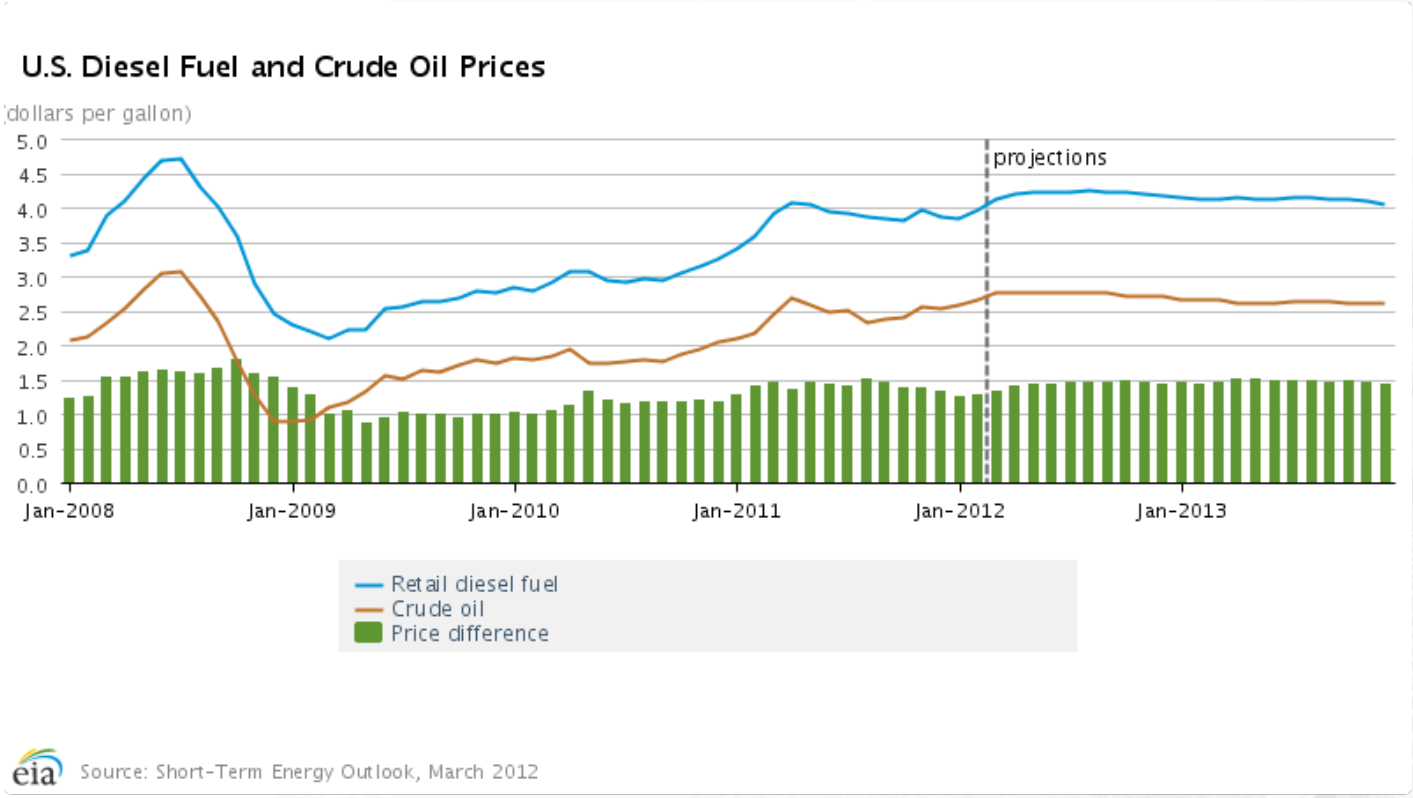
Goal

Identify an optimum blend of biodiesel fuel for railroad equipment through research and demonstration activities focusing on

- Emissions testing
- Engine durability testing

Drivers

Demonstrate a domestic renewable alternative fuel for locomotive engines



Drivers – U.S. DOT Strategic Goal

"Advance environmentally sustainable policies and investments that reduce carbon and other harmful emissions from transportation sources."

Program Activities

Amtrak B20 Demonstration – Revenue Service

- Revenue Service Trial - Heartland Flyer Passenger Service
- Exhaust Emission Testing
- Engine Tear Down

Amtrak B20 Demonstration – Revenue Service

Revenue Service Trial

- Amtrak maintained its on-time performance during the test period
- 331 roundtrips – 136,372 miles on B20 biodiesel fuel
  - Overall more than 150,000 equipment miles were logged
- More than 180,000 gallons of B20 biodiesel fuel used

Amtrak B20 Demonstration – Emissions Testing

Emissions Tests were performed by GE Transportation Services, following revenue service test

Federal test protocol as defined in 40 CFR Part 92

- CO, HC, NOX, PM, Opacity and fuel consumption
- B20 biodiesel fuel and conventional diesel fuel
- Locomotive was evaluated against EPA Tier 0 limits

Amtrak B20 Demonstration– Emissions Testing

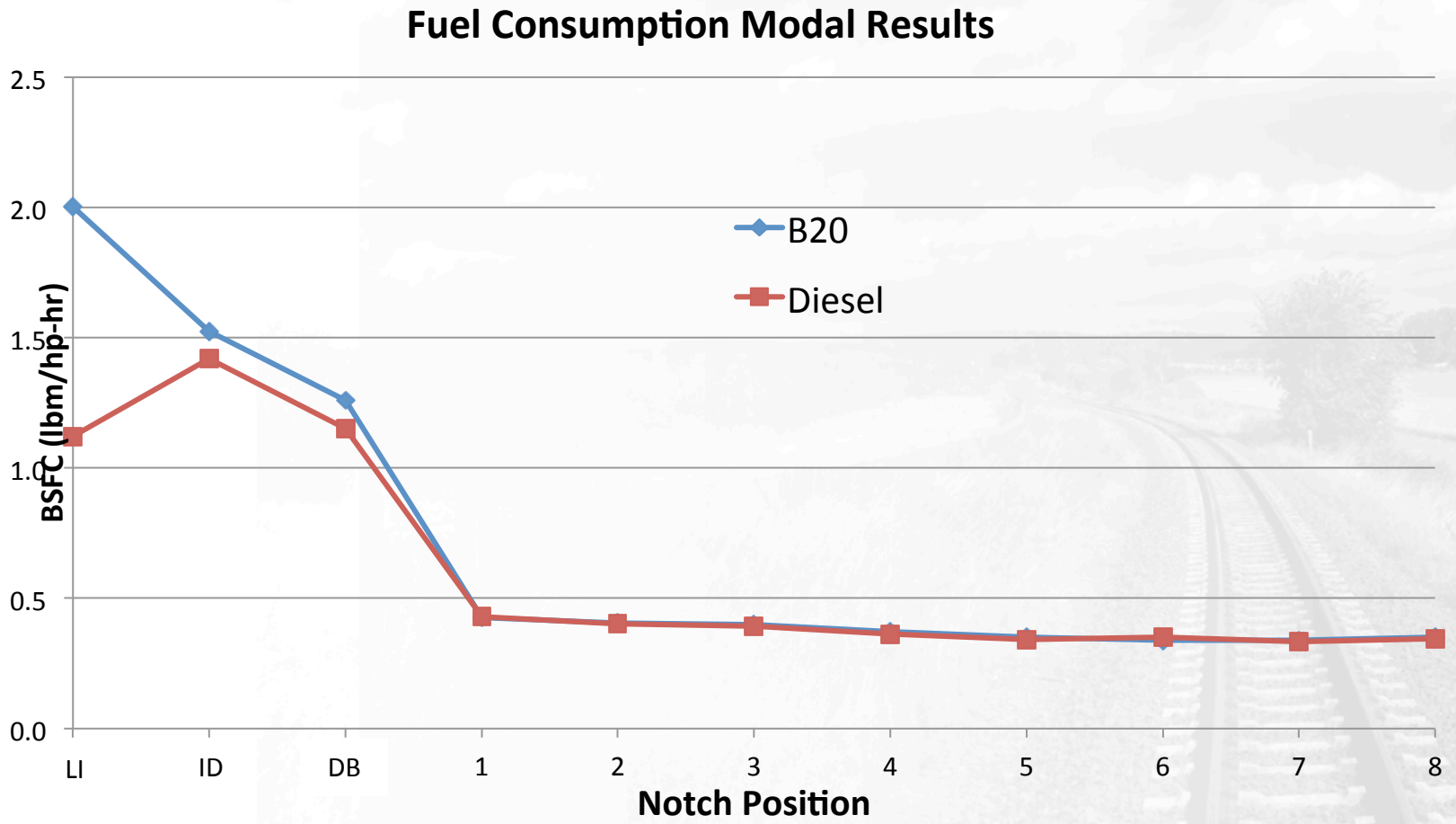
Line-Haul Duty-Cycle Results				
	BSHC	BSCO	BSNOx	BSPM
	(gm/hp-hr)			
B20 Fuel	0.38	0.9	8.3	0.13
Diesel Fuel	0.39	0.8	7.9	0.14
Tier 0 Limits	1.00	5.0	9.5	0.60

Switch Duty-Cycle Results				
	BSHC	BSCO	BSNOx	BSPM
	(gm/hp-hr)			
B20 Fuel	0.68	1.2	10.7	0.26
Diesel Fuel	0.68	1.2	10.0	0.24
Tier 0 Limits	2.10	8.0	14.0	0.72

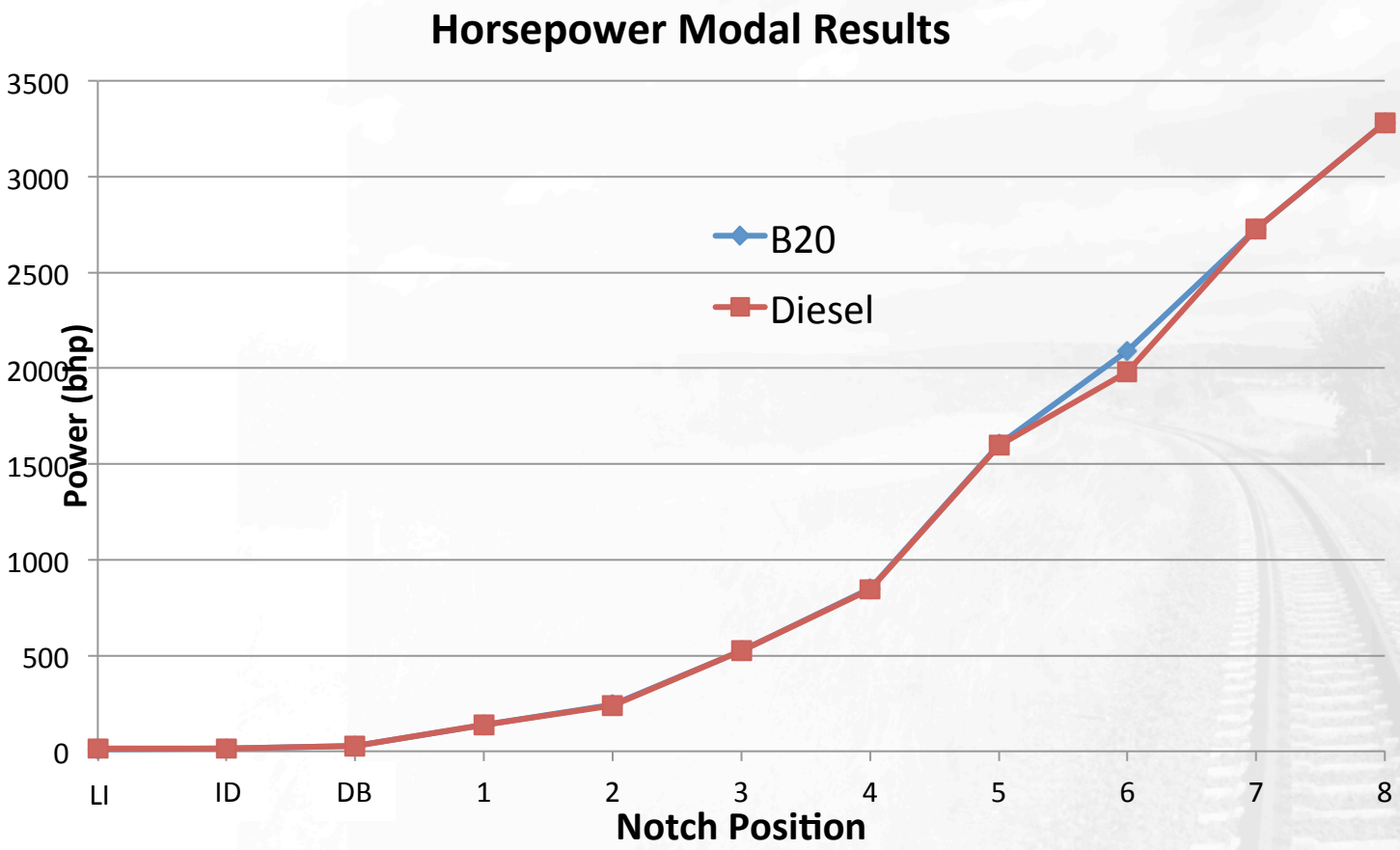
Amtrak B20 Demonstration – Emissions Testing

Smoke Opacity Results			
	Steady State	30 Sec	3 Sec
	% Opacity		
B20 Fuel	12	16	35
Diesel Fuel	11	15	34
Tier 0 Limits	30	40	50

Amtrak B20 Demonstration – Emissions Testing



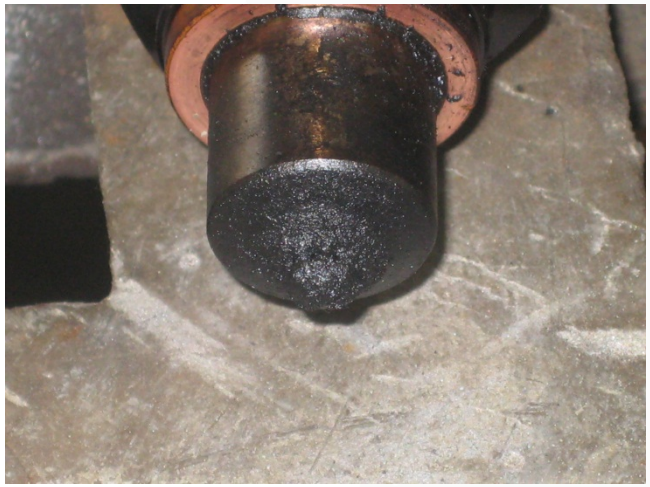
Amtrak B20 Demonstration - Emissions Testing

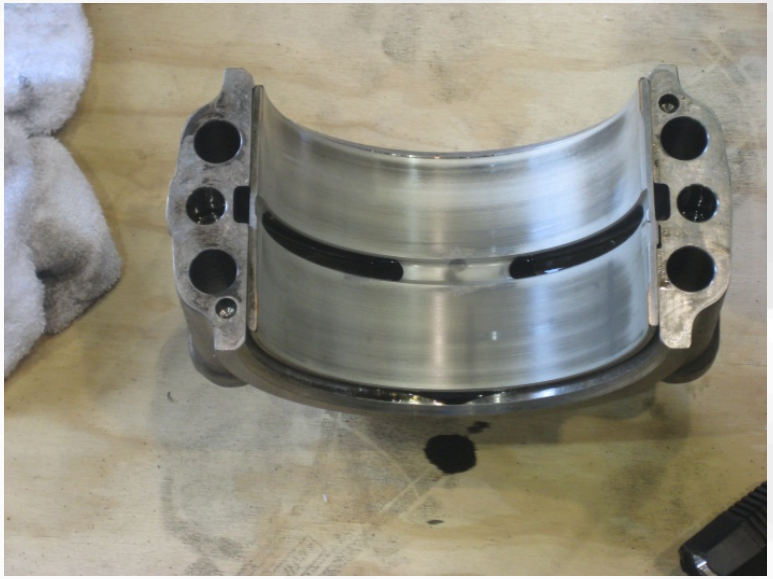


Amtrak B20 Demonstration – Tear Down Inspection

Chevron Oronite- Performed tear down inspection of two new power assemblies

The condition of the parts was deemed comparable to normal passenger or freight locomotive operation





Amtrak B20 Demonstration – Tear Down Inspection

- The engine parts inspected showed normal piston deposits.
- The liner wear was minimal, with most of the original crosshatch still evident.
- Piston rings also showed low wear and were in serviceable condition.
- The engine bearings showed normal wear (overlay not worn through) and even loading with no evidence of corrosion.

SAE TC7 Subcommittee Biodiesel in Railroad Application

Charter

- Identify issues of concern to the railroads, engine and equipment manufacturers, and fuel suppliers upon introduction of biodiesel blends in the diesel pool in North America.
- Formulate and propose a practical path forward.

SAE TC7 Subcommittee Biodiesel in Railroad Application

Emissions Testing of Various Blends of Biodiesel Fuel

- Southwest Research Institute
- B5 and B20
- ULSD, CARB Diesel and B100 base fuels
- Federal test protocol as defined in 40 CFR Part 92

SAE TC7 Subcommittee Biodiesel in Railroad Application

Engine Durability Assessment

Test plan in development stage

- Full scale Locomotive Maintenance Officers Association (LMOA) field test protocol or
  - Four test units and two reference unit of each manufacturer (~24 locomotives)
  - Tier 0, 1, 2
- Smaller incremental field tests

Conclusion

- Biodiesel is a viable alternative fuel for railroad applications

- Further research is needed to identify the limitations of the fuel use in higher blends, i.e. B20