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Lube1 Fuel System Cleaner

Comparative Clean-up Performance Test Results



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What is the purpose of this training?



To present a technical overview of **Lube1 Fuel System Cleaner**, which includes features, benefits, key differentiators, and performance test results versus competitors in direct injection and port injection engines.

What is Lube1 Fuel System Cleaner?



A fully synthetic, concentrated additive that provides clean-up, keep-clean, and stabilization performance.



- The only “3-in-1” fuel additive available on the market today
- Total control of deposits for entire fuel system, intake system, and upper cylinders
- State-of-the-art, proprietary synthetic technology developed for complete fuel system and combustion chamber deposit cleanup
- Contains proprietary protonated polyether amine (PEA) detergent
- One of only a few PEA type products to pass oil sludging tests
- The only product formulated to meet the very specific needs of direct injection (DI) engines

In what engine types can it be used?



Lube1 Fuel System Cleaner provides extensive benefits to engines with DI, PI, and carbureted fuel delivery systems.



- DI = Direct Injection
- PI = Port Injection
- Gasoline, ethanol blends, diesel, any/all biofuels
- Normally aspirated, turbocharged, or supercharged engines
- One product that serves the entire spectrum of applications
- Utilizes an entirely unique detergent and carrier technology that specifically suits today's newer DI engines, while still providing the same benefits to PI and carbureted engines

What are the key features?



- One tank provides total clean-up performance
- Using every 3,000 miles provides keep-clean performance
- Cleans injectors, carbs, intake valve deposits (IVD), combustion chamber deposits (CCD), piston crown deposits
- Provides optimal flow characteristics of fuel through injectors
- Approvals: US EPA, CARB, TOP TIER™
- Does not cause octane requirement increase (ORI)
- Cleans better than mineral-based and other PEA-based additives
- Stabilizes fuel during off-season and storage
- Counteracts ethanol's harmful side-effects
- Can be used in E0, E5, E10, E15, and E85
- Prevents oxidation/emulsion of fuel in the tank
- Prevents fuel system corrosion
- Prevents premature fouling of spark plugs
- Does not cause/promote sludging of motor oil
- Proprietary PEA detergent that is exclusive to Royal Purple

What are the key benefits?



- Increases horsepower and performance
- Reduces emissions
- Improves fuel economy
- Provides octane requirement reduction
- Allows less expensive, lower octane fuel to be used
- Saves money at the fuel pump
- Prevents rough idle, hesitation and stalling
- Enhanced throttle response, decreased hesitation
- Quicker/easier starts reduces battery wear
- Helps with cold startup problems
- Helps prevent premature spark plug fouling
- Reduces deposit-related engine knocking and pinging
- Protects against fuel system sulfur deposits
- Protects gas gauge sensors from malfunctioning
- Prevents DIG Injector coking
- Prevents DIG misfire codes
- Easier starts after seasonal storage of vehicles
- No corrosion particles to clog fuel filters and lines

What are the marketable claims?

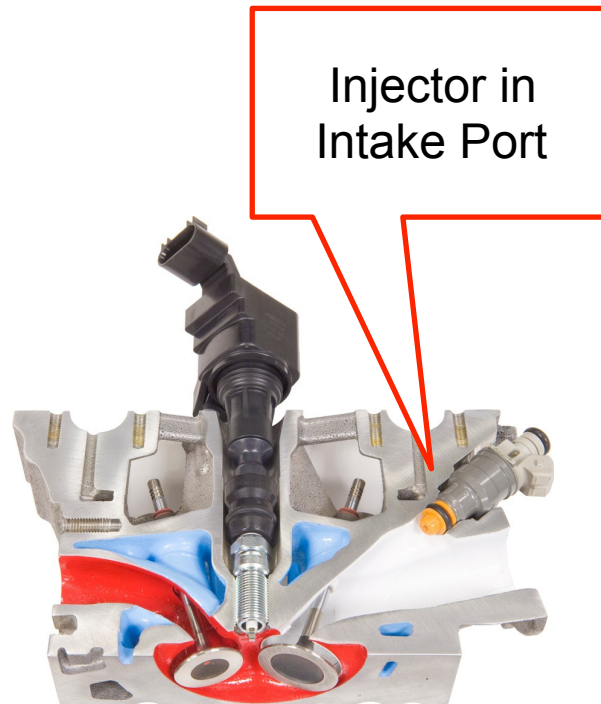


Extensive testing has yielded data that supports the following quantifiable performance claims:



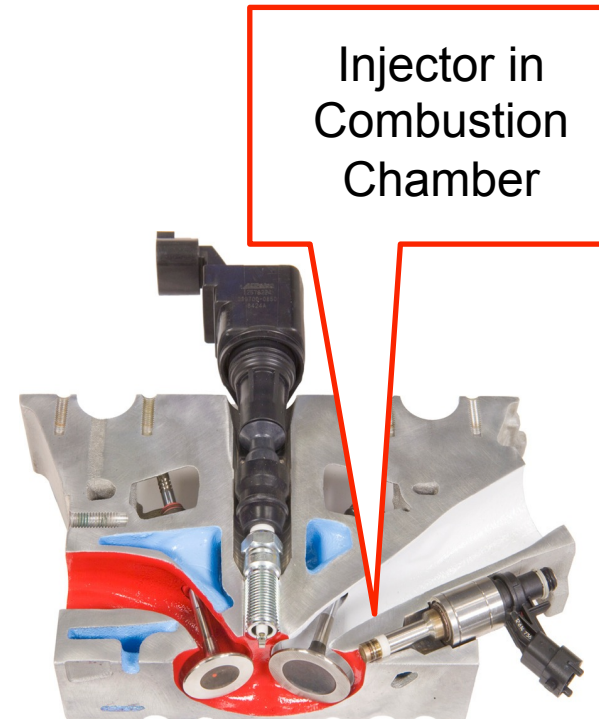
- Average 3.2% improved fuel economy, with up to 6%
- Average 12% reduction in hydrocarbon emissions, with up to 44%
- Average 18% reduction in CO emissions, with up to 30%
- Average 13% reduction in NOx emissions, with up to 18%
- Average 4% reduction in particulate emissions, with up to 10%
- Average 2.6% increase in horsepower, with up to 5%
- Average Octane Requirement Reduction of 1.2 numbers, with up to 5 numbers

How are PI and DI different?



Port Fuel Injection

Fuel stream washes over intake valves



Direct Fuel Injection

Fuel stream does not wash over intake valves

How does this create an opportunity?



Lube1 Fuel System Cleaner is the right technology, at the right time, to address DI issues.



- 1) DI is clearly the future of OEM engine development
 - Increased fuel prices are driving DIG demand
 - Already many DI engines on the road today
 - Continued growth in DI engines will occur
- 2) **Lube1 Fuel System Cleaner** has been developed specifically for DI
 - Tested extensively in DI engines
 - Proven to resolve DI issues
 - Outperforms competitor products in DI
- 3) This represents a significant opportunity for **Lube1 Fuel System Cleaner**
 - There is evidence of DI deposit issues in the field
 - These issues are likely to grow as DI is used more
 - Consumers are increasingly aware of these issues
 - **Lube1 Fuel System Cleaner's** proprietary PEA cleans/prevents DI deposits

What makes Lube1 Fuel System Cleaner better for DI?



Lube1 Fuel System Cleaner is the first total fuel system cleaner to be developed specifically for DI engines.



- Due to the unique fuel stream characteristics of DI, deposit formation in DI engines occurs differently than in PI
- Our research indicates that DI requires a more concentrated, less viscous product, due to DI's thinner fuel streams
- **Lube1 Fuel System Cleaner's** unique PEA detergent is highly concentrated, and designed to provide maximum benefit to DI engines
- **Lube1 Fuel System Cleaner's** lower viscosity provides better flow and clean-up in DI's thinner, higher pressure injection streams
- **Lube1 Fuel System Cleaner's** higher flash point PEA allows it to reside in the combustion chamber longer, providing more effective clean-up during DI's shorter injection cycle

How do we know it really works?



We conducted a controlled field test that quantified Lube1 Fuel System Cleaner's performance in DI and PI engines.



- **Lube1 Fuel System Cleaner** and seven competitive products were added to the fuel tanks of a fleet of vehicles at recommended doses
- Each vehicle was operated for a clean-up test duration 806 km (500 miles) of on-road driving
- Intake valve deposits (IVD) and combustion chamber deposits (CCD) were quantified and recorded before/after the test
- The values were used to calculate percent deposit removal
- Vehicles having engines with two different fuel delivery types were tested: port fuel injection (PI) and direct fuel injection (DI)
- Differential performance was identified for DI and PI engines

What types of vehicles were used?



Mercedes Sprinter

Model years 2005-2006

Engine: 2.3L I4 DOHC 16V
143 horsepower
Port Injection



Audi A3 Hatchback

Model years 2005-2006

Engine: 2.0L I4 DOHC 16V
150 horsepower
Direct Injection

Which products were tested?



AMSOIL
Performance Improver



BG PRODUCTS
44K



CHEVRON TECHRON
Concentrate Plus



GUMOUT
Regane



LIQUIMOLY
MTX Vergaser-Reiniger



LUBE1
Fuel System Cleaner



REDLINE
SI-1

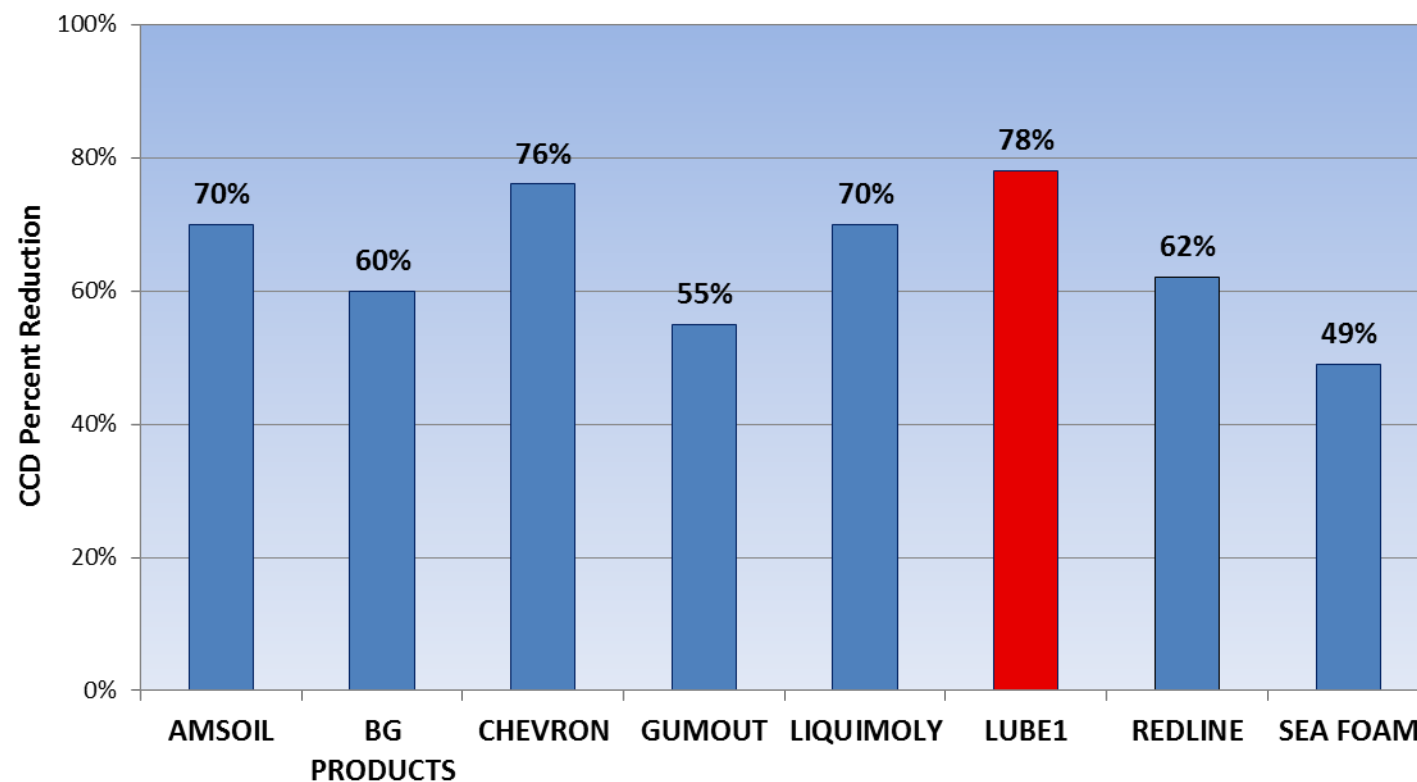


SEA FOAM
Motor Treatment

Port Injection CCD Test Results



Engine: Mercedes 2.3L Port Injection
Test: Combustion Chamber Deposit Reduction
Duration: 806 km (500 miles)

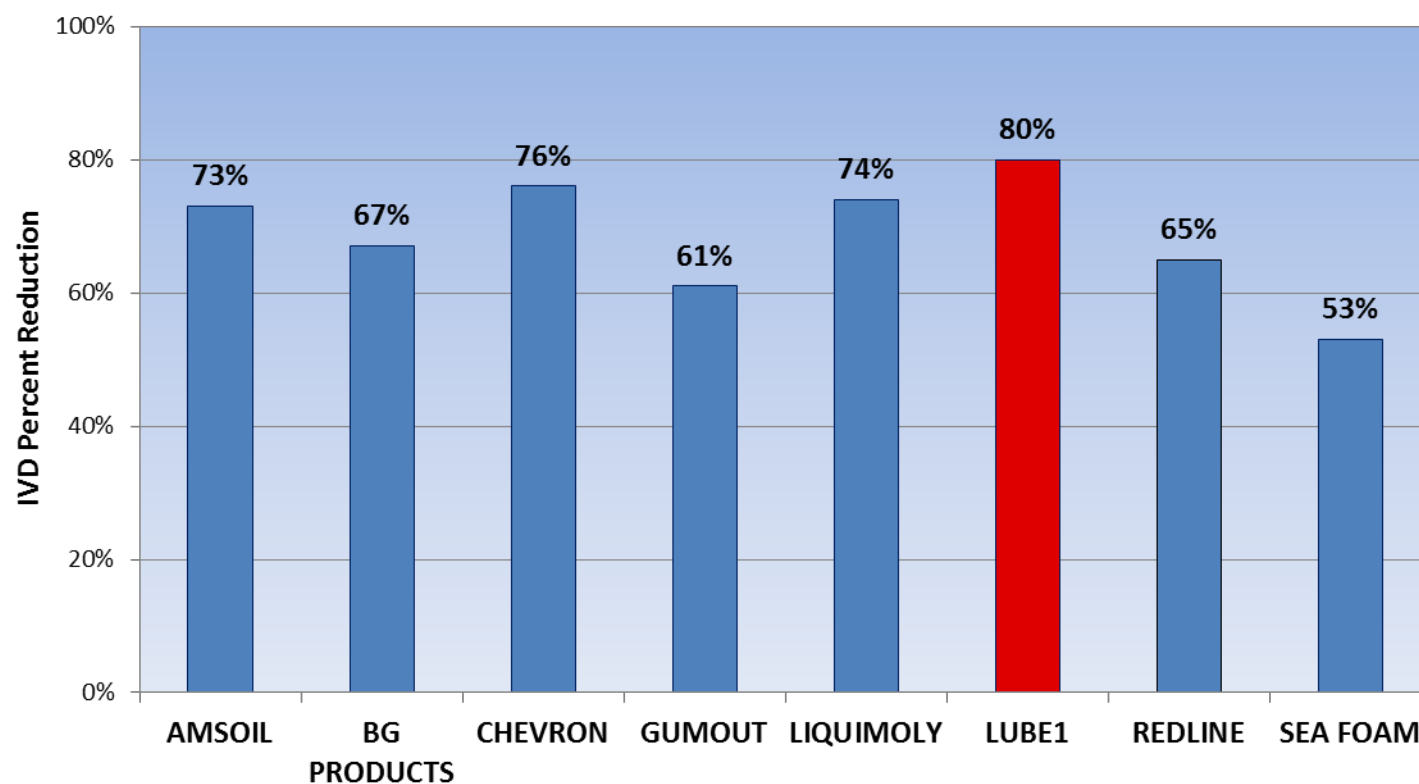


Average Reduction = 65%

Port Injection IVD Test Results



Engine: Mercedes 2.3L Port Injection
Test: Intake Valve Deposit Reduction
Duration: 806 km (500 miles)

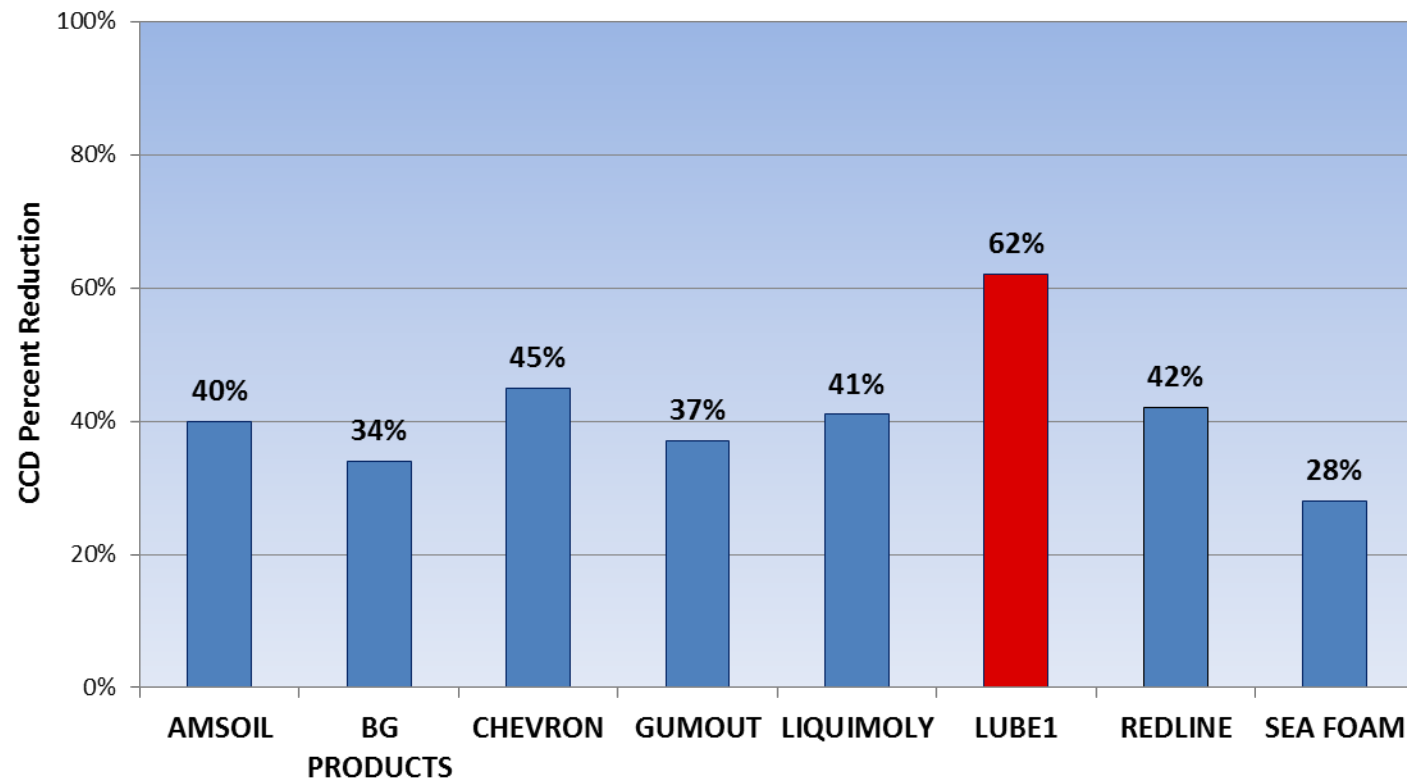


Average Reduction = 69%

Direct Injection CCD Test Results



Engine: Audi 2.0L Direct Injection
Test: Combustion Chamber Deposit Reduction
Duration: 806 km (500 miles)

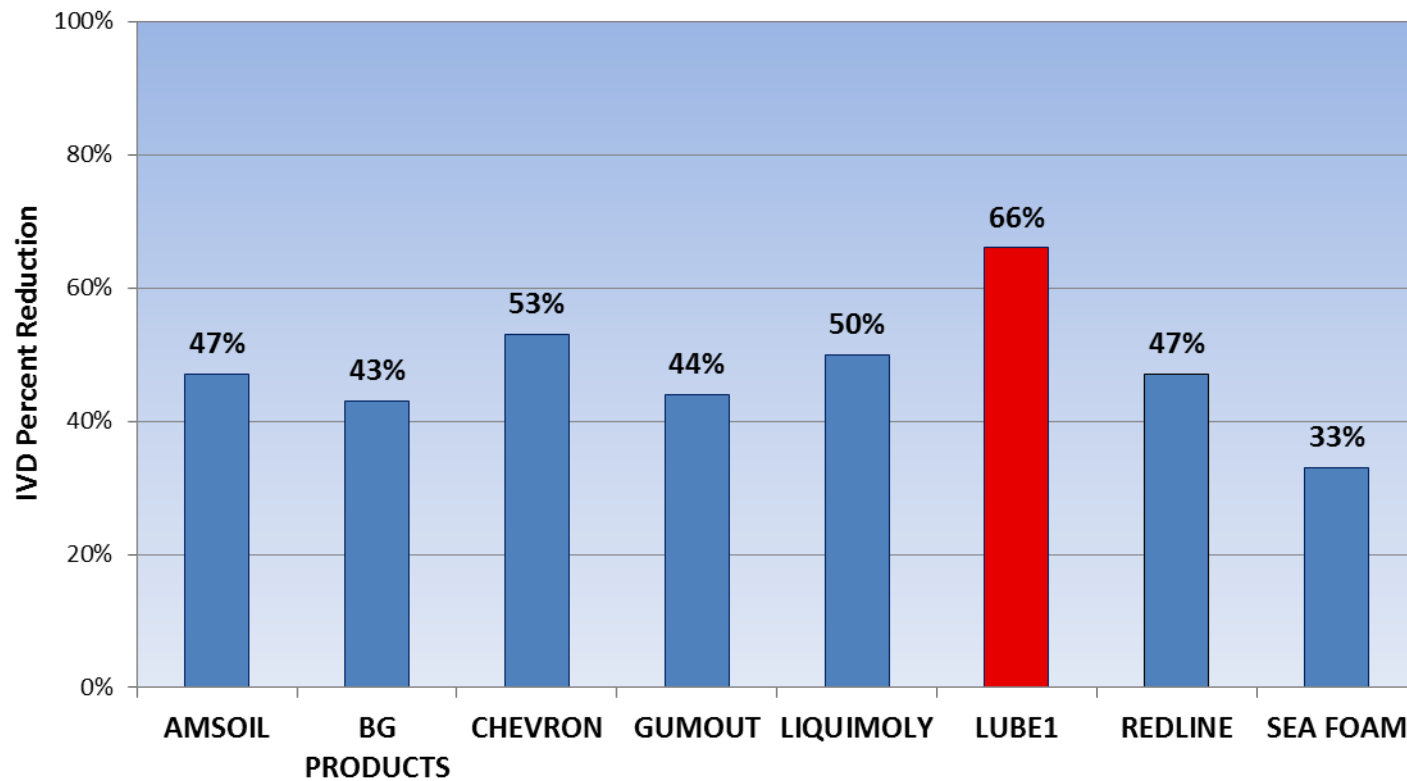


Average Reduction = 41%

Direct Injection IVD Test Results



Engine: Audi 2.0L Direct Injection
Test: Intake Valve Deposit Reduction
Duration: 806 km (500 miles)

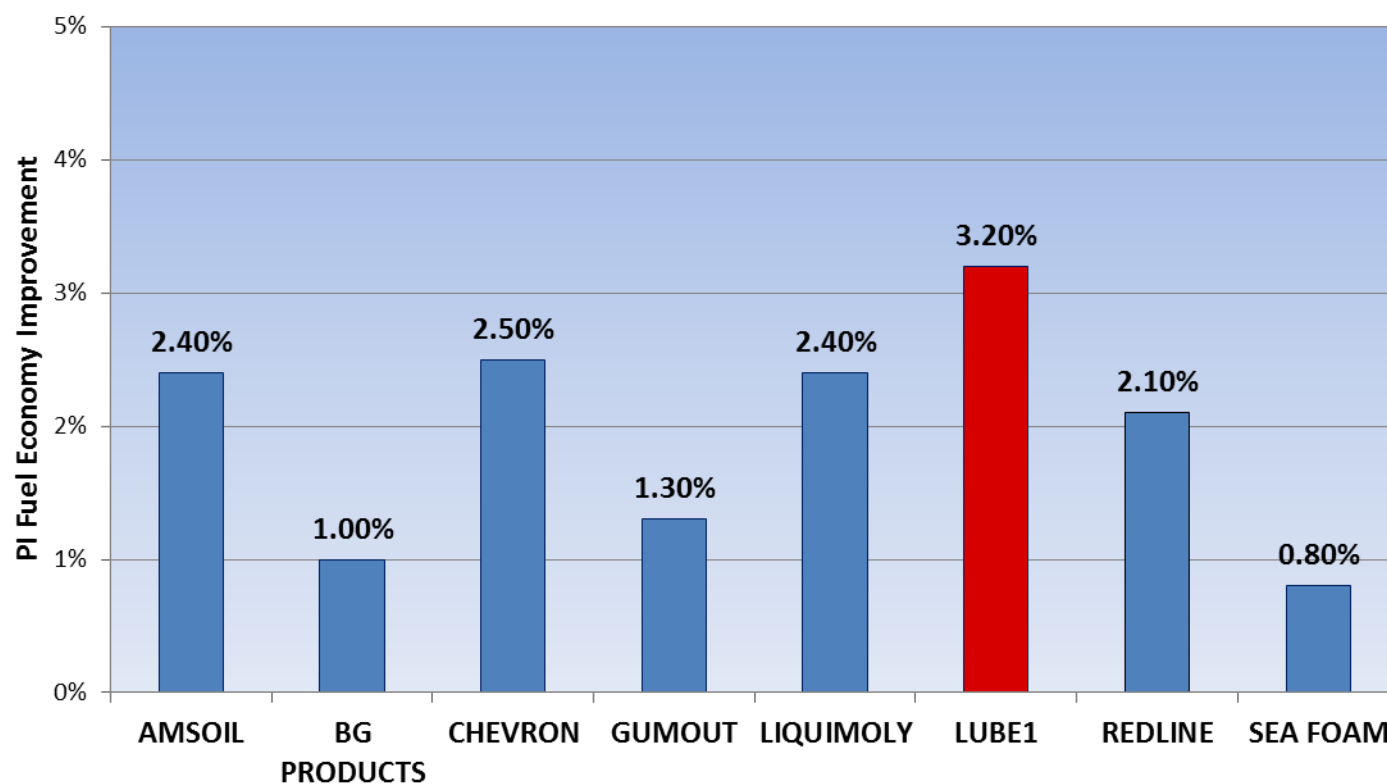


Average Reduction = 48%

Port Injection MPG Test Results



Engine: Mercedes 2.3L Port Injection
Test: Fuel Economy Increase
Duration: One tank (pre-clean and post-clean)

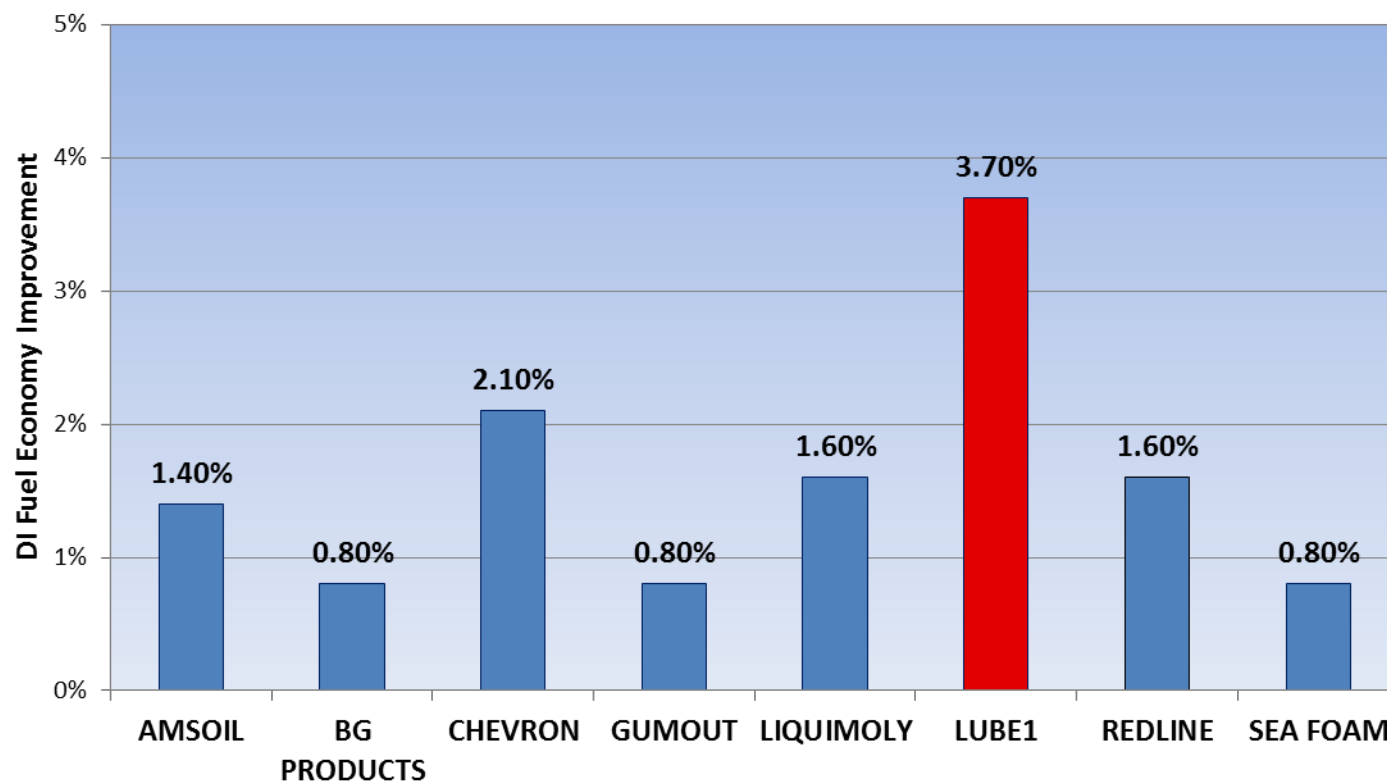


Average Increase = 2.0%

Direct Injection MPG Test Results



Engine: Audi 2.0L Direct Injection
Test: Fuel Economy Increase
Duration: One tank (pre-clean and post-clean)



Average Increase = 1.6%

What were the test conclusions?



- **Lube1 Fuel System Cleaner** removed 80% of IVD and 78% of CCD in PI engines, and 66% of IVD and 62% of CCD in DI engines
- **Lube1 Fuel System Cleaner** was the best performing product in its ability to reduce IVD/CCD and increase fuel economy in both fuel delivery types
- Sea Foam was the worst performing product in its ability to reduce IVD/CCD and increase fuel economy in both fuel delivery types
- The margin by which **Lube1 Fuel System Cleaner** outperformed competitor products is greater in direct injection engines than port injection engines
- **Lube1 Fuel System Cleaner** increased fuel economy by over twice as much as the test average in direct injection engines
- Due to the inherent design of direct injection engines, all products tested (including **Lube1 Fuel System Cleaner**) did not remove deposits as effectively in direct injection engines as they did in port injection engines