Fall 2022

Dear No-Rosion Customer,

A large number of domestic and international factors continue to wreak havoc not only on pricing of gasoline, but even the composition of blends available at your local gas station. In this newsletter, we'll share information that we think you'll find helpful in preventing these issues from causing you problems.

In April, the Federal Government announced a plan to suspend a ban on summertime sales of gasoline blended with higher ethanol content. Their goal was to reduce gasoline prices. The EPA issued a waiver that allowed E15 (15% ethanol blends) to be used between June 1st and September 15th. Fortunately only 2,300 stations, or about 1.5% of all stations across the US, sold this blend.

While the government touts E15 as being 10-15 cents per gallon cheaper, they fail to recognize that, in fact, gasoline with higher ethanol content yields less energy – meaning you end up consuming more of it. So in the end, any cost savings from less dollars-per-gallon is offset by less miles-per-gallon, resulting in net-zero savings.

The other thing they fail to recognize is E15's higher degree of chemical instability and corrosivity.

As identified in previous newsletters, ethanol reduces gasoline's oxidative stability. This causes it to form gums and varnishes that not only clog carburetors and fuel injectors, but also function as precursors to stubborn engine deposits. And the water that ethanol readily and continuously absorbs from humidity in the air causes corrosion of metal components in a fuel system. This is most notably the case for fuel tanks, as emulsions that result from water absorption in gasoline eventually separate into a heavy water-laden layer that sinks to the bottom of the tank and causes it to corrode.

No-Rosion Fuel System Combustion Optimizer contains a potent proprietary PEA (Polyether Amine) detergent that effectively cleans and prevents gums, varnishes, and deposits. It also contains fuel stabilizer that prevents oxidation, including all ethanol blends. A demulsifier in the product prevents water absorption, and a corrosion inhibitor protects metal components from any water that may already exist in the fuel system. In each of these important key performance areas, it outperforms "*leading*" competitor products. How do we know this?

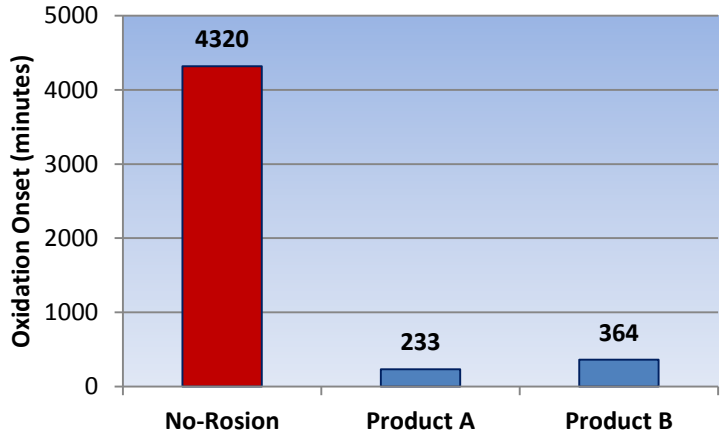
Every few years we purchase bottles of "*leading*" competitor products from retail shelves, and send them to third-party test laboratories for evaluation. Incidentally, the reason I put the word "*leading*" in quotes is because even though these products lead by sales volume, they do **not** lead by performance. And that's exactly what the test results bore out.

To make the engine deposit removal portion of testing as stringent and accurate as possible, we utilized the most up-to-date standardized testing available. And to make it relevant to our older classic cars, we focused on problems associated with high-mileage (over 75,000 miles) engines, as legacy deposits are particularly stubborn to control. Two competitor products were tested. Rather than refer to them by name, and risk provocation of their well-funded legal departments, we'll just refer to them as: **Product A**, and **Product B**. Both products are sold nationally on shelves of major retailers and parts stores.

What follows is an overview of each test conducted, along with results and discussion of influencing factors.

TEST ONE: ASTM D525, Standard Test Method for Oxidation Stability of Gasoline.

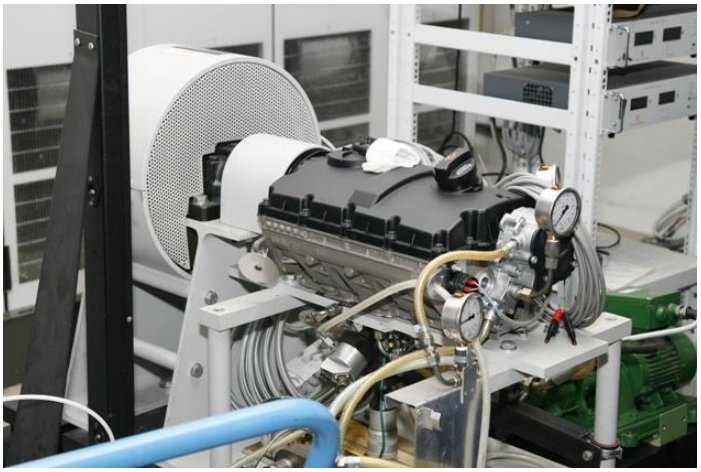
This test evaluates the amount of time before oxidation of fuel, and the ability of the additive to delay its onset. Purposefully unstable test fuel is used to accelerate/exacerbate instability. The test terminates after a maximum time of 4,320 minutes if the treated fuel still has not begun to oxidize.



By delaying/preventing the onset of oxidation, less gums are formed, resulting in fewer deposits. This reduces the clean-up burden of fuel detergents. In this way, fuel stabilizers function synergistically with detergents to maintain total engine cleanliness. Test results demonstrated that No-Rosion Fuel System Combustion Optimizer passed the test, as it stabilized fuel until the test ended at 4320 minutes. Both Product A and Product B failed the test, as oxidation began after only 233 minutes and 364 minutes respectively.

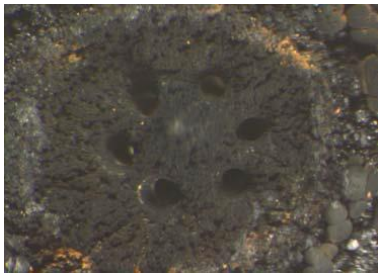
TEST TWO: CEC TDG-F-113 VW DISI DU/CU.

This test evaluates Dirty-Up (DU) and Clean-Up (CU) of injector deposits in direct injection spark ignited (DISI) engines, and the additive's ability to control deposits. Developed by Volkswagen AG, it is a newly minted, state-of-the-art test being used in Europe, but to-date not yet made it to the US.

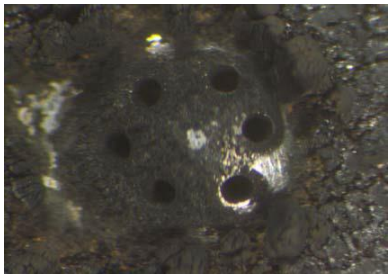


The 1.4L GDI dyno test engine runs a 48 hr Dirty-Up (DU) phase to build injector deposits using a purposefully "dirty" gasoline blend. Then the fuel is additized, and the engine runs a 24 hr Clean-Up (CU) phase. Coked injector deposits form, which reduce fuel flow due to clogging of holes, and optimal spray patterns are disrupted due to carbon deposits on injector tips, altering emissions, fuel economy, and horsepower. Long-Term Fuel Trim (LTFT) data is accumulated to quantify injector shift necessary to overcome injector deposit buildup. The engine is torn down at 48 hrs / 24 hrs for photographing injectors.

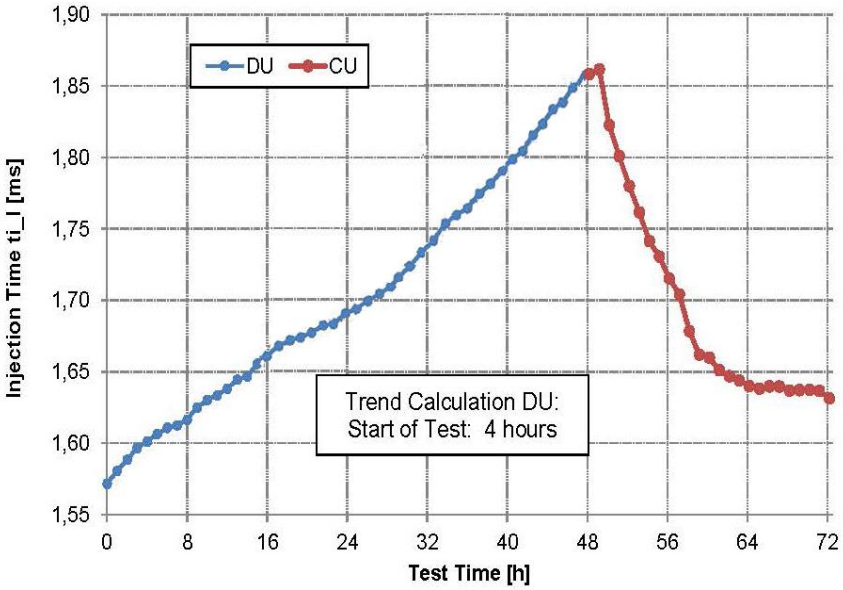
Injector deposits form quickly in modern Gasoline Direct Injection (GDI) engines because injectors are located in the combustion chambers. This extreme high-temperature environment cokes (bakes) deposits onto injector nozzles, making them difficult to remove. Even a small amount of deposit on injector tips prevents optimal atomization of fuel, causing performance loss and reduced fuel economy.



GDI fuel injector nozzle tip with coked deposits, after 48 hr Dirty-Up (DU) test phase.



GDI fuel injector nozzle tip with coked deposits, after 24 hr Clean-Up (CU) test phase.



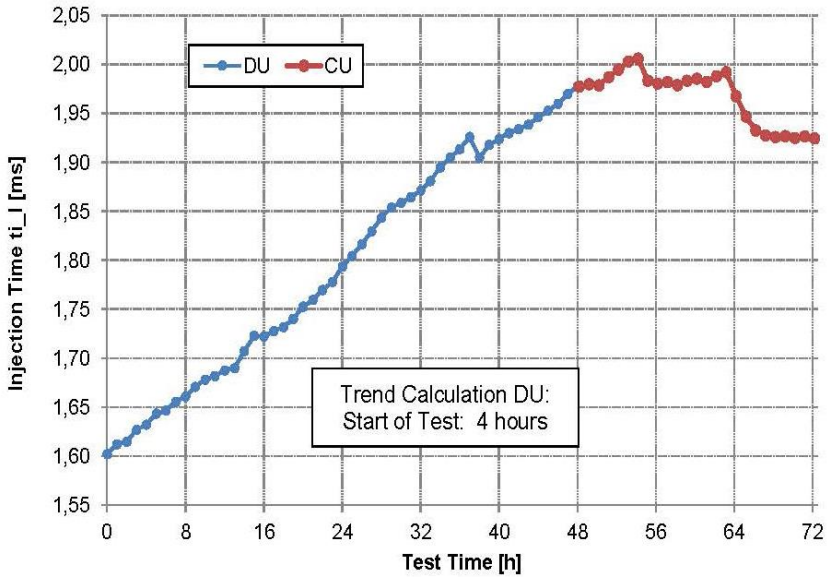
No-Rosion Test Results

Solubilized deposit removal began immediately at 48 hours, resulting in 79.2% total Clean-Up related to Dirty-Up fouling. This is indicated by the steep downward red portion of the LTFT injector timing data. Importantly, the smoothness of the red line indicates the mechanism of deposit removal is dissolution, not break-off. As SAE research has shown, the problem with break-off deposits is that small pieces can lodge in exhaust valve seats, causing damage, leakage, and performance deficits as a result of compression loss. *

* SAE Technical Paper 971638 (1997) International Fuels & Lubricants Expo, "*Exhaust Valve Seat Leakage*," John Hoard, Peter Moilanen, Ford Motor Co., Dearborn, MI.

No-Rosion dissolves carbonaceous engine deposits without breaking them into small pieces due to the chemistry of its PEA detergent. It has a high flash-point, which prevents volatility loss, allowing it to reside in combustion chambers longer. This results in a more complete chemical interaction with deposits, resulting in dissolution.

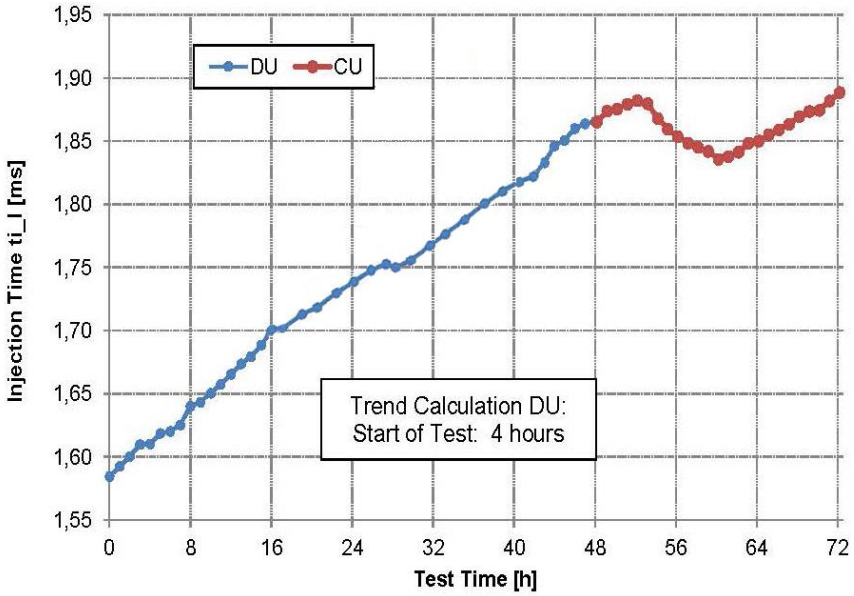
No-Rosion's PEA also is lower in viscosity than detergents in other products, allowing it to better atomize when it enters the chamber, resulting in more active dissolution. This is especially the case in the finer injection streams of modern GDI engines. It interacts with carbonaceous deposit residues to form reaction byproducts that leave behind films resilient to future deposits. This disrupts deposit beds, making it difficult for deposits to re-form, which enhances keep-clean performance.



Product A Test Results

Break-off deposit removal had a delayed onset, with the first small break-off event occurring at 54 hours, and a second more significant break-off occurring at 64 hours. This resulted in nominal 14.1% total Clean-Up related to Dirty-Up fouling. Break-off deposit events are indicated by the sudden jagged drops downward in the red line. If the duration of the test were extended beyond 72 hours, we would expect to see even more significant break-off events occurring, resulting in exhaust valve issues and engine performance loss.

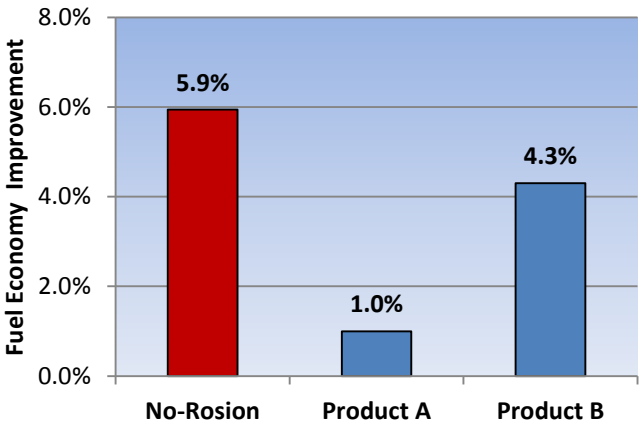
While Product A does contain a PEA detergent, its chemistry is more conventional – meaning, it does not have an elevated flash point, and it does not have a reduced viscosity. This limits its ability to reside in the chamber long enough to fully interact with carbonaceous engine deposits, resulting in an incomplete interaction, and therefore the deposit break-offs. It also does not atomize as well, again resulting in incomplete interaction with deposits.



Product B Test Results

Nominal deposit reduction occurred at 54 hrs, with deposits reforming at 60 hrs. Deposits were heavier at the end of CU than the end of DU, resulting in -8.3% Clean-Up, or a net gain in deposits. This product contains mineral oil as a friction modifier to help increase fuel economy. While this old-school technique does provide a short-term mpg boost, it comes at the long-term expense of carbon footprint in combustion chambers that acts as a precursor for future deposits. SAE studies show that oil in combustion chambers acts as a "significant source" of future deposit accumulation. *

* SAE International, Vol. 100, Section 4: JOURNAL OF FUELS & LUBRICANTS (1991), pp. 1058-1068: "*Engine Combustion Chamber Deposits: Fuel Effects and Mechanisms of Formation*," Changsoo Kim, Shi-Wai S. Cheng, GM Research Labs, Warren, MI.



The most effective means of restoring fuel economy remains complete removal of deposits. For this reason, additional testing focused on quantifying increases in mpg as a result of deposit removal. Per graph at left, No-Rosion's deposit control allowed it to achieve 5.9% improvement in fuel economy. Product A removed only enough deposits to achieve 1.0% increase in mpg. Product B's friction modifier did yield increased mpg of 4.3%, but as previously identified, at the expense of longer-term deposit reaccumulation because this ingredient is a petroleum-based mineral oil.

As promised in our Spring 2022 newsletter, here's how **No-Rosion Fuel System Combustion Optimizer** pays for itself at today's fuel prices. Assuming a fuel tank that holds 18 gallons, with a 5.9% increase in mpg, you will consume 1.06 gallons less per tank. At $4.00/gallon, this equates to $4.24 per tank saved. No-Rosion costs $10/bottle, so it pays for itself after less than 3 tanks, regardless of whether your engine's fuel delivery is carburetion or fuel injection.

Please find the enclosed order form that you can use to place your next order. Or for quicker service, visit our web site and order online at: www.NoRosion.com.

We thank you very much for your support, and look forward to continuing to be of service to you and your cars.

Sincerely,

Applied Chemical Specialties, Inc.