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Dear No-Rosion Customer,

In our spring newsletter, we shared test results for our No-Rosion Fuel System Combustion Optimizer. Since then, we've heard from many of you with questions about fuel chemistry, how our product works, and the best ways in which to use it. In this newsletter, we'll address the questions we've been hearing the most.

Q. How do I use No-Rosion Fuel System Combustion Optimizer? Just add it to your fuel tank. To achieve optimal mixing, it's best to wait until the tank is nearly empty. At the time of refueling, pour in the proper dose of No-Rosion, and immediately fill the tank. This will facilitate mixing on a more immediate basis.

Q. Can I add it to a tank that is already full? Yes. But it will just take a little longer for it to fully disperse throughout the entire tank. Assuming a 16-20 gallon fuel tank, 3-4 days is typically sufficient. No-Rosion is a solvent-based additive, and gasoline itself is one of the best solvents known. Likes dissolve likes, and this is definitely the case when our product is added to fuel.

Q. What is the proper dose? The ideal dose is 1 ounce per 2 gallons of fuel. No-Rosion is highly-concentrated, and packaged in an 8 ounce bottle, which will treat 16 to 20 gallons of fuel.

Q. Is it ever necessary to increase the dose? Yes. Engines that are known to be particularly carbon-fouled should add No-Rosion at a dose of 1 ounce per gallon of fuel. By doubling the dose, a highly concentrated clean-up will occur. Engines that run a very rich fuel mixture, have had ignition problems preventing complete ignition of fuel, constantly foul the plugs, or have previously burned aged or broken-down fuel are all candidates for requiring a higher dose of the product.

Q. Is it possible to overdose? We have tested the product at 10 times the recommended dose and not observed any harmful effects.

Q. How often should I add No-Rosion Fuel System Combustion Optimizer? Regularly-driven vehicles should add No-Rosion every 3,000 miles in order to maintain a clean system. A good rule of thumb is to add at every oil change. Particularly fouled engines will require No-Rosion to be added to 2-3 tanks in a row during the first treatment, in order to facilitate a fully-effective initial clean-up. After that, treatment frequency will revert to once every 3,000 miles in order to keep the system clean.

Q. What if my vehicle is not regularly driven? Infrequently-driven vehicles, and those that are laid-up for more than 2-3 months at a time, should add the proper dose both before and after the idle period. Adding right before storage will allow the product to provide maximum fuel stabilization performance. And adding it right after storage will provide assurance that any fuel degradation byproducts that may have accumulated in the tank during storage will not form engine deposits during combustion.

Q. Should I drain the fuel tank for particularly lengthy storage periods? No! An empty fuel tank allows air (and humidity) to stimulate oxidation of the metal fuel tank. This rapidly accelerates the formation of rust in the tank. When the tank is eventually filled with fuel after the storage period, small rust particles enter the fuel, and clog carburetors, injectors, pumps, and filters. Keeping a tank full of fuel prevents air and humidity from making contact with metal inside the fuel tank, which minimizes corrosion. And using No-Rosion provides further protection, as it passes the NACE TM-0172 fuel corrosion test, when it is used at the proper dose.

Q. How does No-Rosion prevent corrosion inside fuel tanks? Ethanol in today's fuel blends is hygroscopic. This means that it readily and continuously absorbs water from humidity in air through a process known as "*emulsion*." When ethanol becomes saturated, it separates from the gasoline, forming two separate solutions. This is called phase separation. An engine won't run on the (water-soaked) ethanol solution, which sinks to the bottom of the tank, and is highly corrosive. It causes fuel tanks and lines to corrode from the inside out. No-Rosion contains ingredients that stabilize fuel – particularly the ethanol in fuel. And through utilization of additional ingredients called dispersants, phase-separated ethanol in aged fuel is solubilized by No-Rosion, and burned through the combustion process – without associated octane loss or risk of deposit formation.

Q. What other problems does ethanol cause? In addition to corrosion of fuel tanks due to phase separation, ethanol's lack of chemical stability makes it highly susceptible to oxidation. In this process, oxygen in air causes ethanol in fuel to form insoluble, non-combustible "gum" byproducts. (You will know that fuel has oxidized from a tell-tale odor that sometimes smells like turpentine.) Because these byproducts are non-combustible, running oxidized fuel through an engine forms carbon deposits in combustion chambers and on intake valves. These materials can also clog carburetor jets and fuel injectors, and generally wreak havoc not only on the fuel delivery system, but the entire engine.

Q. How rapidly does ethanol oxidize? Ethanol begins to oxidize as soon as it comes into contact with air. When you fill your tank, aeration of the fuel as it leaves the pump immediately introduces air to the fuel. In our testing, we've seen 20 gallon tanks of fuel oxidize in as little as 30 days. In most tanks, it takes about 60-90 days before the degradation byproducts of oxidation reach concentrations high enough to cause problems.

Q. How do carbon deposits cause damage to an engine? Carbon deposits remain incandescent in the chamber between combustion cycles, and cause pre-ignition detonation. This produces significant additional cylinder heat, which can lead to engine overheating. It severely hinders engine power and performance, and has very negative effects on fuel economy. In some cases, it can cause pistons to shatter, cylinders to burst, or cylinder heads to overheat and crack.

Q. What is detonation? It is the igniting of the fuel charge before the regular ignition spark. If the premature combustion is completed before the occurrence of the regular spark, there may be no identifying noise. So you won't even know it's happening. However, if the regular ignition spark follows shortly after the pre-ignition occurs, you will hear a tell-tale pinging noise when the two flame fronts collide.

Q. If ethanol causes all these problems, why do fuel refiners use it? It is the cheapest and safest antiknock additive available today. Even though tetraethyl lead is the absolute best antiknock compound, it was banned years ago by the EPA due to toxicity. So in order to manufacture gasoline having sufficient antiknock qualities, or "octane," refiners have had to resort to blending with "oxygenates," most of which are either alcohols or ethers. Because of toxicity and cost issues associated with other oxygenates, the most popular one being used today is ethanol. And then there's the matter of government subsidies to corn growers, who provide the raw material used to produce ethanol. But that's a whole different topic…

Q. How much ethanol is in today's fuel blends? In most states, ethanol is added, by law, to a minimum level of 5.9%. So even when you think you're buying gasoline that contains no ethanol – these days referred to as "E0" – there's usually some ethanol in the blend. Most fuel pumps display a sticker stating the fuel "may contain up to 10% ethanol," an intentional disparity which allows the minimum level to be raised over time without requiring modification of the labeling.

Q. Are vehicle manufacturers aware of the problems associated with ethanol? Yes. Most new vehicle warranties (except for flexible fuel vehicles) authorize fuels that contain no more than 10% ethanol. Our government is continuing to push for E15 gasoline. Court challenges between the EPA, auto manufacturers, and oil companies remain ongoing on this issue.

Q. Do old cars have more problems with ethanol than new ones? Yes. Carbureted engines built before 1990 are calibrated at the factory to run on one kind of fuel. They can't make adjustments like modern electronic fuel injection. Engines that were built before the introduction of ethanol were calibrated to run on straight gasoline. Ethanol contains extra oxygen, which throws off the air/fuel ratio, making the engine run too lean. Lean engines run hotter, and have what vehicle manufacturers refer to as "drivability problems"— i.e. hard starts and rough running. Before 1990, many carburetors were also built with alloys that are more prone to corrosion from ethanol. When ethanol contacts older alloy carburetor housings, corrosion can cause tiny orifices to clog. This further contributes to drivability problems, and is a serious problem for owners of old cars. Usually an upgraded carburetor can't be retrofitted – at least not without sacrificing the car's originality.

Q. What is the chemistry behind No-Rosion Fuel System Combustion Optimizer? It is a 100% synthetic fuel additive that utilizes an aliphatic isoalkane solvent and contains an entirely new, proprietary "polyether amine" (PEA) detergent.

Q. What is polyether amine (PEA)? Polyether amine, often abbreviated "PEA," is a chemical term used to identify a number of different proprietary fuel detergent compounds. Chevron was the first to apply PEA chemistry to engine fuel additives. In the early 1990's, Chevron patented this technology after discovering that these compounds were highly effective deposit control additives. Eventually Chevron's patent expired, and other manufacturers (including ourselves) undertook the process of reformulating and improving this technology. There are many SAE technical papers, peer reviewed by the industry, that tout the benefits of polyether amine deposit control additives versus any/all other types of fuel additive technologies.

Q. By what mechanism does PEA remove and prevent deposits? PEA detergent is used with a carrier fluid. With our product, we use a high flash point, thermally stable solvent carrier. The mechanism by which deposits are removed is affected by forming a thin hydrocarbon film through the detergent's polar head adhering on the metal surface. The deposit is cleaned by dissolving the soluble part of the deposit, which binds the deposit to the metal surface. Once dissolved, the solubilized deposit is combusted in the engine, and exits through the exhaust. The mechanism by which deposits are prevented involves laying down a surface-active film on a clean metal surface that inhibits the buildup of deposits (or gums) that may form from the fuel.

Q. Why is PEA more effective than other fuel additive technologies? Other fuel additives contain detergents composed of ingredients such as dimethylbenzene, trimethylbenzene, ethylbenzene, polyisobutenamine, and various other aromatic hydrocarbons. Some also contain various alcohol ingredients. The mechanism of carbon/sludge deposit removal differs significantly for these types of chemistries. Our studies have indicated that the big benefit of PEA is that it fully solubilizes, and washes away, the deposits. In other words, the deposits are put into solution, washed away, and then fully burned during the combustion process.

The problem we have seen with chemistries in other products is that they do not fully solubilize the deposits during the mechanism of cleaning/removal. So often the deposits can break off in small chunks. When these chunks exit through the exhaust valves, they can damage valve seats, and get lodged in catalytic converters. Pre-combusted deposits can also get lodged in various areas of the fuel system, causing fuel delivery problems. And because these other products don't fully solubilize the carbon/sludge, the entire deposit is not removed. This leaves behind parts of the deposits that can act as a "bed" on which additional deposits can form. It is also important to know that alcohol ingredients in other products can cause drying and cracking of plastic and rubber parts in fuel lines, gaskets, etc. No-Rosion contains no alcohol ingredients whatsoever.

Q. How do I know which chemistry is in a fuel additive? Obtain a copy of the Material Safety Data Sheet (MSDS). For safety and regulatory reasons, most manufacturers will indicate what type of chemistry is contained in their product within this document.

Q. What is meant by "clean-up" and "keep-clean"? These are industry-standard terms used to describe the process of deposit removal (i.e. "clean-up") and deposit prevention ("keep-clean").

Q. If one product contains more PEA than another, will it provide better clean-up? Not necessarily. The term "polyether amine" is just a type of substitutive nomenclature that is used to identify a number of possible different chemical compounds. These different PEA compounds are also formulated in different concentrations. So simply looking at the percent composition of PEA on a MSDS is not going to be fully indicative of a product's ability to clean. Take this example. Let's say Product A contains 30% of a diluted form of a PEA compound. Product B contains 10% of a highly concentrated PEA compound. Which will clean better? You might assume Product A, because it contains a higher percent of PEA. But you could easily be wrong.

Q. Is the PEA in No-Rosion the same as the PEA in other products? No. We developed our own, proprietary PEA formula. There are many different chemical compounds included in the chemical description "PEA," most of which are proprietary. This is why the CAS (Chemical Abstracts Registry) Number is always listed as "proprietary" on MSDS's for PEA-containing products. If the manufacturer were to provide a CAS number for their specific PEA formula, they would be divulging the compound and be giving away proprietary information.

Q. Do all fuel additives contain detergents? Believe it or not, no. Some are 100% solvent. While solvent itself can provide some nominal clean-up benefit, it's not nearly as effective in providing total clean-up as detergent ingredients that are combined with solvent. And solvents alone do not provide any keep-clean performance.

Q. What makes the PEA technology in No-Rosion better than PEA in other products? Through research, we discovered that better detergent qualities could be achieved with a PEA compound having a higher flashpoint, and lower viscosity. The higher flashpoint allows the detergent to reside in the combustion chamber slightly longer during the combustion cycle, which facilitates a more effective clean-up. And the lower viscosity allows it to penetrate/solubilize deposits more fully and effectively. These are a couple of the physical properties that differentiate the proprietary PEA technology found in our product.

Q. Can I use No-Rosion in my daily driver as well? Yes, it will not harm catalytic converters or oxygen sensors, and will clean/remove deposits in port injected, direct injected, and carbureted engines.

Q. Does No-Rosion increase octane? No, but a cleaner burning engine has a reduced octane requirement, which allows less expensive, lower octane gasoline to be used without the risk of detonation.

Q. Will No-Rosion rejuvenate old fuel? No, but it will prevent it from breaking down any further, and allow it to be safely used without forming engine deposits.

Q. Can synergistic benefits be gained by using No-Rosion Combustion Optimizer along with No-Rosion Octane Booster? Yes. Fuel with a higher octane rating more effectively combusts the solubilized byproducts created during clean-up with our PEA.

Hopefully this information is helpful as you try to best manage the limitations of today's fuel blends in your older (and newer) cars. As always, we're here to help with all your engine fluid maintenance needs.

Thank you for being a customer. We appreciate your support, and look forward to continuing to be of service.

Applied Chemical Specialties, Inc.