Fall 2017

Dear No-Rosion Customer,

Now that autumn has arrived, it's time to make sure your car is properly prepared for the winter…

Before we dive into the details, it's worth mentioning that we enjoy preparing these newsletters, because it provides us the opportunity to highlight some of the "finer points" of our products, how they perform, and how this correlates not only to preservation of your cars, but also optimization of your driving enjoyment!

Regarding winter's impending arrival, here's one such "finer point" of which you may not be aware… You probably already know that our **HyperKuhl Super Coolant** enhances heat transfer to help your cars run cooler during the summer. But did you know it can also help your cars heat up quicker during the winter?

HyperKuhl Super Coolant contains three separate surfactants, also known as "wetting agents." Each surfactant provides optimal wetting performance in a different range of temperatures – almost like a multi-weight oil. Similarly, as a multi-weight oil conforms to different performance parameters at both low and high temps, our HyperKuhl Super Coolant provides optimal wetting at both low and high temps as well.

Most engines do NOT perform to spec until or unless adequate heat is in the engine. Tolerances are designed with a specific operating temperature range in mind. This is especially the case for precision-built racing and performance engines. For this reason, we formulate HyperKuhl with a low-temperature surfactant that helps cut surface tension between engine coolant and "warming" cylinder heads as a means of transferring maximum heat during warm-up. Getting heat into the engine quicker means the engine will be operating at peak efficiency sooner – which is especially important in racing, for example.

But we also have a completely separate surfactant in HyperKuhl for the opposite end of the temperature spectrum. When engines are operating at extremely high temperatures, the goal is to minimize nucleate boiling of engine coolant where it contacts extremely hot cylinder heads. Less nucleate boiling means more coolant directly contacts the cylinder head, and therefore more heat can be absorbed, transferred to the radiator, and drained to the external environment – which of course reduces operating temps and prevents overheating.

Getting back to the original point – Specific to winter operation, the low-temperature surfactant in HyperKuhl reduces coolant surface tension of engine coolant in cold temperatures. This allows heat to be transferred more rapidly from the warming cylinder heads to the rest of the engine – and importantly, also the heater core. So if you live in a cold region of the country, and you want the interior of your vehicle to warm up roughly 30% quicker during cold morning start-ups, for example, consider adding a bottle of HyperKuhl.

If you REALLY wanted to maximize heat transfer, and warm up your engine even quicker during the winter, you would run straight water. But of course, that's a preposterous notion, because water's freeze point of 32^{o}F makes it entirely infeasible to run it as engine coolant during the winter. But this begs the larger question:
Why is it that water transfers heat more efficiently than ANY other fluid?

The answer relates to a scientific term known as "Specific Heat Capacity." Specifically (pun intended), it is defined as: "*The amount of heat per unit mass required to raise the temperature by one degree Celsius*."
As you will note, the Specific Heat Capacity of water is 1.00 calorie/gram °C = 4.186 joule/gram °C, which is

higher than any other common substance. That explains why water is used as a baseline reference for expression of Specific Heat Capacity of all other materials. Whether you know it or not, water even has a Specific Heat Capacity that is higher than all metals, including copper. This in spite of the fact that copper is among the very best metallic conductors of heat – better than aluminum, by the way. (You may have been told otherwise by the guy wanting to sell you an expensive new aluminum radiator.)

Back to the point. We are often asked about the efficacy of "**waterless coolant**." This 100% glycol coolant is advertised as "THE SOLUTION TO BOILOVER & CORROSION." Big claims indeed, with an equally big price tag of about $50 per gallon – or roughly $200 to fill the average 16 quart cooling system. The questions we hear are: "*Does it work?*" "*Is it worth the cost?"*

On the surface, this may seem like a pretty straightforward question, that should yield a correspondingly straightforward answer. Unfortunately that's not exactly the case. Because the answer to this question is a fairly complex one – and because we're asked this question so often – we've decided to dedicate a good portion of this newsletter to the topic of waterless coolant.

Let's begin by having a look at some numbers. As already identified, water has a Specific Heat Capacity of 1.00. The Specific Heat Capacity of 100% glycol (i.e. waterless coolant) ranges from 0.64 to 0.68. So it conducts roughly half as much heat as water. **This means that engines converted to waterless coolant run significantly hotter**.

We put this to the test, and evaluated a Chevrolet LS-1 engine that was converted from straight water coolant (plus our **No-Rosion Cooling System Corrosion Inhibitor** for corrosion protection) to waterless coolant. The result was an average increase of 128°F at the cylinder heads, as measured with an infrared thermometer in different locations along the heads. And whereas the stabilized bulk coolant temperature was around 192°F with straight water coolant (again, with No-Rosion for corrosion protection), it maxed out at 236°F with the waterless coolant. So the coolant temperature increased by 44°F after converting to the waterless coolant.

Incidentally, the aforementioned LS-1 test engine experienced some performance setbacks after conversion to waterless coolant. With cylinder heads 128°F hotter, the engine required gasoline having octane of 5 numbers higher to avoid detonation. This required the computerized ignition system to retard timing by 8-10° to avoid trace knock, resulting in horsepower reduction of 4-5% (as confirmed on a chassis dyno.)

Notably, the electric radiator fans ran constantly during our test. Most vehicle ECUs are programmed to turn the fans on at a coolant temperature of 200-210°F, and turn the fans off at 180-190°F. Because engines run hotter with waterless coolant, the ECU requires reprogramming. Sellers of waterless coolant recommend a turn-on temp of 230°F, and a turn-off temp of 215°F. Without reprogramming the ECU, the fans will run continuously.

Why doesn't the engine overheat, since it runs so much hotter with the waterless coolant? The answer obviously relates to the fact that the boiling point of 100% glycol waterless coolant is very high – around 375 °F. But this "insurance policy" against overheating comes at a cost. In this case, the "cost" is higher operating temperatures. And as already referenced, engines are built with clearances designed for a specific range of operating temperatures. There is not a single OEM that has ever built an engine with clearances designed for temperatures encountered when running 100% glycol. So ask yourself: How comfortable would you be with your engine's cylinder heads running 128°F hotter, and coolant running at 44°F hotter, than the engine was built to tolerate?

There are other "costs" associated with converting to waterless coolant – both figuratively and literally. More on the literal conversion costs in a second. But another figurative "cost" is the fact that waterless coolant is considerably more **VISCOUS** than water, or even a 50/50 mix. At normal engine operating temperatures, water has a viscosity of 0.28 cp. A 50/50 mix has a viscosity of 0.70 cp. Waterless coolant has a viscosity of 2.3 to 2.8 cp. So the waterless coolant is almost 10 times more viscous than water, and 3-4 times more viscous than a 50/50 mix. This creates drag on water pumps, as OEM water pumps are spec'd for the viscosity of a 50/50 mix.

In our research, we have also observed a 20-25% reduction in coolant flow through radiator tubes when waterless coolant is used. This is a result of the greater viscosity. As coolant flow through radiator tubes decreases, the ability of coolant to transfer heat via the radiator has a corresponding drop as well. Coolant's decreased ability to transfer heat at lower flow rates is a result of the **Second Law of Thermodynamics**, as best expressed (relative to the closed system of an automotive cooling system) in the following the equation:

$Q = M \times Cp \times \Delta T$

Where:
- Q is the heat load
- M is the mass flow rate of coolant
- Cp is the specific heat capacity of coolant
- ΔT is the change in temperature of coolant in the radiator

Expressed in simpler terms, the Second Law basically states that heat must always flow from a warmer object to a cooler object. So using the equation, we see that, assuming a constant heat load, a DECREASE in coolant flow rate must necessarily result in an INCREASE in the temperature of coolant in a radiator.

In recognition of how their high viscosity waterless coolant products negatively impact flow rates, waterless coolant sellers now offer high volume water pumps for a limited number of engines, to include the Chevrolet LS1/L6. These pumps provide 20% more flow than OEM units, which is almost enough to overcompensate for the greater pump effort required to move the considerably more viscous waterless coolant.

Now to the "literal" cost of converting to waterless coolant. Before adding the $200+ worth of waterless coolant, it is necessary to first flush the system using a "**Prep Fluid**" that costs $33 per gallon. The reason is that waterless coolant will corrode a system if only 3% of old coolant remains in the system. When this happens, water combines with the glycol in the waterless coolant to form glycolic acid. The result is a reduction in coolant pH, and corresponding corrosion problems severe enough to prevent waterless coolant from meeting performance parameters as specified in the all-important ASTM D3306 Standard Specification for Automotive Engine Coolant.

It's not easy to remove 97%+ of existing coolant from a system! It is a tedious process. Frost plugs must be removed, the radiator disconnected, hoses blown out, etc. In our testing, when we followed the recommended conversion procedure for complete removal of coolant for our various test vehicles, the average observed removal rate was 92%-94%. This is less than the required 97% removal rate, and would therefore result in corrosion problems. Not to worry – waterless coolant sellers will refer you to an authorized "conversion center" that will perform the conversion for you. Typical conversion costs are $150-$180 in labor, plus the Prep Fluid, plus the waterless coolant. Roughly speaking, your **all-in conversion cost would be somewhere north of $400.**

It is also advertised that waterless coolant's high boiling point reduces nucleate boiling inside the cylinder heads. While this is true, the problem is that any extra heat it absorbs is not efficiently conducted, due to its low Specific Heat Capacity – thus making this a moot point. And by the way, there are better ways to reduce nucleate boiling without the associated costs of converting to waterless coolant. **HyperKuhl Super Coolant** contains surfactants that reduce nucleate boiling of any coolant – including straight water! It also provides 100% corrosion protection. So by using HyperKuhl, you can reduce nucleate boiling, AND efficiently transfer the extra absorbed heat due to water's high Specific Heat Capabity. This allows you to have your cake and eat it too, so to speak.

Several years ago, we authored a white paper that communicated some of the "costs" of waterless coolant. It was discounted by some as fictitious propaganda geared only toward selling our No-Rosion and HyperKuhl products. We respond by pointing out that as recently as May of this year, significant debate has taken place within the **ASTM D15 Committee for Engine Coolant** with regard to waterless coolant. As mentioned in past newsletters, the ASTM D15 Committee for Engine Coolant plays a preeminent role in the engine coolants industry. It is composed of OE engine manufacturers, as well as scientists from all the leading coolant and antifreeze manufacturers worldwide. We are a participating member of the D15 Committee.

Active debate took place during the most recent D15 Committee meeting with regard to validity of certain test methodology, specifications, and performance claims for waterless coolant (referred to as "*non-aqueous*" coolant by scientists). Several dissenting scientists defended their negative positions, stating as follows:

Scientist 1:
"The non-aqueous coolants specified in the draft specification have very different thermal and physical properties from the factory approved OE coolants, and a large portion of vehicles in use today have electronically mapped (or controlled) cooling systems. It is not clear whether the use of non-aqueous coolants in the vehicles equipped with electronically mapped cooling system will lead to operation difficulties or issues. The draft specification should address this potential incompatibility between the non-aqueous coolants and electronically controlled cooling system operation before being approved. A description of the operation of electronically mapped cooling system written by VW/Audi is attached for review."

In his dissent, this scientist is essentially iterating concerns largely similar to our finding that recalibration of the ECU for the Chevrolet LS-1 is necessary to prevent the electric radiator fans from running constantly.

Scientist 2:

"There is no mention of any seal compatibility and/or elastomer testing such as ASTM D 471, Standard Test Method for Rubber Property-Effect of Liquids. Many types of elastomers exist in light duty and passenger car vehicles, and diols can be harmful to these seals. Current seals are designed with aqueous coolants in mind, and data on how non-aqueous coolant behaves when interacting with elastomers is essential. Higher boiling point of the non-aqueous coolant negatively affects the heat transfer properties. This will lead to engines running at higher temperatures. Many components in an engine are designed with a certain temperature in mind. Heat transfer properties of non-aqueous coolant must be investigated, reported, and a limit set for them. There is no test data about compatibility of this type of coolant with other coolants, maybe because it is not! Compatibility is a very important issue as many operators would top off with whichever coolant is available. Many operators would simply top off with water. These are issues that need to be addressed. Labeling needs more specifications such as: Do not top off with conventional coolant (SLC). Do not top off with extended life coolant (ELC)."

In his dissent, this scientist is expressing several concerns. First is his concern about the long-term effects of waterless coolant's higher operating temperatures on rubber hoses, seals, and gaskets. Second is his concern about the fact that waterless coolant causes engines to run hotter than they were originally designed to run. And third is his concern about possible long-term chemical stability, compatibility, and resultant corrosion issues if users of waterless coolant accidently top-off systems with coolant other than waterless coolant.

Other dissenters expressed opinions at the meeting, but these two scientists' comments were the most notable.

As you can see, we're not the only ones with concerns over the "costs" of converting to waterless coolant.
Is it "THE SOLUTION TO BOILOVER & CORROSION"? "Does it work?" "Is it worth the cost?" You be the judge.

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

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

Sincerely,

Applied Chemical Specialties, Inc.