Bell Performance, Inc. **tel** 407-831-5021
1340 Bennett Drive **fax** 407-331-1125
Longwood, FL 32750
www.bellperformance.net

BELL PERFORMANCE FUEL ISSUES SERIES: ETHANOL PROBLEMS FACING CONSUMERS

EXECUTIVE SUMMARY

The blending of ethanol into gasoline across the nation is now a common practice due to recent EPA mandates for 10% ethanol blends. These mandates are aimed at improving air quality and reducing air pollution from fuel emissions, which ethanol blends achieve through the lowering of harmful emissions. But ethanol causes major issues for consumers, who face loss of mileage, storage issues and a tendency for ethanol to corrode plastic and fiberglass tanks and parts, especially in marine applications.

POPULARITY OF ALTERNATIVE FUELS AND OXYGENATES

In many states, it's hard to find a gas station that isn't selling at least 10% ethanol in their gasoline; you see the warning stickers on all of the pumps. Most people don't really know why it's put into gasoline; they just know they may have heard bad things about it. Ethanol is classified as an "oxygenate", meaning it increases the oxygen content of the fuel that it is blended into. The EPA has historically used government mandates (as allowed by the Clean Air Act) to force the introduction of oxygenates into gasoline, as a way to help reduce emissions like carbon monoxide and improve urban air quality.

There are really three pieces of legislation that were the biggest influencers in the rise of alternative fuels like ethanol. Actually, there were four. President Carter, some of you may remember, talked during his presidency about reducing the US dependence on oil imports and one of his efforts was spearheading the 1980 Synthetic Fuels Act – one of the initial efforts to get people to think differently about the fuels they use. Unfortunately its momentum was thwarted when the price of oil plummeted in the 1980s, and alternative fuels kind of dropped off the radar – gasoline and diesel were too cheap for people to seriously consider using other things.

Three pieces of legislation followed. The 1988 Alternative Fuels Act required government agencies to purchase vehicles that run on alternative and provided financial incentives for auto makers to develop more kinds of vehicles to run on these fuels. This was a big step of faith at the time because ethanol and biodiesel really weren't widespread in availability. The 1990 Clean Air Act gave the EPA authority to push for mandates (like requiring use of alternative fuels) in order to make air quality better. The 1992 Energy Policy Act codified a long-term goal that by 2010, non-petroleum alternative fuels would have penetrated 30% of the fuels market.

So for changing the mainstream fuel supply, the EPA really first started mandating this practice on a large scale in 1992, when MTBE (which had already been used in the 1970s as an anti-knock agent in gasoline) began being blended into gasoline to help cut harmful emissions. At its peak in 1999, 200,000 barrels (8.4 million gallons) per day of MTBE were being produced, all being added to gasoline at a 10% treat ratio. Unfortunately, scientists began to find evidence that MTBE was linked to ill-health effects, and also found it easily contaminated ground water; these led to its widespread withdrawal from the market. This is what allowed ethanol to displace MTBE as the dominant oxygenate of choice to blend into gasoline which satisfied these EPA emissions requirements.

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THE GOOD – ETHANOL ADVANTAGES

Lower Emissions

To be sure, ethanol imparts some advantageous qualities when blended into gasoline. First and foremost are reduced emissions. These may not be so important to the average consumer (unless they are concerned about going green), but this is the advantage the EPA and environmental scientists like. Ethanol blended into gasoline at a 10-85% ratio makes fuel that produces lower levels of carbon monoxide, unburned hydrocarbons, particulate matter (another form of unburned fuel) and harmful aromatic compound emissions (which have been linked to cancer) than pure gasoline. All of these together offer positive effects on smog and pollution levels in urban areas that may have traditionally struggled with this problem. These urban areas, if they aren't concerned about their citizenry, have a financial incentive to care about the problem, because areas out of compliance with Federal air quality standards (hence, the EPA's jurisdiction applies here) can be at risk of losing access to important federal funds for the many things they use federal money to pay for.

Higher Octane

Oxygenates like ethanol and MTBE already had historical use before the 1992 Clean Air Act as octane improvers. Pure ethanol has an octane rating of 113, while E10 blends have the octane rating listed at the pump, which is usually the same as regular or premium gasoline. Unfortunately for the consumer, it is likely because, despite the ethanol additive having a high octane rating, the fuel blender uses a lower octane base gasoline in order to end up with the same octane rating in the E10 blend as they had before. So the consumer doesn't really get an added octane benefit in an E10, despite the ethanol fraction having a higher octane rating.

Renewable Fuel

Ethanol is made in the United States from corn (in Brazil it is made from sugar cane), making it a renewable fuel that reduces (somewhat) our dependence on oil imports. This is a big plus for a lot of people who want to go more "green".

Flex-Fuel Vehicles

No doubt you've heard of the "flex-fuel" vehicles. These are vehicles that have had engine modifications to enable them to run on either gasoline or a high concentration of ethanol like E85. Putting such a high concentration of ethanol in an engine that has not been modified is never a good idea – flex-fuel vehicles have special fuel sensors to properly read the ethanol-fuel mixture and special fuel injection changes to ensure the mixture isn't too rich or lean. Without these modification, the vehicle won't run right and you can very easily get a damaged engine over time.

THE BAD – ETHANOL PROBLEMS FOR CONSUMERS

Loss of Mileage

Loss of mileage from use of ethanol blends results from the ethanol molecule containing less energy value than gasoline. The energy value in petroleum fuels is a function of the number of carbon bonds in the molecule. Gasoline molecules are much longer with more carbon bonds than the small ethanol molecule, so you have less energy potential in that blended fuel. Pure ethanol has a gross BTU value

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35% less than the equivalent amount of gasoline. However, most cars don't run on pure ethanol – in fact, running on higher than 15-20% ethanol concentration can cause engine damage because the engine has to be adjusted to account for the differing combustion property of that concentration.. The commonly found E10 blend only has 10% ethanol, so the actual drop in energy value is more along the lines of 3.5%-5.0%.

In October 2010, Congress will consider raising the minimum ethanol requirement from 10% to 15%. When this happens, fuel mileage drops will be even larger. 5% may not seem like that much, but consumers have already demonstrated that they are extremely price conscious and do not take any added expense lightly in this economy.

Water Attraction

Pure ethanol has a strong ability to absorb water from the atmosphere around it. This is true also of the blends made from pure ethanol and gasoline. Ethanol has such a strong attraction to water that chemical producers cannot even sell 100% pure ethanol – it is always 99.8% or less, because there will always be at least a tiny bit of water. As you may expect, attraction of water is an even bigger problem for marine users of E10-E85 than it is for on-road drivers.

When water accumulates in a fuel or storage tank, it sinks to the bottom of the tank because water is heavier than fuel. It then contributes to a whole host of fuel problems and issues, which can be summarized here:

Breeding Ground for Microbes

Microbes like bacteria and fungi all need accumulated water in order to grow and thrive in a fuel storage tank. If an infestation takes hold, problems with corrosion, filter plugging and reduction in fuel quality can follow. However, ethanol blends, like gasoline, tend to be used quicker than stored diesel fuels, so this is not so much of a problem in actual practice.

Phase Separation

Phase Separation means the ethanol 'phase' separates from the gasoline 'phase' and results in two layers of two different compounds, instead of a homogenous mixture of gasoline and ethanol. At this point the ethanol will sink below the gasoline phase and mix with any more accumulated water, giving an ethanol-water phase mixture.

Loss of Octane

When ethanol separates from gasoline, it causes a loss of 2-4 octane points in the fuel mixture; in effect, as it separates, it drags the octane value of the gasoline. An 87-octane fuel that separates can have its octane rating drop to 83-84, which is unsatisfactory for most vehicles and will cause performance issues.

Potential for Equipment Damage

An ethanol blend that has separated will have the ethanol and water mixture settled at the bottom of the tank, where the fuel line is. The fuel line potentially can suck this mixture up into the combustion chamber, where it will burn like an overly lean mixture (lean = not enough gasoline). Because it is not

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mostly gasoline now, burning this kind of fuel gives real potential for valve damage. This becomes an expensive proposition.

Oxidation and Deposit Buildup

Water is one of the impurities that will accelerate oxidation reactions in any petroleum-based fuel, whether gasoline, diesel, biodiesel or ethanol blends. Oxidation reactions are responsible for fuel stratification and the fallout of heavy ends from the fuel mixture. These heavy fuels can build up in the bottom of a fuel storage tank, and when they are injected as fuel, they do not burn like pure fuel but will leave deposits in all parts of the combustion system – combustion chamber, valves and fuel injectors. At best, you get raised emissions to the catalytic convertor, rough running and poor engine performance, while at worst you get a drop in mileage.

Ethanol Solvency

Boat owners in the northeast can readily testify how ethanol blends up to E85 attach and dissolve rubber and plastic parts, even fiberglass fuel tanks. Ethanol has always been an excellent solvent and unfortunately this is not a good thing for engines and fuel delivery systems which rely on rubber and plastic parts for their function. Repeated exposure over time will cause the plastic resigns to dissolve in the ethanol; they subsequently build up as new deposits on valves, causing the same kind of performance issues as carbon deposits can.

CONCLUSION

In exchange for becoming more “green”, consumers face a trade off with certain problems that ethanol blends can cause in their vehicles and boats. The EPA’s pending increase of ethanol concentration to 15% in all reformulated on-road gasolines will only increase these problems. Subsequently there is a substantial market for additives out there to treat ethanol blends and blunt these problems. Some of them are better than others. The best ethanol additives will contains combustion improvers to blunt the mileage drop, detergents to clean out deposits and any dissolved resin buildup, an ingredient to disperse and control water buildup sand an ingredient to protect rubber and plastic parts from ethanol solvency. Beware of products that make outrageous claims and guarantees – if it seems too good to be true (guaranteed 35% mileage increase?), it very likely is too good to be true.