Ethanol Blended Fuel

The Unsung Villain – Excessive Heat

Ethanol has been in the news more and more lately talking about phase separation, corrosiveness, etc. However, there is one subject that has stayed hidden from the spot light, excessive heat caused by the use of ethanol. Possibly the most important thing that an engine can do to prolong its life is to run cool. An engine running hotter than it is designed to, has shown to have issues with the integrity of metals components, electrical components, and oil.

The ethanol content in the fuel is put in there to help reduce emissions. The ethanol is an oxygenated fuel that when burned, turns into water instead of carbon monoxide (CO) and other pollutants. According to an Argonne National Laboratory report, an approximate 10-ton (9.07-metric ton) decrease in greenhouse-gas emissions has resulted from the use of ethanol fuel in 2007 alone. That is the good part, but is it enough?

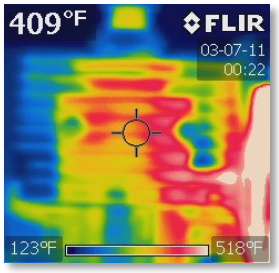
The ethanol used in today's blended gasoline burns hotter than plain gasoline and it does not provide the same BTU's that gasoline does. The efficiency of the engines is also reduced due to the lower BTU's. Ethanol only contains 77,000 BTU's (compared to gasoline 114,000 BTU's) but it requires 131,000 BTUs of energy to produce 1 gallon of ethanol. The decrease in BTU's can range from 3% up to 40% depending on the ethanol content. However, the amount of heat generated within the engine using ethanol blended fuel can be 30-40+ degrees Fahrenheit higher depending upon the blend.

This "extra" heat has a tremendous impact on all of the parts of an engine. In a study performed by Mercury Marine under the supervision of the National Renewable Energy Laboratory (NREL), this extra heat caused quicker gasket deterioration, more carbon deposits, metal fatigue, and in some engines higher Hydro-Carbon emissions. The study compared the use of ethanol blended fuel to plain gasoline. Some of theengines used during the tests had either mechanical failures that prevented them from completing the study or they did not pass the 300 hour emissions tests at the end of the study. The engines that did pass the 300 emissions test had internal issues that would have quickly lead to engine failure if the engines had continued to run. It needs to be noted that the study above only used four sets of engines (total of eight engines) to do the study. One set per engine family.

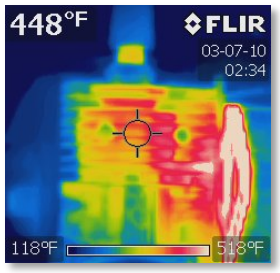
The metal fatigue that was experienced showed pistons from the ethanol blended gasoline had lost some of its hardness compared to the engines that usedplain gasoline. Using the Rockwell C scale (on steel parts) and The Brinell scale (on aluminum parts), it was found that the pistons and other cylinder component parts had lost an average of 13.1% of its hardness on the various engines. Micro fractures were also found on the exhaust valves and exhaust seats.

Engine performance is also affected by the extra heat caused by the use of ethanol. It has always been difficult to "see" if an air cooled engine is overheating. Symptoms of an overheating engine

include lack of power, external engine covers hotter than normal (for example a clutch cover on a trimmer), smoking coming from under the engine housing, hard to restart when hot, bluing color on the dipstick, to name a few. Even liquid cooled engines are subject to overheating. However, the temperature gauge, if watched, will indicate when an engine is running hotter.



Non-Ethanol Gas with 50:1 Oil Mix



Ethanol Blended (E-10) Gas with 50:1 Oil Mix

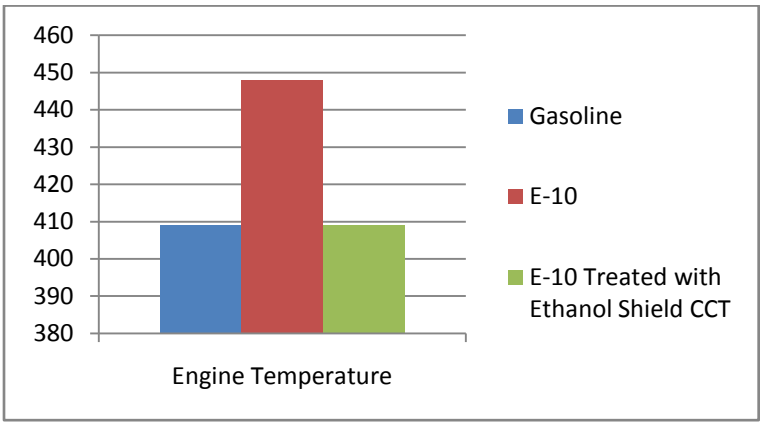
Another issue with an engine that runs hot is that oil, sludge, and other substances will literally burn onto surfaces of the engine. Piston rings, valves, dipsticks, and other parts are subject to this “cooking” issue. The only way to clean this is to disassemble and carefully scrape off the burnt on material.

A critical function of engine oil other than lubrication is cooling. Heat developed in the combustion chamber will thermally transfer to theoil. Oil then dissipates the heat through the engine block, oil coolers, etc. However, if the oil temperature is higher due to higher combustion temperatures, it will take longer to dissipate the heat. Increased oil temperature will not only cause the oil to breakdown faster but it will cause combustion by-products to build-up faster. This includes both 4 stroke and 2 stroke engines. On 4-stroke engines, this means that the time between oil changes are decreased. This in turn increases maintenance expenses.

As most people know, chemical reactions occur more rapidly at higher temperatures. Everyone knows that milk turns sour much more rapidly if stored at room temperature rather than in a refrigerator. Oil is similar. The hotter the oil becomes, the faster the chemical reactions occur. According to Arrhenius Law, for every 10 degrees Celsius (18 degrees Fahrenheit) increase in temperature, the rate of reaction doubles. The chemical reaction we're concerned with in so far as oil life is oxidation - due to the presence of air; and hydrolysis and the presence of moisture (from the air). In other words, the hotter the oil, the faster the rate of these reactions occurs. The more ethanol that is in the fuel the hotter the engine will run; in turn this means that the oil breakdowns that much faster and oil deposits (sludge) build up faster.

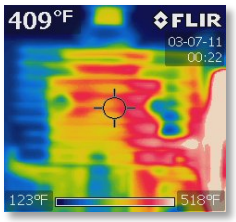
Except for any added oxygenates and/or additives, gasoline is made up almost entirely of hydrocarbon “light ends” – molecules constructed from the building blocks of elemental carbon and hydrogen. However, there are two types of hydrocarbon “light ends” (olefins and diolefins) that can combine slowly with the oxygen in ethanol and in the air ("oxidize") at ambient

temperatures. There are two main types of oxidation that have a dramatic effect on gasoline, *Thermal Oxidation*, whichrefers to high temperatures and *Photo Oxidation*, whichrefers to the exposure of sunlight. The stronger the sunlight, the faster gasoline can oxidize.

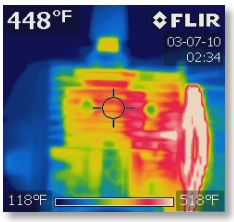


There are other issues that are too numerous to name. Almost every service center will tell you that fuel related issues are the number one issue. The great news is that **B3C Fuel Solutions** has a complete family of products that will prevent issues caused from the use of E-10 and E-15 gasoline. *Ethanol Shield with Combustion Cool Technology (CCT)* will prevent ethanol issues even if E-15 is accidently used in a piece of equipment. It drastically reduces engine heat and extends the life span of 2 and 4 cycle equipment. Engines will run cooler, phase separation will not occur, plastic and rubber parts will be protected, and it eliminates hot starting issues. In 2 cycle engine applications, Ethanol Shield with CCT has the ability to prevent lean seizures because it provides a bond between the oil and ethanol. Conventional 2 cycle oil does not bond with ethanol. *Mechanic In A Bottle* fixes poor and non-running engines and will clean the fuel system in case the fuel has been sitting too long. It removes all varnish in the fuel system without having to remove the carburetor, removes carbon deposits, removes water, reconditions rubber and plastic components, and revitalizes old fuel. *Mechanic In A Bottle* rejuvenates your equipment's fuel system so that it starts efficiently and operates in top condition.

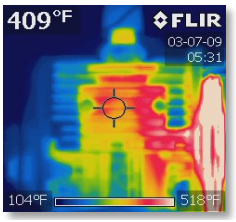
As ethanol use increases across the United States, we will continue to educate the public about the issues associated with its use and will continue to offer solutions to combat the negative effects that may result from using ethanol blended fuel.



Non-Ethanol Gas with 50:1 Oil Mix



Ethanol Blended (E10) Gas with 50:1 Oil Mix



Ethanol Blended (E10) Gas with 50:1 Oil Mix using Ethanol Shield with Combustion Cooled Technology (CCT)