

Ethanol and Two-Stroke Cycle Engines

Impacts of an Alternative Fuel in Small Engines

Ethanol has received much attention as it is the only commercially-available renewable fuel blended for gasoline engines. Although ethanol meets many requirements of an alternative to petroleum-derived gasoline, its performance in two-stroke cycle engines (also known as two-stroke or two-cycle engines) has created some concerns.

Because ethanol has different combustion characteristics than gasoline, some people suggest it will cause harm to two-stroke engines found in all-terrain vehicles (ATVs), lawn and garden equipment, and marine engines. Two-stroke engines require an oil and gas mixture for a fuel source, and the oil and gas are mixed in a ratio specified by the engine manufacturer. Fortunately, the concern with ethanol blended fuels is primarily associated with older engines. The majority of engine manufacturers have now designed their engines to run on E-10 blends (10% ethanol, 90% gasoline), but some precautions still remain. This bulletin will discuss the reasoning behind these precautions and why owners of some equipment powered by two-stroke engines may have concerns.

ETHANOL FORMULATIONS AND MARKETING

Ethanol is an organic alcohol produced by sugar fermentation involving yeast. The majority of fuel ethanol in the United States is a product of corn starch processed into simple sugars (such as glucose, fructose, and sucrose), then fermented and distilled to produce ethanol. Energy independence, improved air quality, and the need to replace the fuel oxygenate known as MTBE have significantly increased the production and use of ethanol in the United States over the last decade. Many gasoline pumps in America today contain a blended



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fuel that may be up to 10% ethanol with the rest being gasoline. This blend is known as E10. In addition to replacing MTBE blended gasoline, the prevalence of E10 is also a result of air pollution reduction strategies regulated by the US Environmental Protection Agency (EPA). Recently, the US EPA approved a waiver that allowed the ethanol formulation to be increased to 15% ethanol, or E15, for most vehicles newer than 2001. Less than 1% of gas stations in America, however, are distributing E15. Also, the EPA's rule does stipulate some exemptions, which include outdoor power equipment, motorcycles, and off-highway vehicles. We simply don't have enough data on two-stroke engine performance when burning E15 fuel to suggest that it can be safely burned in these engines. So there is currently no requirement for these engines to operate on either E10 or E15 fuels.

PROBLEMS WITH ETHANOL

The introduction of ethanol to gasoline-based fuels changes the combustion characteristics within the engine as well as presents unique fuel storage

challenges. Several concerns regarding the use of ethanol fuels can be found on websites, message boards, and in the popular press. These are the four biggest concerns with ethanol-blended fuels:

1. The addition of ethanol changes the way fuel combusts in the engine, the “power” of the explosion, and fuel efficiency.

This is true as ethanol has a higher octane rating that changes the optimal compression ratio, spark timing, and fuel-air ratio. Most cars have electronic fuel injection controls to monitor and change the injection of fuel based on ethanol content. Small two-stroke engines do not have computerized controls and cannot make adjustments to the timing of the engine. Engine manufacturers have compensated for this fact, however, and modern two-stroke engines can burn fuels with up to 10% ethanol content. Checking with the manufacturer is the only way to ensure which fuels can be used efficiently in a particular engine. The energy content of an E10 or even E15 fuel is not that different from regular gasoline with MTBE as its oxygenate, so switching between these three fuel types is not a serious concern.

2. Ethanol introduces a risk that water will be absorbed into the fuel tank.

This is somewhat true because ethanol is hydroscopic (it attracts water) and will absorb water into the ethanol-gasoline fuel mixture. This water can come from condensation in the fuel tank

or from outside sources (particularly a concern with marine applications). However, if fresh fuel is used or additives are mixed into the fuel if water contamination is suspected, this problem can be avoided. Otherwise, increased corrosion of engine components may be noticed.

3. Ethanol is a solvent and releases deposits into the fuel and combustion systems in the engine that will cause damage.

This is also true and a great concern for two-stroke engines. Ethanol is a solvent and can breakdown sludge and deposits in the fuel system, releasing them to flow throughout the engine. Two-stroke engines have small holes known as ports and jets that could become clogged and harm engine performance. There are tools and methods available to clean the openings if and when this occurs. Clogging is most likely to occur with older engines that have operated for many seasons using nonethanol.

4. Ethanol dissolves plastics, hose materials, and gaskets.

This is also true for older engines, but most engines sold today use materials that are resistant to alcohol and will not pose a problem. Contacting the equipment manufacturer (or reading the operator manual) is the best way to determine if a particular piece of equipment has ethanol-resistant components. There is no hard manufacturing date when all engines went to ethanol-resistant components.

Table 1. Engine manufacturer websites that address ethanol-blended fuels (accessed August 24, 2013)

Manufacturer	Website
Briggs and Stratton	www.briggsandstratton.com/us/en/support/faqs/fuel-recommendations
Honda	engines.honda.com/parts-and-support/fuel-recommendations/
Husqvarna	www.husqvarna.com/us/outthere-news/take-the-ethanol-challenge-by-husqvarna/
Kohler	www.kohlerengines.com/maintenance/faqs.htm
KTM	www.ktm.com/us/dealer-service/service/fuel-recommendations.html
Mercury Marine	www.mercurymarine.com/service-and-support/storage-and-maintenance/faqs/outboards/?category=ethanol
Poulan	www.poulan.com/customer-support/faq/chain-saws/
Stihl	www.stihlusa.com/information/articles/gasoline-guidelines-outdoor-power-equipment/
Yamaha	www.yamahaoutboards.com/owner-resources/blog/pro-anglers/yamaha-offers-help-ethanol-fuels

These concerns associated with ethanol-enriched fuels are valid for older engines. Most engines sold today have accounted for these factors. Water attraction and the evaporation over time, however, are real concerns that can lead to varnish deposits, which require operator precaution and attention. For example, if storing an engine over several months, take appropriate precautions, such as removing the gasoline or using a fuel stabilizer. The majority of engine manufacturers say that running 10% ethanol blended fuels in their engines is acceptable and will not cause problems. Table 1 provides a list of engine manufacturers with the websites for their fuel recommendations.

PAYING FOR REPAIRS FROM FUEL ISSUES

Repairs related to fuel issues can lead to disputes that are hard to resolve. An engine warranty covers only parts and workmanship for manufacture of the engine. If the engine manufacturer believes that fuel is the reason for the warranty claim, then they will either ask for the fuel supplier to pay for the repairs (assuming poor quality fuel was purchased) or the customer would have to pay for repairs (for example, if he or she used the wrong oil-gas mixture or wrong fuel type). In other words, if a fuel-related failure occurs, it can be difficult to successfully process a warranty claim.

SUMMARY

The majority of two-stroke cycle engine manufacturers have information in printed technical manuals or on their websites that discusses the use of ethanol fuels. Most approve the use of fuels with up to 10% ethanol. If you have concerns about the fuel being burned in an engine, there are a couple of options for the consumer. First, contact the manufacturer with the year, make, and model of the implement in question and inquire about the types of fuel that can be burned in an engine without causing harm. Talking to the manufacturer directly will provide the most accurate information as opposed to talking to a local mechanic or repair shop. Second, there are a number of ethanol fuel treatments that can be mixed into fuels as well as boutique fuels (100% gasoline) available to run in an engine without causing harm. Otherwise, these suggestions are useful:

- Buy fuel at the engine manufacturer's recommended octane level.
- Keep the fuel supply fresh (less than two months old).
- Do not keep fuel in an engine's fuel tank for long periods.
- Monitor fuel for changes in color, odor, separation, and viscosity (for example, check to see if the fuel is getting thick and syrupy).

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