



Report on Ethanol in Gasoline: Recommendations from the Compact Equipment and Technology Working Team-January 2010:

The members of the Compact Equipment and Technology Working team have compiled this report and recommendations to assist in safe operation of gasoline combustion engines commonly used in wildland fire suppression.

With much current discussion in the use of ethanol based fuels in small engines, the purpose of this report is to outline some of the problems associated with ethanol in gasoline and make some recommendations.

In researching the topic of ethanol as an additive to gasoline, it became clear that although there is a lot of “anecdotal” evidence of ethanol causing problems in small engines, there have been very few scientific studies on the subject. All scientific studies used in this report are associated with the use of E10 fuel (gasoline with 10% ethanol).

Problems: There are essentially 2 main problems with ethanol as an additive in fuel: “Phase Separation” and “Incompatibility” of engine components and equipment to ethanol.

Water Phase Separation: Ethanol has hygroscopic qualities in it that attracts and mixes with water. In low concentrations (up to 0.5% volume) of water the alcohol will mix and remove the water as the fuel is burned and not harm the engine. At higher concentrations, the heavier water will separate from the fuel and pool at the bottom of the fuel container. This can be a problem if the fuel pick up is at the bottom of the fuel tank. In the case of a two stroke mixture the lubrication oil will mostly be in the gasoline at the top of the tank, resulting in the water/ethanol phase being combusted in the engine first. The result is possible engine damage due to a lack of lubrication. A four stroke engine may experience a loss of power and possible engine damage. However water in the form of moisture in the air is not generally enough to cause phase separation if fuel is stored for only short periods of time. The bottom line is ethanol will attract water in the air extremely slowly; however it will most likely stay in solution and be harmless to the engine.

Incompatibility of Engine Components and Equipment to Ethanol: Material used in constructing certain engine components may be incompatible with ethanol. There is some evidence to suggest that certain plastics, fiberglass, cork gaskets and natural rubber may be attacked and degraded by ethanol. These materials are often used in fuel and carburetion systems. Resulting damage due to deterioration of materials would result in loss of critical engine components, fuel leaks and equipment failure.

Ethanol also corrodes certain metals. Corrosion occurs through three different mechanisms including acidic attack, galvanic activity, and chemical interaction. Ethanol

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attracts and dissolves water creating a slightly acidic solution. Unlike gasoline, ethanol alone or combined with water conducts electricity. This conductivity creates a galvanic cell that causes exposed metals to corrode. Direct chemical interaction with ethanol molecules on certain metals can also cause corrosion.

Recommendations for use of gasoline with up to 10% ethanol:

1. Always follow the manufactures recommendations.
2. Store fuel in air tight containers. Many small engine tanks have vents that should be stored closed.
3. Store tanks full to prevent condensation of water from air.
4. Store fuel for no longer than 30 days.
5. Use of engine and fuel system materials that are compatible with ethanol.
6. There are a variety of fuel stabilizers that may help minimize water and corrosion problems. Always check with the manufacturer regarding use of additives.
7. In the absence of perfect knowledge, diligence in the form of routine inspection and maintenance is the best way to avoid problems.

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