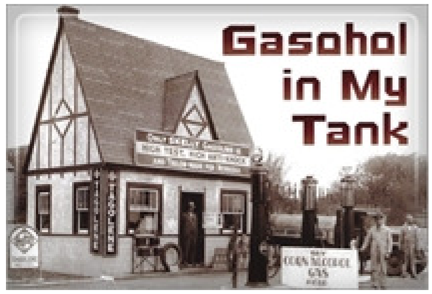
COMPARATIVE EVAULATION OF PREVENTION OF GASOHOL PHASE SEPARATION BY FUEL ADDITIVES

by Benjamin Kellogg



The Lundt Brothers gas station in Blair, Nebraska, in 1934. Their sign emblazoned with "Buy Corn Alcohol Gas Here" proves that gasohol is an idea that has been around for quite some time, at least in Nebraska!

Do ethanol fuel additives really deliver what they promise and help save your engine from the ravages of E10? In this article, some popular fuel additives are put to the test. Did you know that certain fuel additives can increase the stability of fuels containing ethanol? Author and chemist Benjamin Kellogg discusses several readily available additives and how they can make modern fuels less harmful to your historic vehicles. This article, which first appeared in the Fall 2011 issue of Army Motors, presents the results of an objective experiment designed to prove or refute the benefits of "fuel stabilizers." --The Editors

Introduction:

To design a simple, yet reproducible experiment to test the "storage enhancing" properties of fuel stabilizers, I decided to test the ability of these additives to alter phase separation points. Two additives were compared by a simple titration experiment.

Background:

E10 gasohol is an inherently hygroscopic (absorbing and retaining water) solution due to the chemical nature of the ethanol (ethyl alcohol) added to the petroleum gasoline. The hygroscopic character of the ethanol means that gasohol will contain water. The actual amount of water that can be held in solution in E10 varies directly with temperature. At 20° C, E10 can contain as much as 0.5 ml of water per 100 ml of E10. At -10° C, E10 can only hold 0.3 ml of water per 100 ml of E10.

Once the water content exceeds these limits, the phenomenon of "phase separation" will occur. Gasohol phase separation happens when the ethanol and water components separate from the petroleum gasoline; i.e., the “phases” of the E10 gasohol solution “separate.”

During phase separation, the more dense ethanol and water components settle to the bottom of the container (i.e., the fuel tank), while the less dense gasoline components rise to the top. The process is essentially irreversible. If phase separation happens in a fuel tank, corrosion can occur in the lower aspects of the tank exposed to the ethanol and water component. Fuel stabilizers purportedly allow a greater amount of water to remain in solution in the gasohol before phase separation occurs. This claim could be tested.

Methods:

Two Eastwood “Fuel Guard” products were obtained for these tests: Fuel Guard Protection formula to be used for every fill-up and Fuel Stabilizer formula for fuel stored up to 12 months. These fuel additives were mixed separately and in combination into 50 ml of E10 gasohol according to manufacturer’s instructions. The amounts of each that were added to 50 ml of E10 are given in the following table:

CONTROL	No additive
Fuel Protection Formula	0.15625 ml
Fuel Stabilization Formula	0.15625 ml
Fuel Protection Formula and Fuel Stabilization Formula	0.15625 ml and 0.15625 ml Additive total = 0.3125

These solutions were placed in flasks and cooled to 10° C in an ice bath. The solution in each flask was stirred with a magnetic stirrer while distilled water was titrated in. The end point of each titration was visually determined upon noting the occurrence of phase separation.

Results:

E10 with no additives underwent phase separation with the addition of 0.30 ml water. In contrast, addition of either the Fuel Protection or Fuel Stabilization formulas delayed phase separation until the addition of 0.50 and 0.49 ml of water, respectively. Finally, the addition of both the Fuel Protection and Fuel Stabilization formulas to 50 ml E10 delayed phase separation until 0.69 ml water was added.

Discussion:

When used separately, either the Eastwood Fuel Protection Formula or Fuel Stabilization Formula increases the amount of water that can be retained in solution by E10 gasohol by 66% before phase separation occurs. Furthermore, the combination of both additives in E10 increases resistance to phase separation by 133 percent; a significantly better result than when either product was used alone.

These results demonstrate that the risk of phase separation is reduced when these products are used in E10 gasohol. The reason for the increased effectiveness of the combination of the two formulas is unclear. Product information available to the consumer states that both additives contain exactly the same chemical ingredients: napthenic oil, hydroethylated aminoethylamide, and petroleum naptha. The proportions of these ingredients in the different products are not given (nor were they provided to me despite a direct request to Eastwood). It is possible that the advantage derived from combining the Fuel Protection and Fuel Stabilization formulas represented a mere doubling of the ingredients rather than some other enhancement derived from combining the two products.

Conclusions:

Eastwood Ethanol Fuel Protection and Fuel Stabilization formulas significantly increase E10 gasohol resistance to phase separation and decrease the probability that phase separation will occur in the fuel tank of stored vehicles.

Epilogue:

Given the results of the foregoing experiment, I will incorporate the fuel additives into the gasohol that goes into my HMVs. The additive's cost will be insignificant compared to the cost of repairs that could result from the use of E10. In addition, tanks of fuel last a long time in my historic military vehicles and thus increases the risk of gasohol related problems, so I have decided to keep a minimal amount of fuel in their tanks so that the fuel is replenished frequently with new fuel and the now-proven-effective anti-alcohol additives. The fuel additives worked in the lab, so they should work in the tank.
Results:

E10 with no additives underwent phase separation with the addition of 0.30 ml water. In contrast, addition of either the Fuel Protection or Fuel Stabilization formulas delayed phase separation until the addition of 0.50 and 0.49 ml of water, respectively. Finally, the addition of both the Fuel Protection and Fuel Stabilization formulas to 50 ml E10 delayed phase separation until 0.69 ml water was added.