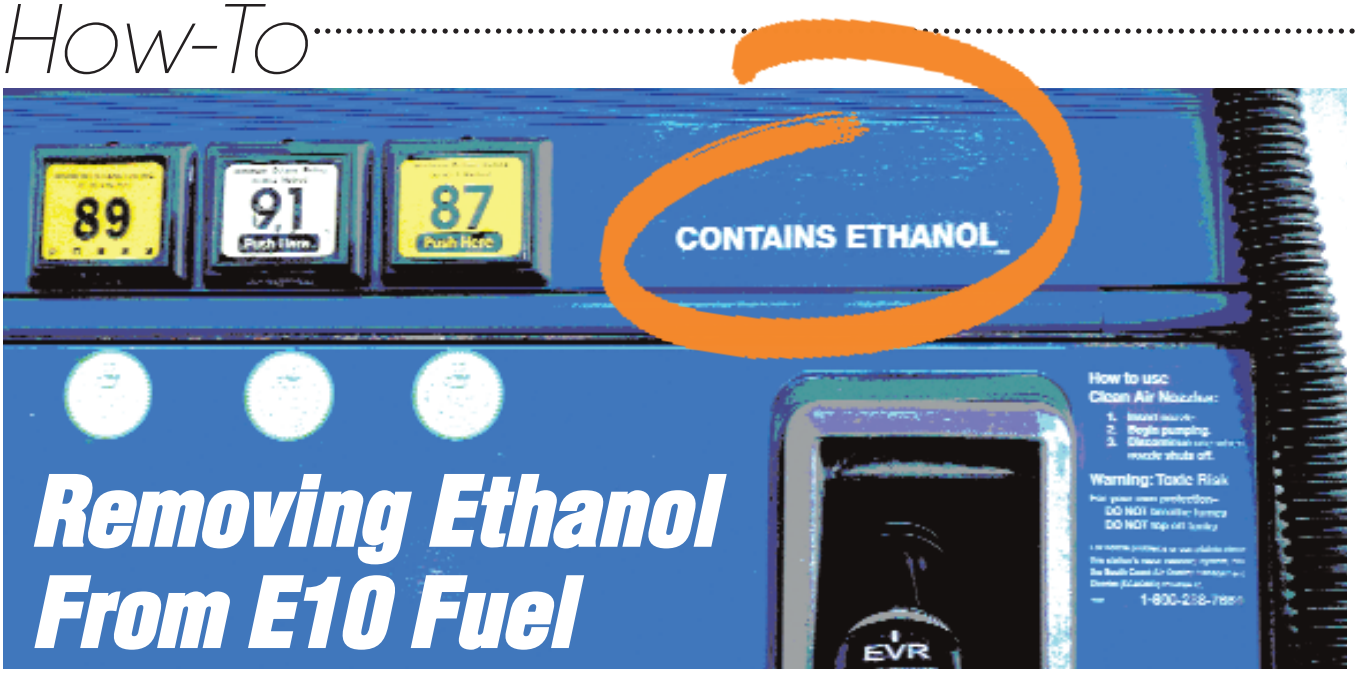


Removing Ethanol From E10 Fuel

by Dave Searle

E10 FUEL, CONTAINING 10% ethanol, is now the only fuel sold across the majority of the country. And E15 is coming. Pushed by the ethanol lobby, it has received EPA approval for 2001 and newer automobiles despite the fact that the car manufacturers don't want it and it is not approved for use by any motorcycle OEM either. Because the fuel hose on most gas pumps contains about three-quarters of a gallon of whatever was sold previously, to accommodate motorcyclists, E15 will be restricted to sales of four gallons or more so that motorcycles won't be filled inadvertently with much more ethanol than their bikes are allowed. Comforting, no? Does your motorcycle even have a tank bigger than four gallons?

As my September 2012 Open Road column revealed, the problems with gasoline/ethanol blends include phase separation, which happens when the ethanol (which is hygroscopic, meaning it has an affinity for water) has absorbed enough atmospheric moisture to fall out of suspension with the gasoline. We're told the precise amount of water required to affect this separation depends on temperature. At 60° F, it's said to take just .45% water to create separation, slightly more at higher temperatures and even less at lower temperatures. Exposure to a breeze will also accelerate water condensation, as the ethanol will chill the fuel container, creating beads of water on its walls.

Of course, most new motorcycles as well as cars have essentially sealed fuel systems that prevent much contact between the fuel and the atmosphere, so phase separation is less of a problem.

However, many of us own older motorcycles with fuel vents that aren't so particular, and many of these are powered by two-stroke engines. Two-strokes have additional problems due to the fact that ethanol breaks down the effective lubrication of fuel/oil mixtures, leading to seizures. I'd never seized my go-kart engine until I first used E10 in premix.

Corrosion is the other problem. E10 is particularly corrosive to plastics, rubber, aluminum and fiberglass compared to straight gasoline, and the mixture of water and ethanol that settles to the bottom of the gastank when E10 phase separates is possibly even more corrosive.

While a phase-separated mixture of alcohol and water is supposedly actually combustible in an engine, it would create a much leaner mixture than E10 or gasoline, with the potential for engine damage from high temperatures.

And it's not just the fiberglass tanks on vintage bikes that experience ethanol issues. The swollen gastanks on late model Ducati Sport Classics are also caused by ethanol. Thankfully, the reason that most aftermarket plastic gas tanks don't react the same way is that they are made from a different polymer formulation. The Ducati tanks couldn't share this type because they needed to be paintable.

When E10 is allowed to sit for a long time in a fuel system, the volatile portion of the fuel will eventually evaporate, leaving a milky residue behind. And this goo will eventually harden into an amber solid that cracks into tiny pieces—creating a mass of insoluble debris that must be physically removed before the engine can be brought back to life.

As the problems that E10 creates with small engines and also with marine engines (which naturally have much greater atmospheric exposure to moisture than land vehicles) are well documented, let's say you'd like to run your vintage dirt bike, personal watercraft, snowmobile, go-kart, lawn equipment or other machine on pure gas, but it's either not available in your area (see *pure-gas.org*) or you would have to buy expensive race gas to have ethanol-free fuel. In fact, it's possible to remove the ethanol from E10 fairly easily, leaving you with pure gasoline and a small quantity of left-over water/ethanol.

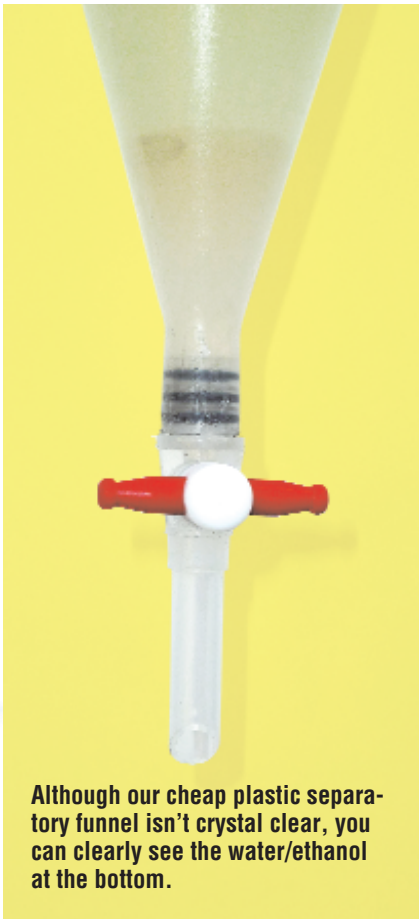
Removing Ethanol

Since phase separation happens naturally to E10 when exposed to water, all you have to do is deliberately introduce a small quantity of water into a quantity of E10, shake or stir and wait for it to separate; the lighter gasoline will rise to the top, leaving the heavier water/ethanol on the bottom.

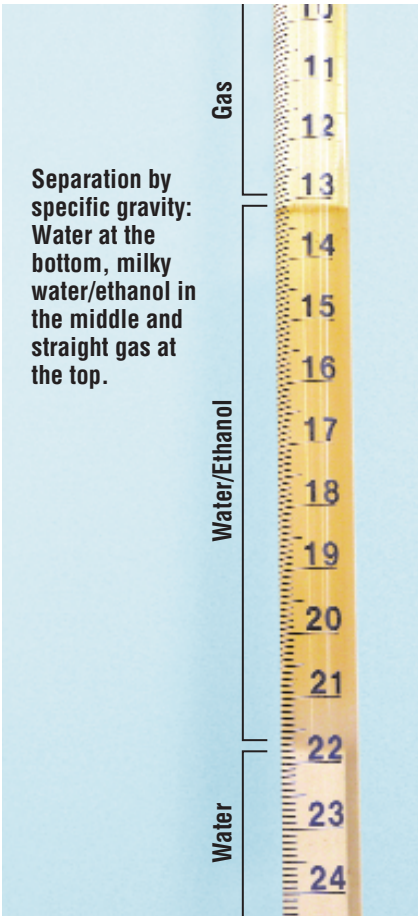
We've illustrated the procedure with a laboratory device called a separatory funnel, a bottle with a screw-on cap and a tapered bottom that ends in a valve, which allows the separated water/ethanol to be drawn off precisely.

We first tested the claim that as little as .45% water at 60°F will create phase separation. As our ambient temperature was slightly higher, we used .5%. To start, we added 500cc (one-half liter) to our separatory funnel, and added .5% water, which is 2.5cc. We used the same 25cc graduated burette we used for combustion chamber measurement for accurate water dispensing. The funnel was then capped and shaken to achieve mixing. Phase separation happened within a matter of minutes. However, the amount of water/ethanol separated was much less than the 10% anticipated, just 8.6cc instead of the 50cc that E10 would be expected to contain.

Our chemistry set included a 500cc graduated cylinder for measuring fuel; a 25cc burette for accurately adding water, and measuring separated water, gas and water/ethanol; and a separatory funnel to drain the phase-separated water-ethanol.



Although our cheap plastic separatory funnel isn't crystal clear, you can clearly see the water/ethanol at the bottom.



This result suggests partial phase separation, which might also be expected to happen with even smaller amounts of water. So we tried a second test with 5cc of water in 500cc of E10. This time, the amount separated was 48cc, nearly the 50cc we'd expected. But, as you can't be absolutely sure the gas pumps have added just the 10% ethanol allowed by law in E10 fuel, we'd suggest an even larger quantity of water (say 2%) if all you want to do is remove all the ethanol. (Per gallon, 2% would be 75.7cc or 2.56 oz. of water, and 5 tablespoons, equal to 2.5 oz., is close.)

Determining Ethanol Concentrations

If you have a few relatively inexpensive lab tools, it's also possible to determine the actual quantity of ethanol in a given sample of E10. Starting with our 500cc separatory funnel, a 500cc graduated cylinder and a 25cc burette (see photo), we'd suggest you add exactly 10cc of water to 500cc of E10, stir vigorously and wait for the ethanol to fully separate (an hour will probably be plenty of time).

To measure the ethanol, first fill your graduated burette to the bottom 25cc mark with water, and with it resting upright (inside the graduated cylinder is handy), you can carefully dispense the cloudy ethanol/water portion into the burette, being careful to stop when it reaches the zero mark. Because you'd expect to collect 50cc of ethanol and 10cc of water, you will probably have to fill the burette more than once. Each time, note the amount of milky water/ethanol in the sample, draw off the lower portion of water in the burette and then save the separated ethanol/water in a closed container. Refill the burette with water to the 25cc mark before repeating the technique. Ideally, you will collect 60cc of water/ethanol from a 500cc sample of E10 if it truly contains 10% ethanol. With good tools, you can separate without creating toxic waste. The ethanol is only grain alcohol, now suspended in water, and the gasoline is reused.

Pure ethanol is ~113 octane, so removing it from E10 will reduce octane, turning premium to regular. To re-achieve high octane, a booster must be added.

Final Thoughts

To achieve high octane, your separated pure gas should be dosed with octane booster to replace the ethanol's contribution. Although our quantities were admittedly small, to speed the process, we'd recommend 5-gal. glass or PET plastic jugs (see eBay or beer brewing suppliers like *midwestsupplies.com*) fitted with stopcocks and vent tubes. At this size, you can quickly and easily make all the pure gasoline you want and forget about ethanol's problems.

Resources

Nova Tech Intl.—Laboratory Supplies. Separatory Funnels 500cc: glass $31.87; plastic $20.62. Graduated Cylinders 500cc: Glass $26.10; plastic $6.48. Burettes 25cc: Glass $27.69. Phone: 866-433-6682; novatech-usa.com