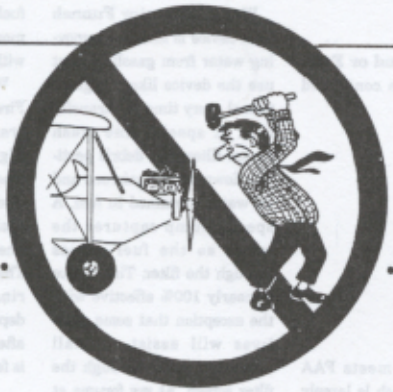
THE PROPER CARE & FEEDING OF THE ROTAX MOTOR



PART 37

by Mike Stratman

THE GOOD, THE BAD, AND THE UGLY OF OXYGENATED FUELS

Thanks to a multitude of government bureaucrats, what you buy at the gas pump may or may not be hazardous to your 2-cycle engine. Ever since the Sharp-Rockefeller Alternative Fuels Act of 1988 (Bill #PL100-494), which mandates increasing levels of oxygenated fuels all the way to the year 2004, operators of 2-cycle engines must be more educated and vigilant than ever. Way back in 1989 in Part #19 "Taking Control of What Your Engine Burn," we first discussed the various types of gasoline additives. As we predicted then, the quality of fuel has taken a real beating in the name of the environment.

This month we'll take an in-depth look at the common types of additives, the positive and negative effects they have on combustion in 2-cycle engines, and what you can do to be a smart operator and avoid trouble.

Remember these names so you can be sure to vote them out in the next election!

Increasing Use Of Additives: As the Alternative Fuels Act is implemented, the percentage of additives will continue to increase. The term "Oxygenated Fuels" is now commonly used to characterize additives that burn cleaner and produce less pollution when added to pure refined gasoline. Some of the more common of these additives are ethanol, methanol, isopropyl alcohol, tertiary butyl alcohol, and MTBEs. Of course there are more than these listed, but these are the most common and some of the deadliest to 2-cycle engines.

Methanol: The "ugliest" of all the additives is methanol. The dictionary lists methanol as also being called Methyl Alcohol. . . A colorless flammable liquid, CH3OH, used as an anti-freeze, general solvent, fuel, and denaturant for ethyl alcohol. Also called "wood alcohol" or "wood spirits." This highly corrosive additive will literally "eat" rubber, aluminum, steel, fiberglass, which includes your crankshaft, pistons, gaskets, fuel tanks, etc. If this isn't bad enough, methanol has an unlimited ability to consume water. Remember the TV commercials that stated "Rolaids consumes 47 times its weight in excess stomach acid"? Methanol's ability doesn't stop at 47 times its weight. It will attract all the water it can find in the air, in condensation, or anywhere during transportation and never gets tired. If you live in a humid climate, this will obviously be accelerated. Methanol also leans out carburetion, causes poor cold weather starting, decreases fuel economy, and increases chances of vapor lock.

What is "good" about methanol is that it is an excellent octane booster, has potential to boost power, reduce exhaust emissions, and is widely available. Obviously a load of this stuff in a tank full of fuel can have some lasting effects. The government does require that service stations must label the pump if more than 3% methanol exists in the fuel. This percentage figure may vary slightly by state and will continue to rise in accordance with the Alternative Fuels Act. As discussed in Part 19 "Taking Control of What Your Engine Burns," there is a simple way to check for methanol or other additives with an affinity for water. More about this test in a minute.

Alcohol: As the name suggests, alcohol could be considered the "bad" of the gasoline additives. The dictionary lists alcohol a colorless volatile flammable liquid, C2H5OH, synthesized or obtained by fermentation of sugars and starches, and widely used, either pure or denatured, as a solvent, in drugs, cleaning solutions, explosives, and intoxicating beverages. Also called "ethanol," "ethyl alcohol," or "grain alcohol".

Generally alcohol is not considered corrosive like methanol, but does have the same affinity for water and will draw water in from the air. This is a real drawback to good, clean combustion vitally important in all 2-cycle engines. Law requires that more than 10% alcohol (including methanol) must be labeled on the pump.

Methyl Tertiary Butyl Ether (MTBE)s: MTBEs are commonly found in the better grades of pump gas. They have no affinity for water, but do not have the excellent octane boosting characteristics of methanol or alcohol. Therefore the percentage needed to boost octane will be considerably higher, up to 15% in many cases. Because this additive lacks the drawbacks of alcohol or methanol, it is considered to be okay for use in 2-cycle engines. On the other hand, it is fairly expensive to produce meaning you will only find this additive used by more famous or recognizable gasolines. Currently law requires pump labeling of MTBEs at more than 15%. While the major oil companies will not be specific for proprietary reasons, Chevron's "Techroline" or Shell's "SU-2000" are some of the places you will find MTBEs.

Figure #1—The Olive Jar Test is a sure fire way to detect alcohol or methanol in fuel. Any rise above the marked water level indicates their presence.

Testing For Additives: For what we have discussed so far, the "Olive Jar Test" is an extremely accurate way to spot these additives at the pump. Let's review this method for those readers not av are of how it works. Locate a tall slender glass jar or test tube with a sealing lid. I've seen fancy test kits with markings for percentages on the glass, but the $15 price tag makes them a little silly. An olive jar for less than $2 will do fine after you eat the olives. Permanently mark the jar at a point about 1/4 from the bottom. Fill the jar exactly to this mark with water. Fill the rest of the jar with your fuel sample and seal the lid. Shake the sample vigorously for a few seconds and let stand. Because methanol or alcohol has such an attraction to water, any percentage present in the fuel will mix immediately with the water sample, causing the water level to rise. The amount of rise is, of course, equal to the additive percentage present in the fuel. Of course MTBEs will not show in the test because they lack the affinity for water. The nice part of this test is you can usually get enough fuel out of the pump hose before you buy the gas, although the station attendant may not share your enthusiasm.

AV Gas - Friend or Foe?: Aviation gas is a controlled substance that meets FAA specifications which is largely the reason it sells for considerably more than pump gas. The positive quality of AV Gas is that you will not find any strange additives and certainly not alcohol or methanol. Any water found in AV Gas is a result of poor storage and testing by the FBO and can be removed easily with the use of a water separator funnel. More about this device in a minute.

AV Gas is found in three grades: 80 Low Lead (red in color) is becoming rare as it is only used in older Lycomings and Continentals. If you must rely on AV Gas, 100 Low Lead (blue in color) is the best choice for your Rotax. But the lead content will foul plugs quicker and will lead to more carbon deposits than unleaded fuel.

The third grade of AV Gas is 100/130 Octane (green in color) and should be avoided for use in a Rotax. At most airports you will find only 100LL or 100/130LL.

STC-Certified Auto Gas is available at some airports. Generally the octane rating is considered too low for use in Rotax engines. Certified auto gas is allowed to have MTBEs but not alcohol or methanol. A mix of Certified Auto Gas 50-50 with 100LL would actually be an excellent choice when buying aviation fuel.

Figure #2—A water separator funnel, brand name Mr. Funnel, is a real necessity in the fight against problems associated with the use of oxygenated fuels.

Water Separator Funnel: This device is ideal for removing water from gasoline. Just use the device like a regular funnel every time you transfer fuel. A special fine mesh screen filters out debris particles down to .005 microns and all water contained in fuel. A special sump captures the water as the fuel passes through the filter. This device is nearly 100% effective with the exception that some additives will assist a small amount of water through the filter screen. At my forums at Oshkosh the last few years, I performed my best David Copperfield impression by pouring large quantities of water into this type of funnel. Nothing comes out the bottom! Next pour a fuel sample in and the fuel goes right on through. This year an oldtimer approached me afterwards and said this idea is really not that new, he used a regular steel funnel lined with an old chamois skin for years before this device was available. So much for magic tricks!

A Mr. Funnel brand funnel is available in two sizes: 2.5 gallons per minute (about $10) and 5 gallons per minute size (about $25). It's an excellent product used by many safety-conscious pilots. Technically speaking, the funnel should be grounded with a safety ground strap during use. In rare instances, static electricity has created sparks and fires during fueling. A simple length of wire and two alligator clips works fine.

Problems With Water: Now that you can see how to keep water out of your fuel, we need to explain why this is so important. In a regular 4-cycle engine, water in the fuel is nowhere near as deadly as in a 2-cycle engine. Unlike 4-cycle engines which use a dedicated lubrication system, two-strokes are lubricated by the fuel mixture which means all moving parts come in contact with the fuel.

Water causes two problems. First, like all metal parts, the crank and piston parts are highly susceptible to rust when exposed to water. Water also collects at the bottom of a fuel tank where the pickup line can suck it up all at once. This usually results in stuck rings and massive carbon deposits in engines even right after rebuilds. Oftentimes this is falsely blamed on "the oil."

Choosing A Two-Cycle Lubricant: Premature failures of con rod bearings are becoming a new problem plaguing 2-cycle engines. It is my opinion that this is a result of more exposure to oxygenated fuels (water) as well as pure synthetic 2-cycle lubricants with reputations for poor rust protection. Yes, that's right, I am pointing fingers at (or is it more like sticking my head in the lion's mouth?) some brands that boost superior quality lubrication through the use of "pure synthetic" ingredients. In actuality, these products are alcohol- or ester-based products. It has long been the Achilles heel of synthetics that they do not provide sufficient protection from rust or "inter-granular corrosion" as I have heard it stated by Rotax factory engineers. Makers of pure synthetic oils will insist that they have additives that take care of the poor rust protection problem, but the field results just aren't bearing this out. I have always advocated at least a substantial percentage of mineral base oil for rust protection. Due to oxygenated fuels, it is more important than ever to select the proper 2-cycle lubricant. [See Part #23, "Understanding Two-Cycle Lubricants," *Ultralight Flying!* magazine, June 1990 for more information.]

Conclusions: Now that we no longer avoid the presence of oxygenated fuels (unless you run AV Gas), what should the smart operator do to avoid falling victim to their ravages? Here is a guideline to follow:

1. Don't be afraid to ask questions. Asking the minimum wage employee at the Gas-Food Mart what type of additives his gasoline has is obviously a waste of time. Check the pump for additive warnings. It is law that over 10% alcohol and 3% methanol must be labeled as such.

2. Use the Olive Jar Test religiously. If you see an abundance of alcohol or methanol, move on to another gas station. Avoid the Rotten Robbie Brand gasoline (yes, there is actually a chain of stations in California that go by this name!). While their prices may be the lowest in town, it goes to reason that the quality of the gas may be too! Use only nationally known brands' high octane (91 or better) unleaded fuel.

3. Use a water separator funnel every time you transfer fuel. Be sure to use a grounding strap to avoid static spark.

4. Always agitate fuel tanks completely after mixing and before flight.

5. Never use fuel that is more than two months old. Old fuel is likely to have breathed off a good portion of its octane and has had time to attract water.

6. Always drain carburetors and fuel tanks before prolonged storage. Methanol should not be given all winter to eat away component parts.

7. Always use an oil with at least a substantial mineral base component, especially if you fly less frequently.

8. If you insist on using pure synthetic oils, be sure to run a mineral-based oil in the crankcase before prolonged storage.

Hopefully these guidelines will help take the mystery out of the oxygenated fuel situation. Remember there will never be a replacement for an educated operator and a good program of preventative maintenance.