THE GAMGRAM

No. 52 **JET FUEL ADDITIVES PART 1: ANTI-ICING ADDITIVE** **FEB 2001**

If you read the ingredients on virtually any package of a food or beverage, you almost always see additives listed. It is almost frightening the chemicals that are routinely in the food we eat. You may notice that some candy includes “Propylene Glycol”. Did you know that this is the same chemical we use in northern climates to de-ice aircraft? Additives are a huge business around the world and sure improve most of the products we handle. Aviation fuel is no exception, but there can be problems handling these additives.

We received a call from a customer. He asked, “How do you blend anti-icing additive into jet fuel”? We answered with our usual answer describing the use of an additive injector that is designed to slowly add the additive proportionally to the fuel as if flows through the system. He asked “So you shouldn't just pour the additive into the top of the storage tank before you fill the tank? In shock, we answered “Absolutely not! That would never result in proper mixing. The additive does not readily dissolve into the fuel and is also much heavier. It will sink to the bottom.” He then asked, “Would that hurt a fiberglass tank? Our answer “Absolutely, positively. If you have done this, we'd recommend you stop operation immediately until you can clean out the tank, access the damage to the tank and re-certify the fuel.” Then he explained that he had a complete failure of his brand new tank farm. His tank was damaged, his filters were damaged, and the epoxy lining of the filter separator was peeling. His aluminum meter had damage inside. He had followed the uneducated advice of an additive salesman, and it cost him a great deal of money.

In another case, a pilot called us to ask why his fuel quantity indicators did not work when he took fuel from one particular fuel farm. We suggested a test for static dissipater additive (SDA), and it turned out that an error at the fuel terminal had resulted in over 20 times the correct amount of the additive being injected into the fuel. The fuel was so conductive that his level sensors were rendered useless.

In gasoline, additives are a necessity. There are detergent additives to keep fuel injectors clean, additives to help in the refining process, color dyes and chemical “tags” for product identification and many more. There is a lead-based additive in most Avgas. The chemical industry has made great progress in designing additives for many purposes..

Commercial jet fuel has few, if any, additives. Internationally, static dissipater additive is used very widely, and it is becoming more common in the USA every year. Another common additive is corrosion inhibitor, which is actually used not to control corrosion, but to improve the “lubricity” (the ability of the fuel to act as a lubricant) of the fuel to help fuel pumps and controls last longer. In military fuels, a package of anti-icing, static dissipater and corrosion inhibitor additive is common.

But today we are in a transition on additives. The old anti-icing additive has been changed to a different chemical with different handling concerns and a new additive (+100) is coming into use in some locations, primarily military locations, but also commercial experiments are underway with this promising new additive. Many people believe this will come into wide usage soon.

In this GamGram we will address only the new anti-icing additive known as DiEGME (commonly pronounced dye-egg-me).

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ANTI-ICING ADDITIVE

The most common jet fuel additive used in the USA is anti-icing additive, used only in non-airline (military and general aviation) jet fuels by several oil companies. Perhaps 1/3 of general aviation jet fuel is “pre-treated” from the terminal with this additive. In many other cases, the fueling truck can add the additive if the pilot requests it.

At high altitudes or cold climates, fuel in an aircraft fuel tank will become cooler. As it cools, a haze will condense from water dissolved in the fuel, just like clouds or fog forming in the moist air, as air cools. Filters in your fuel system cannot remove the dissolved water when the fuel is warmer, so the aircraft must be designed to be able to deal with these ice crystals as the fuel cools or else these ice crystals will plug the engine fuel control system filters. Larger commercial aircraft typically have fuel “pre-heaters” to raise the temperature of the fuel entering the engine above 32 degrees F or 0 degrees C. Other aircraft require anti-icing additive. This additive works by being attracted to the water as it comes out of solution to form ice crystals. The additive prevents that water from freezing, and the resulting tiny droplet passes through the filter and into the engine. In small quantities, this water/additive drop does no damage to the engine. The additive may be injected on the refueler or come pre-blended from the oil companies terminal.

The new additive, DiEthylene Glycol Monomethyl Ether, was chosen because it was less hazardous to people than the old additive. It is attracted to water even more strongly than the old additive. This may sound like a good thing for the aircraft, and it is, but it also adds to our concerns. It makes the daily draining of sumps even more important in pretreated jet fuels. This is because if water is left in the bottom of a tank or filter sump, the additive will gravitate to it quite quickly. The resulting mixture can actually become more additive than water! This can cause problems such as:

- The mixture may attack the epoxy tank or filter vessel linings (or directly attack a fiberglass storage tank).
- The mixture may not react properly with standard water finding paste (Special paste must be used).
- The mixture may not "indicate" on electronic water level or water detector devices used in tanks and filter separators.
- The mixture may not be removed fully by filter separators or even water absorbing filter elements. (But the water absorbing elements are safer).
- The fuel is left with less additive than it is supposed to have, which may affect proper performance of the additive in the aircraft.

This additive serves a critical purpose for many aircraft. Indeed it also reduces the growth of microorganisms in the fuel farm and aircraft fuel system. But special care must be exercised to keep the sumps throughout your system drained of water. On the other side of the issue is the fact that untreated fuels can freeze in tank drains, support microorganism growth and of course without additive present at all, many small aircraft and military aircraft cannot safely fly into cold weather or at high altitudes. Even at the equator, air temperature declines rapidly as the aircraft climbs to altitude.

The use of an additive injector on the refueler truck is a viable alternative to pre-treated fuel, but adds its own set of concerns. An empty additive tank, poorly maintained injector or an operator forgetting to turn the injector on (or off) are all problems that have taken place. Some injectors must be calibrated regularly to maintain accuracy.

Of primary concern is the proper concentration of dissolved additive in the aircraft fuel tanks. This requires proper mixing and regular tests are needed to confirm that your system is providing correctly treated fuel to the aircraft.

Another concern is that the additive is properly stored. If water is allowed into the additive tank before it is injected into the fuel, it will not blend at all. As little as 3% water in additive can result in additive not dissolving into the fuel. Do NOT store drums outdoors. Make sure to use a dessicant dryer on the tank/drum vent to keep atmospheric humidity from contaminating the pure additive. The desiccant should be blue. If it is pink, replace the desiccant.

Also be sure to observe the MSDS safety handling instruction to protect personnel.