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## The Use of Biocides in #2 Fuel

We have encountered fuel users who routinely treat their fuel with a biocide. While we have always preached that microbes (bacteria and fungi) are the cause of many common problems in distillate fuels - including sludge and tank corrosion - we have also advised against the routine use of biocides in favor of treatments that stop the bad things these microbes do without trying to kill them. I prefer this approach because, while dealing with cooling water problems at DuPont, I learned how difficult it is to reach and kill slime-forming bacteria with biocides, and I have always known that it is these slime-formers that are the primary builders of biofilms (aka sludge).

Based on my testing of biocides for use in cooling water, my favorite biocide has always been "Kathon", developed by Rohm & Haas (Now Dow Chemical). This product is what chemists call an "isothiazolinone" chemistry, and it has demonstrated excellent kill rates for both bacteria and fungi - but, like all biocides, it needs to contact the living cells in order to kill them. The problem is that slime forming bacteria, once they produce and become encased in slime, are difficult for chemicals to reach. The slime itself is a polysaccharide compound chemically similar to a starch, and this compound is rather selective in what it will and won't allow to penetrate. Scientists who study biofilms have observed that slime-bound microbes often produce what are called "extra cellular" enzymes, which go out onto the slime matrix and convert certain chemical species outside the biofilm into useful compounds that can penetrate the slime and be used by the microbes.

You might wonder why the slime-formers can't be contacted by the biocide and killed before they have had a chance to become encased in their protective slime. Many of them probably are so killed when a fuel system is treated. Many others, though, are already encased in tiny sludge particles brought downstream from a storage tank - perhaps the storage tank at the refinery. These are fast-growing bacteria, so killing, say, 90% of them does little to slow down overall population growth. It might be argued, in fact, that by killing most of the "free-floaters" in the fuel, more of the desired nutrients become then available for the remaining cells that are encased in slime.

Some fuel users treat with biocides on a constant - or at least very frequent - basis. This may be effective in the short run, but the biocide then tends to become less effective with time. This can be because the microbes develop a resistance to the biocide, or it might mean that the treatment has selected for naturally biocide-resistant cells. It is also possible that the biocide has adapted to the biocide and started producing extra cellular enzymes that break down the biocide chemistry. In any case, those most familiar with biocide use generally recommend that biocides be used only occasionally.

I prefer to avoid the use of biocides whenever possible, for this and other reasons (cost, handling safety, etc.) I much prefer to find other ways to defeat the bad things that the microbes do without being a direct threat to the microbes themselves. That is the basis for Fuel Right treatments. For those special situations where biocides are needed, prior treatment with Fuel Right will have helped to dissolve away the protective slime, making the cells much more available to the biocide.

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