A Look Back #5

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This month's reprint – *Opening Your Biocide Toolbox* – originally appeared in NPN's September 1995 issue.

Several of the major points that I made in 1995 need further consideration, based on both changes in the regulatory climate and field experience with microbial contamination control in surface transportation markets.

First, I'll comment to the term *biocides* that I used in the article's title. In the late 1990's the U.S. EPA, Office of Pesticides Programs (OPP) asked that that the terms *microbicide* or *antimicrobial pesticide* be used in reference to products intended for use to kill microbes. EPA officials were concerned that *biocides* inaccurately suggested that these chemicals were highly toxic to all organisms, including humans. Recognizing that many microbicides are used as food preservatives, OPP promoted the use of the kinder and gentler terms.

In the original article, I wrote: "Any product used for fuel treatment must be approved as a fuel additive." That comment was based on the original position communicated by U.S. EPA's Office of Transportation & Air Quality, Fuel & Fuel Additives Division. Subsequently, the Fuel & Fuel Additives Division clarified their position regarding microbicides. Their revised position is that for the most part, fuel-treatment microbicides are used to treat systems rather than fuels. Consequently, unless products are used as fuel additives (see my comments about microbicides as performance additives below), fuel-treatment microbicides do not require approval as fuel additives and are not required to be substantially similar to the fuels in the systems being treated.

In my September 2005 discussion of water-soluble microbicides I focused on the wastefulness of treating bottom-water that was destined for waste treatment. While that argument remains valid, I'd like to offer a more compelling reason for avoiding the use of water-soluble microbicides in fuel-systems. Unless the bottom-water zone is continuous, the microbicide is only going to contact water at the point of treatment. In most bulk storage and underground storage tanks, the bottom is not flat. Consequently, unless the total water depth is greater than the height of the tank bottom surfaces' peaks and valleys, water will accumulate in pools that form in the various low points of the tank. Special measures may be taken to ensure uniform distribution of the water-soluble microbicide across the entire bottom area, but those same measures (aggressive mixing) are also likely to resuspend water and sediment into the fuel-phase. Under most conditions, treating a fuel tank with a water-soluble microbicide is unlikely to expose even the entire bottom-water associated population to the microbicide treatment. That's a poor investment.

The final point that I'll revisit is my suggestion of using fuel-treatment microbicides as performance additives.

I've reversed my 1995 position since writing *Opening Your Biocides Toolbox*. I've come to believe that the potential problems with this strategy far outweigh the potential benefits. To be effective, microbicides must be used at specified dosages. Under-dosing is likely to select for treatment-resistant microbes. As described in the original article, there are several processes that reduce the concentration of a microbicide once it has been added to a fuel system.

These same processes make it very difficult to determine the appropriate starting concentration for a microbicide used as a fuel additive. Moreover, only fuel-soluble or universally soluble microbicides that are approved as both antimicrobial pesticides and fuel additives may be used this way. This limits the choices to products that are not necessarily the most effective microbicides. Moreover, the economics of treatment are unfavorable. Systems holding fuels that contain microbicidal additives will still need periodic microbicide treatment to prevent system biodeterioration.

Bottom line, microbicides as fuel additives does not seem to be a good idea. As I've mentioned in several previous *A Look Back* articles, the best reference for microbicide use in fuels is to be found in Chapter 2 of ASTM Manual 47 – *Fuel and Fuel System Microbiology: fundamentals, diagnostics, and contamination control* – available from ASTM at www.astm.org .

REPRINTED FROM NATIONAL PETROLEUM NEWS **SEPTEMBER 1995**

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OPERATIONS MANAGEMENT

Opening Your Biocide Toolbox

■ Frederick Passman

Regulatory, economic and technical factors make biocide selection complicated and easy to ignore.

Microbes grow wherever water meets fuel. Most people recognize the need to remove bottom water, but even in regularly drained tanks, microbes thrive in tank-wall slime. How do you prevent microbes from degrading fuel and corroding components? The three critical issues determining biocide use are regulation, selection and application.

Biocides kill or inhibit organisms. The U.S. EPA controls biocide use under the Federal Insecticide and Rodenticide Act, which defines manufacturer product registration and stewardship responsibilities. Under FIFRA, each product is approved for specific end uses. Manufacturers may invest up to $250,000 for toxicity data to obtain a biocide registration; therefore, they typically get approval for as many end uses as possible. Since it requires toxicity, but not performance data, EPA registration is no guarantee of performance. The military and the California EPA require rigorous performance data. The prudent biocide purchaser selects products with at least one of these approvals.

FIFRA product labeling regulations are quite strict. For safety, biocide product labels contain use and handling information not required on other equally or more toxic chemicals. Biocides used for fuel treatment are also subject to Clean Air Act regulations. Any product used for fuel treatment must be approved as a fuel additive.

How do you chose a cost-effective product? The three general classes of biocides are:

- *Water-soluble.* These treat water bottoms. The principal advantage is that they're inexpensive. They're best used to treat systems from which you don't drain bottoms-water. Microbes in bottoms-water sent to a waste-treatment plant are adapted to assist the process. Why kill them? The primary disadvantage to water-soluble products is that they don't stay in the fuel long enough to contact the microbes in tank-wall slime or in fuel piping downstream.
- *Fuel-soluble.* These solve this problem and are good for treating systems with little free-water. Completely soluble in fuels, these reach microbes in the slime. Although more expensive, they are generally more cost effective. The biggest drawback is that they are inactivated by water. Breakdown products may contribute to tank corrosion.
- *Universally soluble.* These are typically completely soluble in fuel and partially soluble in water. They combine the advantages and overcome the disadvantages of the other groups. They disperse throughout the fuel phase, reaching microbes systemwide. They partition between fuel and water, meaning as product is consumed, reacting with bugs in the water phase, more product will migrate out of the fuel and into the water. Although the most expensive, they generally provide the best overall cost-effective performance.

Once you've selected a biocide, you need to adopt a use strategy. Traditionally, operators have only treated systems after they've had major problems, which is like waiting until after a heart attack to control weight, blood pressure and cholesterol. Preventive treatment is always less expensive than corrective treatment. There are several appropriate preventive treatment strategies. The common factor is measurement—unless you monitor biocide performance, you risk either spending too much or having the treatment fail.

In certain markets where water and dust contaminate fuel regularly, use a biocide as a performance additive. More fuel distributors are building biocides into premium-grade fuels. Current market trends strengthen the argument for this approach. More severe refining processes produce fuels more susceptible to microbial attack. Oxygenates encourage microbial growth. Pipeline consolidation, resulting in greater fungible product throughput at terminals, decreases the level of control refiners have on product quality. Cardlock and vapor recovery systems at C-stores are more sensitive than older systems to contamination effects.

Once you've established microbial contamination control (this may require tank cleaning as well as biocide treatment), re-treat each time microbial measurement exceeds the target level. Some systems may only need treatment once in two or three years, others weekly or monthly. Re-treatment is generally required because different demands consume biocides. Biocide will be diluted when more fuel is added. Reacting with microbes places a demand on product. More heavily contaminated systems consume biocide faster. Other fuel additives or components may accelerate the rate at which biocide disappears. Don't rely on a fixed schedule, even if recommended. Excellent products get bad reputations when misused. Biocides aren't curealls—they're one group of tools in your system maintenance toolbox.

Regulatory, economic and technical factors make biocide selection complicated and easy to ignore. Use only proven, FIFRA- and CAA-approved products. Biocide-protected systems provide cleaner fuel, reduced corrosion, fewer filter plugging problems, better engine performance and pleased customers.

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