A Look Back

Frederick J. Passman, Ph.D., Biodeterioration Control Associates, Inc., Princeton NJ,
fredp@biodeterioration-control.com

Between 1994 and 1999, I had the opportunity to write a series of articles for *National Petroleum News* (NPN). Each article focused on one aspect of the connection between microbial contamination and operational problems in fuel retail systems. In the 13-years that have lapsed since the publication of *Knowing When You Have Contamination*, our basic understanding of the issue hasn't changes, but some of the tools available to petroleum marketers have.

Beginning with *Uncontrolled Microbes Eat Earnings* last month, and continuing with each of the other articles in the following months, Total Fuel Quality is pleased to present reprints of each of my NPN articles with my comments about what has changed since their original publication.

Knowing When You Have Contamination provided a few very simple techniques that enabled non-technical people to check for microbial contamination. Most of the information in the original article is still valid today, however there are few items that need updating.

My comments about inspecting the fuel-water residue in filter housings need updating. Although I still inspect filters and filter housings that I remove from gasoline dispensers, I no longer expect to find a fuel-water emulsion in the housings. These days, I look for corrosion on the retainer spring and filter-canister base plate. I also cut out portions of the filter medium and run microbiological tests on them.

I still follow the technique that I described for inspecting fuel-tank bottom samples. As the market for ethanol-blended gasoline, ultra low sulfur diesel and biodiesel has mushroomed over the past decade, bottom-sample gross observations have become an even more useful tool for detecting microbial contamination. All of these newer fuels have a greater water-holding capacity and greater risk of microbial attack. Except for long-term storage systems the major issue isn't damage to the fuel; it's damage to the system. Component failure events are strong indicators of serious microbial contamination in the fuel system.

The comments that I made about bottom-water pH are no longer valid for systems holding the newer fuels. Acid production by microbes is masked by additives that move from the fuel-phase into the bottom-water. Even bottom-waters with heavy microbial growth can have alkaline pH values

In my 1994 article I mentioned rapid detection methods in *Knowing When You Have Contamination*. Over the past five years, the ATP test has become a valuable field test for microbes in fuels. ASTM is currently balloting a standard method for testing fuels for ATP content. Increasingly, fuel retailers are using this simple, 5-minute test to monitor their tanks for microbial contamination. Companies that have made ATP testing part of their quality assurance monitoring program have reported substantial reductions in their corrective maintenance costs.

For people who are used to seeing colonies form in or on a growth medium, there are great new kits available now that weren't on the market in 1994. However, it still takes several days for visible colonies to form. This is why I still have a strong preference for rapid methods like the ATP test.

In the years since *Knowing When You Have Contamination* was published, ASTM has created two documents that help non-technical people in the fuel industry to better understand fuel microbiology and its impact on fuel systems. ASTM D6469 *Standard Guide for Microbial Contamination in Fuels and Fuel Systems* provides a brief overview of the problem and simple steps for diagnosing problems caused or made worse by microbial contamination. ASTM Manual 47 – *Fuel and Fuel System Microbiology: fundamentals, diagnostics, and contamination control* provides industry stakeholders with the background information and tools they need to get a good understanding of the problem and its prevention. Both of these documents are available from ASTM at www.astm.org.

Knowing When You Have Contamination

■ Frederick Passman

You don't have to be a microbiologist to detect and control fuel system microbial contamination.

Since there are no microbial standards for fuels, microbial contamination remained undetected unless slime started to plug fuel filters. Dramatic changes in the fuel industry are driving a need to revise the way we monitor and control microbial contamination. Ethoxylated gasoline additives, diesel additives, vapor recovery systems and increased use of cardlock pumps at both wholesale and retail outlets contribute to both increased awareness and incidence of microbial contamination in all fuel grades. Here are a few easy tests to determine if microbes are attacking your profitability.

Fisheyes and rotten eggs

The first place to check for contamination is the filters and filter housings. Microbes flushed from fuel tanks are trapped by filters. There they multiply, forming the slime most often responsible for filter plugging. A slime-coated filter that feels slimy to touch or smells yeasty or like rotten eggs reflects microbial contamination in the fuel tank.

When pulling a filter for inspection, drain or decant the fluid from the filter-housing into a glass jar. Look for water and invert-emulsion (cloudy fuel) layers and flocs (*fisheyes*). Fisheyes are the soft, spherical colonies the fungi forms in fluids. Again, smell the fluid for the odors described above.

Any indication of microbial contamination of the filter and filter housing requires the drawing of two samples from the fuel tank, one from mid-depth, the other from the tank bottom. There are various sampling devices available. Of primary consideration is the need to get samples from known tank-depths.

Decant the fuel sample into a clean glass jar. Compare the mid-column and bottom samples visually. Are there differences in color, clarity or concentration of suspended particles? These differences may be caused by nonbiological, chemical reactions, but, in concert with positive indications from filter inspection, they are most likely to be caused by microbial activity.

Is there a membrane-like layer between the water and fuel phases of the bottom sample? This is a typical biofilm layer in which a community of microbes works to degrade fuel.

With a benchtop centrifuge, spin a sample from each tank depth and check for free water and suspended solids. Use pH paper to test the pH of any free water. Any pH below 5.5 strongly suggests that microbes are producing corrosive, organic acids.

Since microbes grow in the water phase, not the fuel phase, use water samples for microbiological tests. There are several dipstick and broth kits for determining the presence of viable microbes. Alternative rapid detection tests are gaining popularity for onsite microbial contamination testing. Positive microbiological test results, combined with the other symptoms described above, mean that the fuel system must be treated.

Baseline is crucial

The key to detecting and controlling microbial contamination is establishing a baseline of information. If you don't know what contamination-free filters, mid- and bottom fuels or bottom water look and smell like, you won't be able to catch microbial contamination until your system is seriously fouled.

Most systems should be checked monthly. Establish a baseline. If the fuel system is contaminated, treat it. If you know your system is contamination free, monitor all parameters for two to three months. After that, check filters at each change; bottom samples monthly.

If your routine check indicates that the system is changing, run the complete series confirming microbial contamination. Draw a confirmation sample about a week after the first one showing signs of microbial contamination. If the symptoms are worse, initiate corrective action. If the results seem confusing, contact an expert to help interpret the observations.

Compare the relative costs of tank-cleaning and biocide treatment. Including the expense of routine monitoring, early detection and treatment costs a fraction of the expense of tank clearing. Moreover, preventive treatment ensures that the system operates unfouled and that customers get consistent quality.

Remember, you don't have to be a microbiologist to detect and control fuel system microbial contamination. You don't need to be an economist to recognize that contamination prevention can help you retain more earnings dollars.

Dr. Frederick J. Passman, Ph.D., is president of Biodeterioration Control Associates Inc. and an editorial board member for the International Journal of Bioremediation & Biodeterioration and associate editor for Lubrication Engineering. BCA is at P.O. Box 268176, Chicago, IL 60626-8176. (312) 338-0448.

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