NFPA 13, 2016 Edition "Water Treatment" Requirements

How does NFPA 13 2016 Edition change your approach to preventing and treating corrosion problems in FPS?

Section 24.1.5 "Water Supply Treatment" has been revised and includes important changes that affect how corrosion in FPS are tested for and treated. Here are the key changes and the authors' discussion of each issue.

Section 24.1.5.2 states, *"Water supplies and environmental conditions shall be evaluated for conditions that contribute to unusual corrosive properties."*

Chemical characteristics of the water—including pH, and concentrations of oxygen, chloride, sulfate, hardness, alkalinity, and iron—are important in determining the potential for corrosion in the FPS. The potential for developing Microbiologically Influenced Corrosion (MIC) should also be evaluated by testing for MIC-related microbes.

How should these tests be done? Most water testing companies collect, or have clients collect, water sample(s) and ship the samples to their laboratory for some analyses. While this is convenient for the laboratory and the client, it unfortunately results in changes to critical factors such as pH, concentrations of oxygen, sulfate and iron, and microbial parameters. All of these can change in minutes, thereby leading to inaccurate diagnoses and approaches to treatment. Also, there's a significant delay in getting data from the laboratory, which leads to delays in implementing treatment.

Alternatively, test data needed to assess the potential for all forms of corrosion in FPS can be obtained by performing tests on site **immediately** after collecting the water sample using test methods such as those found in MICkit® FPS. This test kit is specifically designed for use by maintenance or FPS contractor personnel. It's used to test for all critical chemical parameters and MIC-related bacteria. Test data are obtained in less than 30 minutes. It includes a site information form, where the client can record information about the FPS being tested. Current pricing and details for MICkit® FPS can be found at www.bti-labs.com.

An economy version of this kit, MIPkit® FPS, is also available. It allows **five** locations to be tested for critical parameters after initial tests using MICkit FPS® have been done. Visit www.bti-labs.com for pricing and product details. Optional confirmation of biological data and a written report providing diagnosis and treatment recommendations can be provided by BTI-Products LLC. Daniel H. Pope, Ph.D. provides input into diagnosis and recommendations for treatment.

Thousands of MICkit® FPS test kits have been successfully used by FPS and maintenance personnel over the last 15 years. The data obtained using MICkits® have been used as evidence, without challenge, in many legal cases. In fact, MICkits® were included in a National Association of Corrosion Engineers (NACE)-sponsored comparison of test methods and found to give the most accurate data (Scott, J.B. and M. Davies. Survey of Field Kits for Sulfate-Reducing Bacteria. Materials Performance pp 64-68, May 1992).

Section 24.1.5.2 continues, *"Where conditions are found that contribute to unusual corrosive properties…a plan shall be developed to treat the system using one of the following methods:"*

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(1) *"Install a water pipe that is corrosion resistant."* Dr. Daniel Pope, BTI, and John Lovell, BTI Products, performed tests of the ability of various chemicals applied to the inside (ID) of pipes to prevent MIC-related microbes from colonizing the pipe surface. Only one chemical was able to **temporarily** prevent colonization. However, after only one drain and re-fill, the chemical was no longer effective. The reason is quite simple: a biocide is only effective if it releases from the pipe surface to contact microbes trying to attach to the pipe. Therefore, the biocide is released into the first water introduced into the pipe and subsequently removed when the pipe is first drained. These studies were done for a major pipe manufacturer and, thus, not published.

(2) *"Treat all water that enters the system using an approved corrosion inhibitor."* The problem with most corrosion inhibitors (CI) is that they cannot be used in FPS since they are toxic (e.g., nitrites), or are used by MIC-related microbes as food (e.g. most quaternary amines). Also, non-toxic corrosion inhibitors **do not** kill MIC-related microbes.

(3) *"Implement an approved plan for monitoring the interior conditions of the pipe."* Ideally, inspections should be performed in areas of the FPS which fit the profile of "hot spots" for corrosion issues. In dry and preaction FPS, these hot spots are usually lower sections of the system that hold water and/or accumulate moist sediments. In wet FPS, these areas are where air pockets are likely to form and/or areas which see frequent flow (such as mains during flow tests). Since the FPS must be at least partially drained and opened to perform the inspection, and since the inspection is limited to aspects of the pipe visible to the inspector—often chosen due to easy access, not because they represent potential hot spots—the results do not give an accurate picture of corrosion in the FPS.

Another option is use of a borescope. However, routine use of a borescope is more expensive, can only be used where there's access to the interior of the FPS, and requires expert use and expert interpretation of data. Also, it's practically impossible to detect sediments and small deposits under which corrosion has initiated and which, in the absence of proper treatment, will continue to corrode (most often as very rapid pitting). In addition, if the FPS is refilled with untreated water, microbes, nutrients, oxygen and corrosion-promoting ions will enter the FPS, and accelerated corrosion will continue.

(4) *"Install corrosion monitoring station and monitor at established intervals."* Typical placement of such monitoring stations (e.g., at the riser or other easily-accessible locations) does not provide an accurate representation of the most corrosion-prone locations (hot spots) in the FPS. Even if a "side-stream" corrosion monitoring station is used to try to create "worse-case" conditions, it won't actually do so. This is because these stations don't experience sediment accumulation and continued migration of important gasses (e.g. oxygen) and ions (e.g., iron, sulfate, and chloride ions) that occur in developing corrosion sites in the FPS itself.

Two other corrosion monitoring devices on the market are corrosion probes and corrosion coupons, but there are major drawbacks to both.

Use of corrosion probes, such as electrical resistance probes, gives some information about the rate of generalized (uniform) corrosion. However, they don't detect pitting corrosion, which is the most important form of corrosion responsible for failures of FPS components.

> Corrosion coupons **do not** accurately reflect conditions on the **bottom** of a horizontal pipe or represent conditions where pitting corrosion most often occurs in dry and preaction FPS. Likewise, coupons **not placed** at the air-water interface in wet FPS will give false negative results. Also, analysis of corrosion coupons for microbial colonization and pitting requires an expert with specialized equipment—an additional expense and delay in obtaining data.

We’ve found that a better approach to items 1 and 2, above, is to treat all water entering the FPS using a treatment chemical that rapidly kills all MIC-related microbes, quickly eliminates oxygen from FPS waters, and is registered with the EPA for use in FPS. Only MICtreat® FPS Chemical satisfies all these requirements. Delivery of appropriate levels of chemical into the FPS is achieved using an automatic delivery device (such as the MICtreat® FPS System) to treat water as it’s flowed into the system. This will prevent **all** forms of corrosion, including MIC, from occurring.

For items 3 and 4, above, we’ve found that testing make-up water, water from low points, and water from the remote inspector’s test valve (ITV) for pH, oxygen, iron, chloride, sulfate, MIC-related microbes, and concentration of treatment chemical gives a much better picture of conditions in the FPS and treatment effectiveness.

Section A.22.30.2.1 states, *“Prior to the 2007 edition, NFPA 13 permitted the pipe for* (dry and pre-action) *systems not subject to freezing to be installed without a back pitch…Proper pitching is an important element in reducing the risk of corrosion.”*

Obviously, dry and preaction FPS installed or remodeled prior to the requirement for back pitching should be treated to prevent all forms of corrosion, most importantly corrosion related to microbes and oxygen. The chemical THPS, the active ingredient in MICtreat® FPS Chemical, kills microbes and eliminates oxygen from the water. Since residual THPS is left in any water in the FPS, it also prevents oxygen in overlying air from reaching pipe surfaces in contact with water.

Even dry and preaction FPS that have been pitched to code are going to have water trapped in grooved and O-ring type fittings, in drops and sprinkler heads, and in areas where moist sediment has accumulated. Therefore, it makes sense to treat all water entering the FPS with an agent that will kill **all** microbes and **quickly** remove **all** oxygen in the water, then purge the FPS with nitrogen to eliminate **most** of the oxygen in the pipes. Finally, use nitrogen as your supervisory gas**.**

Important Note: You don’t have to remove all oxygen in the head space since the THPS (oxygen scavenger) remains in any water in the FPS and will remove any oxygen trying to penetrate the water phase in contact with pipe surfaces. This means less nitrogen is needed, thereby eliminating the need for nitrogen-generating equipment. Also, technical-grade nitrogen can be used. These steps reduce the cost of treatment dramatically and reduce the time required to protect the FPS from corrosion.

We have many clients who have simply treated their dry and preaction FPS using MICtreat® FPS Chemical and successfully prevented further corrosion. On the other hand, we have a number of clients who tried using nitrogen inerting alone and continued to have MIC-related leaks. Only after properly treating their water using MICtreat® FPS Chemical have they been able to prevent further corrosion.

The key here is that **all** microbes are killed and **all** oxygen is removed from the water.

About the Products Mentioned in This Article:
MICkit® FPS test kits, MICtreat® FPS Chemical, and MICtreat® FPS Systems were developed by Dr. Daniel Pope of BTI and are available from BTI Products LLC. Contact John Lovell at 1-800-798-4650, products@bti-labs.com, www.bti-labs.com for more information. Technical support, including walking first-time users through testing and treatment procedures over the phone, is provided at no cost.

About the Authors: **Daniel H. Pope, Ph.D**. is a microbiologist with over 50 years experience in detecting and treating problem microorganisms. He has worked on Microbiologically Influenced Corrosion (MIC)—a term he coined in 1984—for over 35 years and has specialized in detecting and treating corrosion in FPS for over 20 years. He has written industry-sponsored guides to detection and treatment of MIC in many industries, including FPS. He also holds patents for monitoring pitting corrosion and treating cooling systems and FPS to prevent and treat MIC.

John Lovell, Vice President of BTI Products, LLC, has worked with Dr. Pope for over 20 years and has specific experience in testing, inspection, and treatment of FPS. He is co-author of the article, "Fundamentals of MIC in Water-Based FPS," which appeared in Fire Protection Contractor Magazine (January and March, 2014).