Bacteria and Corrosion in Fire Sprinkler Systems

The tiny hole (called a perforation) in the rolled groove in this picture is a sprinkler fitter nightmare: a small leak causes water damage to the building or contents where the sprinkler system is installed. Such perforations causing leaks are commonly caused by Microbiologically Influenced Corrosion (M.I.C.) which is also known as biocorrosion. This corrosion is the result of the growths of microorganisms that are attached to the steel walls and in direct contact with the steel. These growths take on shapes that can be domed (nodules), crust-like (scaling), slimes (biofilms) and irregular resembling volcanoes (tubercles). Such growths attach right onto the steel surfaces and the bacteria inside the growths begin to attack the steel removing the iron. Steel is attacked microbiologically by bacteria producing hydrogen sulfide (the “rotten” egg gas) that then starts drilling into the steel leading to pitting and perforation (leaks). Different growths of bacteria can generate acidic conditions that weaken the steel by increasing porosity and pitting causing the outside of the pipes to become damp and then fail. Other bacteria do not get directly involved in M.I.C. but do grow inside the pipe causing reduced flows and plugging of the line. This means that if there is a sudden demand for water to fight a fire, the plug effectively prevents water from moving to the sprinkler heads and fighting the fire.

Microorganisms get into the fire sprinkler piping system primarily through the water supply. In a dry-pipe system these microbes can lock up and bind any water to allow them to grow. On the other hand in a wet-pipe system the microbes live in the water and usually grows on the surfaces and in the case of plugs, bind up water to make a plug. M.I.C. usually occurs where there is no oxygen and so it is deeper down in the growths that corrosion becomes to become active. Sulfate reducing bacteria (SRB) generally cause rapid pitting and perforation of the pipes. Acid producing bacteria (APB) generate acids that can weaken the steel causing flaking and losses in porosity. Plugging tends to occur more when there is oxygen present and here the iron related bacteria (IRB) such as *Gallionella* and *Crenothrix* tend to dominate; or the heterotrophic aerobic bacteria (HAB) can also cause plugging.

Periodic sprinkler system flow tests and other related activities can introduce fresh water and oxygen that can encourage the growth of the oxygen dependent bacteria such as the IRB and HAB leading to increased risk of plugging. As these bacteria grow then they produce more biomass and the M.I.C. activities occur deep down in the biomass away from oxygen. This is one reason NFPA 13, *Installation of Automatic Sprinkler Systems*, does not requires that an inspector’s test outlet be located on a remote branch line in a wet-pipe sprinkler system. MIC treatments depend on the specific types of microorganisms causing the corrosion (e.g. perforation, SRB; plugging, HAB and IRB; lateral corrosion and increases in porosity, APB). There is “no one size fits all” since the different groups protect themselves in different ways. One plan commonly employed is to periodically introduce chlorine to the system. Many bacteria are traumatised by the chlorine and the biomass compresses at least temporarily. However the chlorine can also create other types of corrosion.

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