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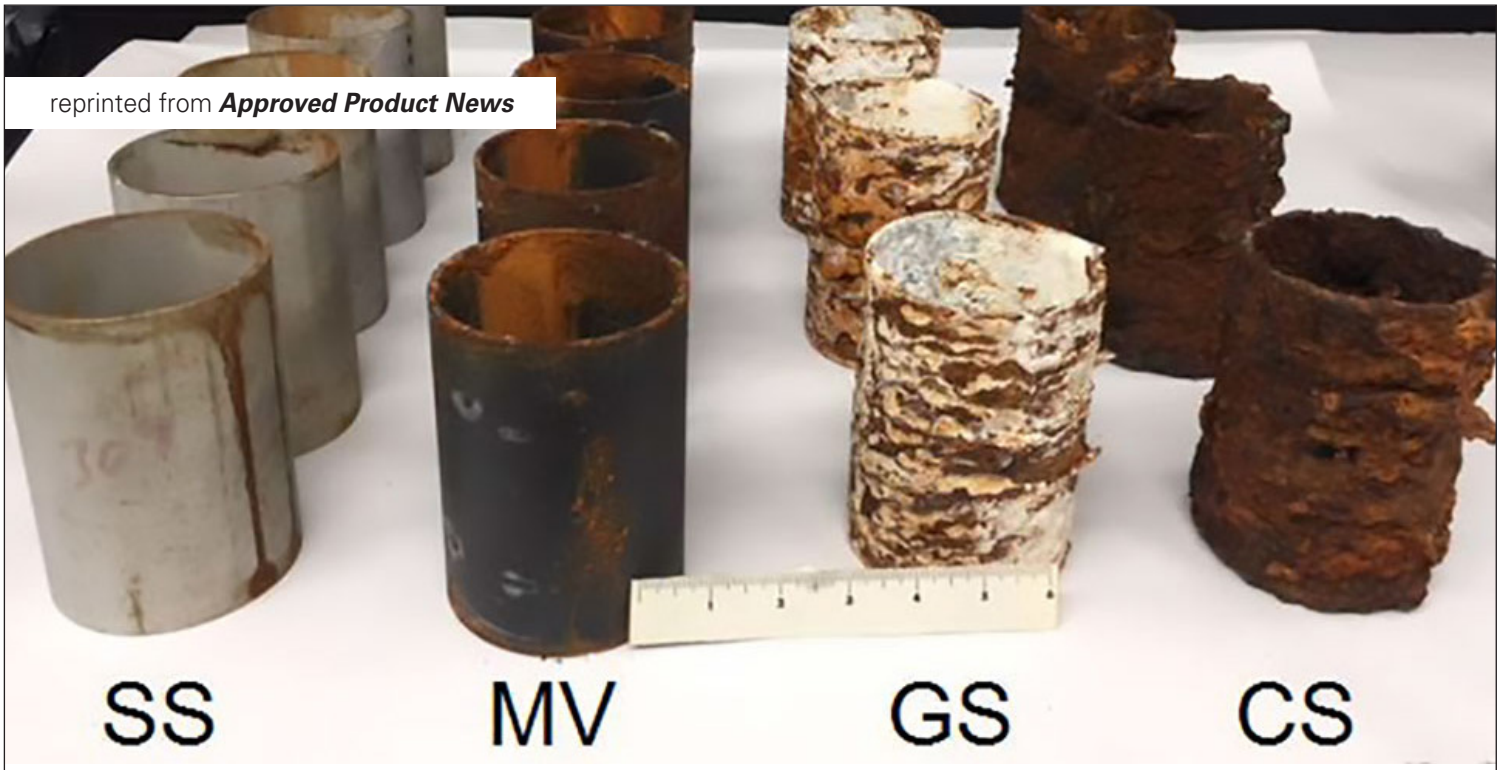

Figure 1 Six months of accelerated salt fog aging. SS = stainless; MV = Minimax Viking; GS = Galvanized Steel; and CS = Carbon Steel

New Corrosion-Resistant Sprinkler Pipe

First Polymer-Enhanced Steel Pipe to Earn FM Approved Mark

An innovative fire protection product that promises to revolutionize the fight against corrosion earned the FM Approved mark in August 2020. The Fendium® polymer-enhanced steel pipe system from MV Pipe Technologies GmbH, of Wittenberge, Germany, offers numerous benefits including permanent internal protection, high flow rates, and the option to use smaller diameter piping and smaller pumps in many cases.

MV Pipe, a subsidiary of the Minimax Viking Group, underwent an extensive certification process that included a materials study by FM Global Research, as well as the usual requirements of FM Approvals Standard 1630, Steel Pipe for Automatic Fire Sprinkler Systems.

Corrosion challenge

Corrosion is found in all sprinkler systems and is one of the leading causes of maintenance and operation problems for fire protection systems. Corrosion damage and mineral deposits can cause pipe leakage, restrict water flow to sprinklers and impair mechanical operation of fire protection equipment, leaving otherwise protected facilities vulnerable to uncontrolled fire loss.

Corrosion increases the lifecycle costs of fire protection systems and can become a significant issue for some owners of water-based systems. It can cause leaks that will reduce the amount of water available if the system is activated and can affect components like sprinklers, making them inoperable.

Corrosion can also cause tuberculation, the buildup of mineral deposits in the system's pipes. These knoblike mounds are frequently observed in steel and galvanized steel pipe, and are capable of obstructing water flow in pipes and/or plugging sprinklers.

The most common causes of these types of corrosion in fire protection systems are pipe weld corrosion, residual water in dry pipe systems and trapped air in wet pipe systems. Other frequent causes are corrosive water chemistry, oxygen injections into the system (fresh water recharged during regular maintenance), stagnant water, dead legs of pipe and microbiologically influenced corrosion (metabolic activities of microorganisms such as bacteria, fungi and algae).

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Figure 2 MV Pipe Technologies GmbH Fendium plant in Wittenberge, Germany.

Research first

Before Minimax Viking could meet the requirements of Approval Standard 1630, it was required to submit samples of its new Fendium polymer-enhanced steel pipe for materials testing by FM Global Research. A team led by senior research scientist and corrosion specialist Paul Su evaluated the corrosion properties of Fendium pipe versus other common steel sprinkler pipe materials, including stainless, galvanized and carbon (black) steel (Fig. 1).

"Corrosion in steel sprinkler systems has always been a major issue for building owners," notes Su. "This was the first time FM Approvals was considering an internally polymer-enhanced pipe for certification and a new test protocol had to be developed before FM Approvals could certify it. For instance, we wanted to know how it would perform damaged and undamaged in accelerated corrosion testing, CPVC chemical compatibility, enhancement pull-off strength and other factors."

Multiple sections of Fendium, stainless, galvanized and carbon (black) steel pipe, as well as 1" x 2" coupons were suspended in a cyclic corrosion test chamber and exposed to salt fog.

The chamber creates an accelerated corrosive environment and the samples were evaluated after 0.5, 1, 3 and 6 months of exposure.

The corrosion rate was measured in mils (0.001 in.) per year (mpy). The average corrosion rates, ranked from best to worst, were:

- Stainless steel at 0 mpy
- Fendium at 1.66 mpy
- Galvanized steel at 9.77 mpy
- Carbon steel at 26.77 mpy

"Even where the Fendium enhancement was intentionally damaged and we saw some corrosion, it was minor when compared to carbon steel pipe or galvanized steel, where the whole pipe is at risk," notes Su. "Even when damaged, Fendium-enhanced pipe is still better than other alternatives, except for stainless, which is much more costly."

Using the new corrosion test protocols developed by FM Global Research, FM Approvals was able to develop a certification program based on Approval Standard 1630 for steel sprinkler pipe. The standard has been updated to incorporate the new protocols and other tests developed for the MV pipe program.

FM Approved polymer-enhanced pipe

"Fendium pipe is much more than a coated pipe material," explains Klaus Hofmann, CEO of Minimax Viking Group. "It is a gradient transition from steel to polymer both on the interior and exterior of the pipe after fabrication. It was essential that we provide our customers with improved corrosion resistance and more efficient flow (C Factor of 140)."

The new corrosion-resistant sprinkler system piping was formally introduced to the market in early September and is produced at the company's new highly automated 270,000 ft^2 (25,000 m^2) factory in Wittenberge (Fig. 2).

James Golinveaux, president and CEO of the Viking Group Inc., based in Caledonia, Michigan, notes that the firm plans to establish an automated Fendium factory in the United States within the next 24 months. "We will build a plant in the Midwest. When you can get this excited about steel sprinkler pipe, it's pretty unique. Corrosion has been the Achilles' heel of good fire protection."

According to MV Pipe, the Fendium polymer protection is produced in several discrete steps, beginning with a thorough cleaning and pretreatment. Then the pipe is immersed in a basin of Fendium polymer emulsion where iron fluorides contained in the emulsion are continuously fed into the pipe and ensure a release of iron ions on the steel pipe surface. As soon as the positively charged iron ions hit the polymer particles also contained in the emulsion, they adhere to them and partially neutralize their negative charge.

The pipe is removed from the immersion tank and is dried and heated so that the "polymer particles run into one another and the pipe is further smoothed. Finally, the polymer is burned in and cured in a hot air oven. The result of the polymer refinement is a smooth transition from the steel core to the pure polymer."

"MV Pipe is the first manufacturer we know of to apply this existing polymer technology, which has been used in the automotive and farm equipment industries, to steel pipe for fire protection," observes Dave Fuller, FM Approvals vice president and manager of fire protection. "The performance shown by this newly Approved piping to reduce corrosion in sprinkler piping is significant.

"The manufacturing process is quite unique given the level of automation they have achieved at their plant in Germany," he continues. "Essentially, they receive sprinkler system piping plans and the robotic plant systems take care of material handling, cutting, welding and all the rest. The completed sections of the fire protection piping then go through the Fendium polymer bonding process. Plain pipe goes in one end of the plant and custom-fabricated Fendium sprinkler piping, ready to install, comes out the other end."

Efficient performance

Because of the smooth finish and corrosion resistance over time, the Fendium pipe provides a highly favorable Hazen-Williams coefficient (C-value) of 140 for the purpose of hydraulic calculations for both wet and dry systems. C-value is a roughness coefficient of piping and can be significantly changed by internal corrosion. Carbon steel, for example, has a C-value of 120 when used in wet pipe systems, but about 100 in dry pipe systems.

The higher C-value of Fendium means less pressure loss and therefore, in some cases, the fire suppression system can be designed with smaller diameter piping or a lower water supply pressure.

"We anticipate that our customers will be able to substitute Schedule 10 Fendium pipe where Schedule 40 black steel might have been specified in the past," notes Viking's James Golinveaux. "You can use Schedule 10 Fendium and still have the corrosion protection of Schedule 40 pipe. You save weight and the low friction coefficient lets you use a smaller diameter. All of these cost factors combined with long-term savings in maintenance and the reduced risk of corrosion related malfunctions make Fendium an easy choice."

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