"Why are my stainless steel filters getting pin-hole leaks?

I thought stainless steel was corrosion free."

This question has been asked more frequently over the past several years. The truth is that stainless steel is available in different alloys (grades) and the various alloys have varying degrees of corrosion resistance. All grades of stainless steel are corrosion resistant, not corrosion proof. The higher the grade of stainless, the greater the corrosion resistance, but none are corrosion proof.

The corrosion resistance properties of stainless are impacted by numerous environmental conditions; temperature, pH of the water, chemical properties of the water (chlorides, sulfates, salts etc.), dissolved solids, time, conductivity, the surface condition of the metal, the metallurgical changes in the heat effected zone of welded fabricated products, chemicals injected into the flow stream and numerous other factors.

Another less known corrosion factor which affects the attributes of stainless steel in water filtration products is Microbiological Induced Corrosion (MIC). MIC is the biological attack by iron (ferrous) consuming bacteria of the ferrous content of the stainless alloy. The bacteria can be found in the source water or in contaminants found within the water. These bacteria will initiate the bacterial attack. The attack occurs through the colonization of the iron-consuming bacteria on the surface of the stainless steel material. The bacterium, once colonized, secretes enzymes that dissolve away the iron in the stainless alloy. Once the iron-consuming bacterium dissolves the iron, the dissolved iron provides food for the bacteria colony, which continues to propagate and grow. As this process continues, the stainless material is progressively dissolved away and an "etched" cavity develops in the metal. Ultimately this degradation will continue to a point where deterioration of the Stainless Steel will occur. Typically this colonization will occur at multiple points or locations within the same system, for example at the end of a season if the system is not properly drained.

These potential corrosion failures are not associated with any one brand of filter product or the material selection for the product. Unfortunately the perception of stainless steel is that it is a premium material that is corrosion proof and will last forever. Unfortunately this perception and understanding is made in error.

Although the failures discussed are all potentially failure modes of the product, not all product applications will experience failure. The specific site conditions, water quality and water chemistry along with how the system is operated, what chemicals and fertilizers are induced and system hygiene all have an impact upon the corrosion failure potential of the system.

Stainless Steel corrosion is not a new problem. The first product failures of this type occurred in the mid - 1970's in horizontal stainless steel filters produced by a manufacture that went out of business in the mid - 1980's due to continual product failures. The problems, failures, disbelief and lack of acknowledgement of this product at that time are consistent with current experiences.

From the standpoint of corrosion potential, Type 304 and Type 316 Stainless Steel are both subject to several different types of corrosion and degradation as discussed below:

1. Crevice Corrosion: This is corrosion that starts as a result of the inclusions (crevices) that occur in the manufacturing rolling process of all

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stainless steel sheets at the steel mill. These minute imperfections in the surface condition of the material are where "pitting" of the material begins. High chloride levels, temperature and pH can accelerate this.

2. Electrolysis: This form of degradation of stainless steel is the dissolving away of the material as a result of aggressive electron activity between the metal and the water. The higher the conductivity of the water the greater the potential of the attack. To help control this form of attack Yardney provides a replaceable sacrificial anode in its stainless steel filters to attract the electron activity to the anode and to help protect the filter from attack. The anode, which is a magnesium, aluminum, and zinc alloy, tends to draw the electron activity to the anode first, thus reducing the attack potential to the filter itself. Electrolysis is also accelerated due to improperly grounded pumps or other electrical equipment.

3. Heat Affected Zone Corrosion: During the welding process all metals incur a heated affected zone. This heat-affected zone becomes vulnerable to corrosion attack within Stainless Steel. Simply put, the heat produced by the welding process changes the metallurgical properties of the stainless steel and many of the corrosion resistant properties of the material are lost or compromised. Yardney works to minimize this phenomenon by using advanced welding techniques and special low carbon content stainless steel alloys, but the potential problem cannot be completely eliminated.

4. Microbiological Induced Corrosion (MIC): This corrosion (as previously discussed) is not commonly known about but has a very aggressive and damaging corrosion potential. The risk of this corrosion potential can be minimized, but not eliminated, by the use of biocides to kill the bacteria before the system is shut down. This biocide treatment along with backwashing and draining of the system, before shut down, will also help to control this risk.

Although stainless steel filters look shiny, are perceived to be corrosion proof, are expected to "last forever" and do not require painting, the potential corrosion risks of the stainless steel filters resulting in pin hole leaks is actually higher than what has been typically experienced with carbon steel filter systems. Yes, carbon steel tanks do require painting and yes, the insides of unlined carbon steel filter tanks are rusty but similar to what happens with steel or cast iron water supply pipes, a protective iron oxide (rust) layer quickly forms on the uncoated steel; it then stabilizes and calcifies. This protective layer (as long as it is not continually chipped away) provides a natural protective barrier to inhibit further rusting and corrosion into the parent metal. As projected by M.S. Shiff & Associates (Professional Corrosion Consultants) in early studies and research on this matter in 1998, we are finding that many carbon steel filters are experiencing a longer useful life, typically 20-25 years than the same filter products produced in stainless steel 10-15 years.

For those looking for enhanced corrosion resistance of carbon steel or stainless steel filter products, Yardney offers internal lining of filter vessels and piping manifolds using 3M Scotchkote® 134 fusion bonded epoxy. This material is a true heat cured, fusion bonded epoxy applied onto sandblasted metal substrate for added durability, protection from chemical or microbiological attack, as well as protection from electrolysis. This coating process is applied after the filter is fabricated which results in an encapsulation of the wetted surfaces of the filter product. Please contact Yardney for further information and costs on this optional coating system.

Yardney offers both carbon steel and stainless steel products to the marketplace and we would be happy to offer either of these products. However, we truly would like to educate the user and or designer to fully understand the attributes and shortcomings of both product lines.

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