Is Your Pipeline Coating 'Fail Safe'?

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When selecting a pipeline coating, the "Fail Safe" characteristics may be more important than other issues that are normally considered. A "Fail Safe" coating system is defined as one that will allow cathodic protection (CP) current to pass through it to protect the substrate - not shield it - should the coating bond fail and adequate CP is available (Norsworthy, June 2004). Therefore, "Fail Safe" coatings will reduce or eliminate corrosion, including stress corrosion cracking (SCC), on the pipe under the coating if a bond failure occurs, water penetrates and cathodic protection is adequate.

Fusion bonded epoxy (FBE) coatings are known to be "Fail Safe." Polyguard RD-6 is a pipeline coating system that provides "Fail Safe" properties incorporated with reduced soil stress problems and shielding problems. It has been used for more than 15 years, but the "Fail Safe" technology is just now being understood by many in the pipeline industry.

Why Fail Safe Coatings?

Several corrosion technical papers refer to this characteristic which may be called "Fail Safe," "CP Compatible," or "CP Friendly." When these CP-compatible coatings degrade or groundwater contacts the pipe, the surface is still protected from corrosion and SCC because the CP current can pass through the permeable coating (King et al., 2004). It is believed that the high permeability of FBE coating to water is the reason for the apparently "transparent" nature of FBE coating to the cathodic protection (Ruschau, 2006). SCC has been studied extensively and has never been observed on FBE-coated pipelines in over 30 years (Neal, 2000).

"Fail Safe" FBE coating in central U.S. with blisters. Water pH was 12 with no corrosion under FBE.

What happens if the coating is not "Fail Safe"? Soil stress, poor surface preparation, poor application techniques and selection of the wrong coating are why pipeline coatings disbond during service. When a coating system fails, the question one must ask is, will the coating shield CP if the bond fails (Moore, 2000)?

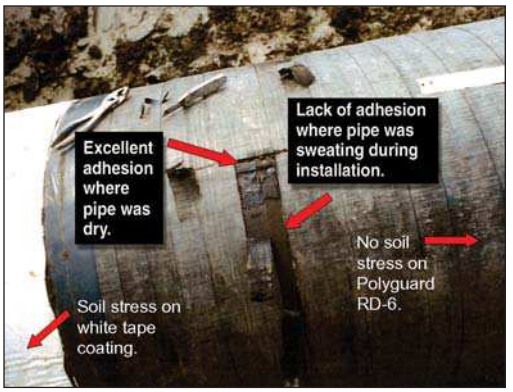
Soil stress caused wrinkles in shrink sleeve on 10-inch pipe which allowed water and SS shielded CP, resulting in significant corrosion after eight years.

Typically, if the bond (adhesion to pipe) is good, there is no water buildup between the coating and the pipe, therefore neither corrosion nor SCC is usually a problem. Even when water permeable coatings absorb water or allow water to penetrate by other methods, the water does not present a problem as long as the coating is well bonded to the pipe surface. The type of coating chosen can lead to potential pipeline corrosion and failure if water penetrates between the coating and the pipe and the coating does not have "Fail Safe" characteristics.

One "Fail Safe" Coating

The advantages of selecting a "Fail Safe" coating system are many. Here are the advantages for the woven geo-textile mesh-backed wrap system:

1. When adequate CP is present, corrosion, including SCC, is significantly reduced or eliminated if water penetrates under the coating.
2. Field- and lab-proven "Fail Safe" properties similar to FBE (Norsworthy 2004). There typically is a change in the pH to between 10 and 13 under the disbondment proving that the pipe is getting adequate CP.
3. This coating system provides an excellent choice for rehabilitation, girth welds and repairing pipeline coatings to provide improved pipeline integrity and safety.
4. The woven geo-textile mesh backing is resistant to soil stress effects, especially when the complete system includes the use of unbonded (slip plane type) outer wrap.
5. Less stringent surface preparation, ease of application, easy cleanup, mixing or off ratio concerns and no cure time (no sophisticated equipment needed).
6. No heat required for application which is much safer for applicators and removes the problems with over- or under-heating.
7. The compound is compatible with most other pipeline coatings.
8. Because current can penetrate at the areas of disbondment, these areas can be located by the use of Direct Current Voltage Gradient (DCVG) surveys.
9. Since the coating is "Fail Safe," the end user does not have to be as concerned about replacing the coating immediately.
10. Compatible with CP (over 15 years of test data and in-service life).
11. Resistant to microbiological attack.
12. There are no known failures after over 15 years of service when proper surface preparation and application were used.
13. The two occasions water has been found under this coating (once was an application problem and the other was the intentional application to a wet pipe) the pH was 10 to 11, indicating adequate CP for protection is being achieved under the disbonded area.



RD-6 applied for three years on partially sweating pipe in severe soil stress area. No bond to area where pipe was sweating at installation, but pH was 11 on water under the coating proving "Fail Safe". Notice wrinkles on white tape, but no wrinkles on RD-6.

Summary

By selecting "Fail Safe" pipeline-coating systems, the likelihood of reoccurring corrosion under disbonded coatings is significantly reduced or eliminated with adequate CP. "Fail Safe" coatings are also less susceptible

RD-6 coating system condition shown is after one year in severe soil stress area. Use of "Slip Plane" non-shielding, non-bonded outer wrap enhances soil stress resistance.

to SCC. Most of the intergranular failures have been on pipes coated with a coal tar primer and coal tar enamel reinforced with felt or fiber glass, although some failures have occurred with asphalt or tape-coated systems, but none with thin film (FBE) coatings (Parkins, 1996).

There have been other documented cases of corrosion under solid film-backed tape, shrink sleeves and other very high dielectric strength coatings (Ruschau, 2006, Norsworthy, 1997, Koch, 1994, Beavers & Thompson, 1997). The ability of coatings such as FBE or the geo-textile mesh strands of the RD-6 to permit CP current to penetrate to the pipe surface if disbondment occurs accounts for the higher potential and subsequent change in pH of any water that may be present. Therefore, the chance of significant corrosion or SCC is less likely.

Since FBE is not easily applied in the field except to girth welds, it is not considered a rehabilitation coating. The alternative is to use another coating that has been proven to be "Fail Safe" through field observations and laboratory testing. The "Fail Safe" choices are limited. At this time, few pipeline coatings have actually been tested for these characteristics. Therefore the question to ask the coating vendor should be: "Has your pipeline coating been proven to be Fail Safe?" ***P&GJ***

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