



TRENCHCOAT*

Film Can Triple the Service Life of Galvanized CSP

Over the past 20 years, The Dow Chemical Company has conducted extensive performance testing on TRENCHCOAT heavy-gauge protective film¹. Results from both the laboratory and the field show that TRENCHCOAT film can dramatically improve the corrosion resistance of galvanized corrugated steel pipe (CSP) and even triple its service life.*

Studies project coating life expectancy.

In general, a polymeric coating used with galvanized CSP will provide some protection as long as it maintains adhesion to the substrate. Most coatings fail due to one or a combination of the following mechanisms:

- Material degradation from environmental stresses.
- Abrasion of the coating caused by existing bed loads.
- Undercutting of the coating, causing delamination.

Given these criteria, studies can be used to project the life expectancy of a coating. Dow has conducted such studies in the laboratory and at field installations around the country.

Testing ranged from bench-top laboratory tests such as film adhesion to metal substrates, salt fog testing and freeze-thaw testing, to more elaborate studies including field inspections of polymer-coated CSP and microscopic and microspectroscopic analysis.

Lab analysis shows coating in good condition.

One laboratory study used microscopic and infrared microspectroscopic analysis of CSP samples coated with TRENCHCOAT film after they had been in service for up to 15 years. The samples, gathered from various locations in the U.S., were examined for cracks with an optical microscope. None of the micrographs showed evidence of chemical degradation or cracking, although some of the samples did show evidence of physical abrasion to the exposed surface. In all samples, the bulk of the TRENCHCOAT protective film coating (effluent side) was in good physical condition.

Infrared microspectroscopy was used to determine the amount of degradation occurring in the TRENCHCOAT protective film over time. On page 2, Figure 1 shows results of spectroscopic mapping of a sample taken from a 12-year-old,

¹ References to TRENCHCOAT heavy-gauge protective film throughout this text are inclusive of protective film from Dow manufactured prior to the adoption of the trademark TRENCHCOAT.

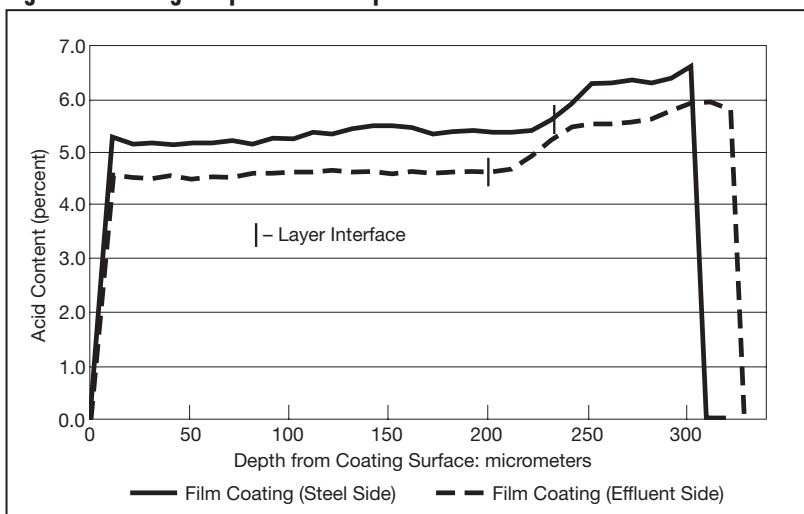
polymer coated CSP installation in the Upper Peninsula of Michigan. The horizontal axis of the graph shows the depth of the region being analyzed from the exposed coating surface. The vertical axis shows the acid content of the film coating at each depth into the coating.

The noted step change at the layer interface area is due to a change in layer formulation. The film layer that lies against the metal substrate is virgin polymer, while the layer exposed to the environment is formulated with carbon black, resulting in a lower overall percent acid.

Data in Figure 1 can also be interpreted using Figure 2, where the horizontal axis is again the depth of the region being analyzed from the exposed coating surface, and the vertical axis shows the percentage of degradation of the polymer.

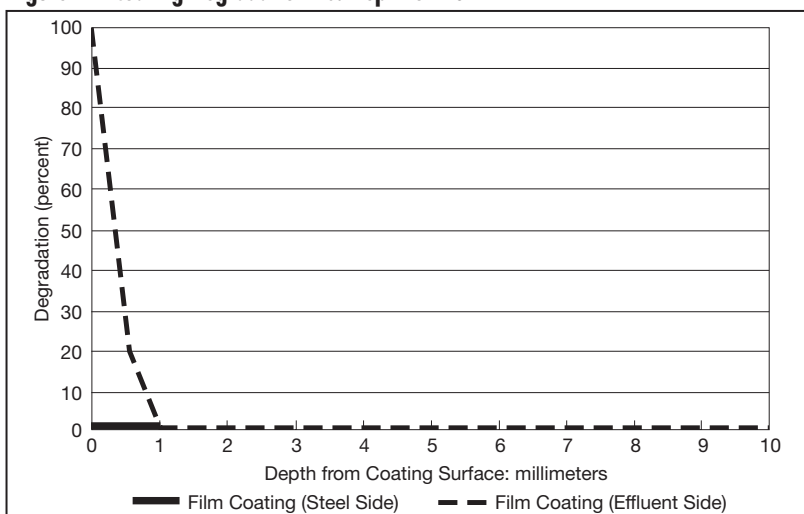
This sample specimen was very representative of the samples analyzed in the study, with very little degradation over its 12 years of service. Given the lack of degradation of the TRENCHCOAT protective film, and employing a linear relationship based on loss-of-polymer to years-of-service, this corrugated steel pipe coated with TRENCHCOAT film could perform, in theory, in excess of 100 years.

Figure 1 - Coating Composition vs. Depth of 10 mil Film¹



¹The reduction of acid content (percent) of the film can be directly related to degradation of the film coating.

Figure 2 - Coating Degradation vs. Depth of 10 mil Film



Field installations document long life of CSP coated with TRENCHCOAT film.

Dow has completed extensive field inspections documenting the performance of more than 40 installations that use TRENCHCOAT film in areas all across the U.S.

Figure 3, page 3, depicts a popular method for predicting

the years to perforation of plain galvanized pipe in a given environment. For instance, a galvanized corrugated steel culvert in an environment with a pH of 7.3 or more, at a minimum resistivity of 100 ohm/cm, can be expected to perforate in about eight years.

Data points representing installations of CSP coated with TRENCHCOAT film, however,

tell a different story. Under the same conditions that would lead to eight year perforation of plain steel, one installation of CSP coated with TRENCHCOAT film shows excellent performance after nine years (A). And two additional installations show good and excellent performance after almost 20 years of service (B,C). Based on the condition of the film coating at these installations, the TRENCHCOAT film should continue to provide protection for many years beyond the service life of uncoated steel.

The data point at the far left of the graph (D) also makes a strong case for the use of TRENCHCOAT film. In an environment where a plain galvanized culvert could perforate after only four years, the culvert coated with TRENCHCOAT film shows only moderate rusting after almost 15 years of service! That's more than three times the life of galvanized CSP – and the film is still providing protection.

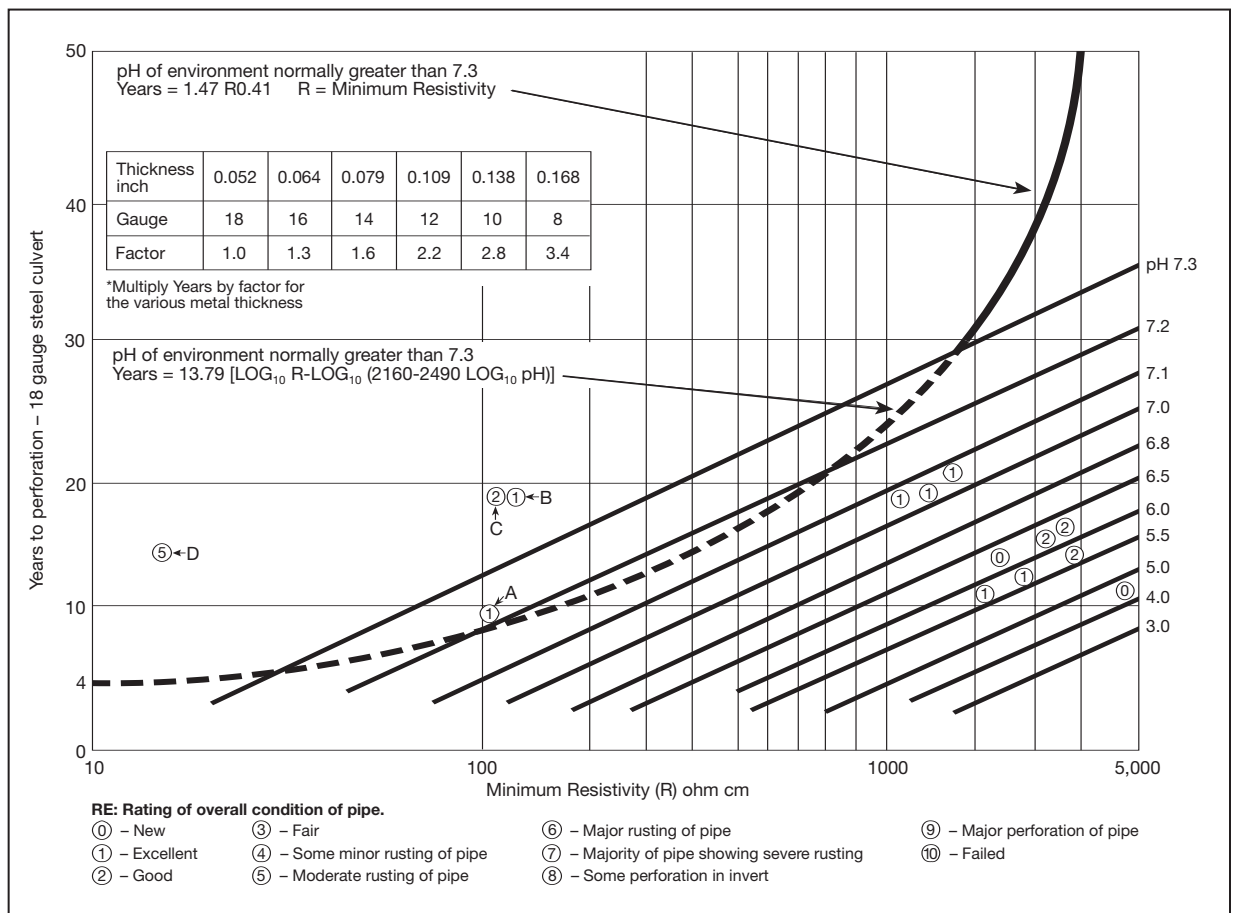
There are many more documented installations of CSP coated with TRENCHCOAT

film that have shown good to excellent performance having 12-20 years of service life. Each installation needs to be evaluated based on specific environmental conditions.

For long culvert life, use TRENCHCOAT film.

TRENCHCOAT film is the best choice for long-term culvert protection. More than 20 years of laboratory and field studies prove it.

Figure 3 - Average Invert Life Estimates for Plain Galvanized CSP Culverts



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TRENCHCOAT Film, The Best Choice For Long-Term Culvert Protection

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Published August 2002

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