

Polymeric Coated Corrugated Steel Pipe Durability Study

Update: October 27, 2016

Field Performance of Polymer Coated CMP
Cass County Minnesota
State Hwy 84 Pine River, MN to Longville, MN



Introduction:

Corrugated Steel Pipe has a long history of use for culverts and storm sewers since the product first came to market in 1896. Galvanized (zinc coated) steel was the first protective metallic coating used to increase the life span of corrugated steel pipe for culverts and storm sewers. Galvanized works well to increase the life span of steel in many environments, but is limited in more severe environmental applications. Many other pipe coatings (both metallic and non-metallic) have been introduced in the market to help increase the life span of corrugated steel pipe such as Aluminized Steel Type 2 metallic coating and non-metallic coating such as; bituminous coating, concrete lining, and ethylene acrylic (polymeric) coatings. The focus on this report is Polymeric Coated Corrugated Steel Pipe. Polymeric Coated CSP may also be referred to as pre-coated and polymer coated.

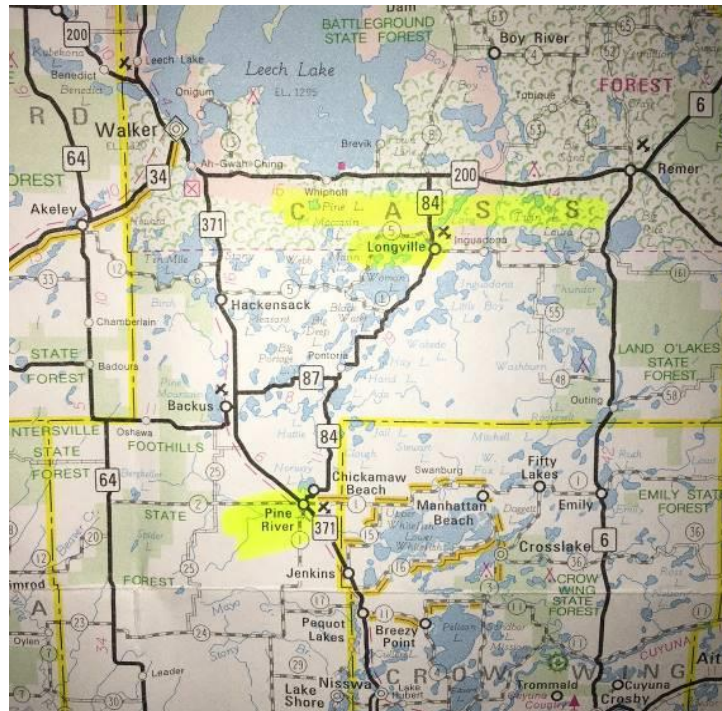
Background:

Ethylene Acrylic (polymeric) coatings were introduced in the mid 1970's to increase the service life of corrugated steel pipe. Polymeric coated corrugated steel pipe is manufactured from galvanized steel coil that is coated with a protective ethylene acrylic film with the trade name "TRENCHCOAT". The material specification that covers the polymeric coated corrugated steel pipe is AASHTO M246.

Purpose:

The purpose is to report the observations and visual condition of polymeric coated corrugated steel pipe culvert installed on a Minnesota DOT project on State Highway 84 in Cass County in the late 1970s. The pipes were installed on several cross drains on Highway 84 north of Pine River, MN and south of Longville, MN. The polymeric coated pipes were installed instead of asbestos bonded and asphalt coated corrugated steel pipe as shown on the culvert schedule. This area of Minnesota is known to be corrosive to plain galvanized pipe with an expected service life of < 25 years per the Minnesota Steel Culvert Pipe Service Life Map.

Project Map Location:



Culvert Rating System Used:

Condition Rating Codes:		
Like new	1	Excellent – like new condition
Still okay	2	Fair – some wear, but structurally sound
Fix in project	3	Poor – deteriorated, consider for repair or replacement
Fix it sooner	4	Severe – serious deterioration
Unknown	0	Not able to rate, not visible

The MN DOT HydInfra Inspection Manual was referenced for rating conditions of the culverts observed.

Field Observations:

Several polymeric coated corrugated steel pipes were installed under highway 84 as an alternate to asbestos bonded and asphalt coated corrugated steel pipe in the late 1970s. The cross drains were fabricated of riveted corrugated steel pipe arch with a polymeric coating. Galvanized end sections were also used on the ends of the culverts. The galvanized end sections will provide a good comparison of the durability of polymeric coating versus plain galvanized coatings at the same culvert location.

A culvert schedule created in 1977 provided by the Minnesota DOT was used to help locate the culverts. On October 27, 2016 a field observation was conducted with industry and Minnesota DOT personnel. The observations started on the south end of Highway 84 in Pine River, MN and traveled north. A total of 13 polymeric coated culverts were located and observed. Various pipe arch dimensions, nominal 42" X 29" pipe arch to nominal 28" X 20" pipe arch culverts were observed. The locations of the culverts did not always match up with the original culvert schedule. All the pipes were fabricated using the riveted method.

Summary of Culvert Ratings:

Location #	Pipe Size	HydInfra Rating	Notes
1	28"x20" Arch	0	Pipe submerged and unable to be evaluated
2	35"x29" Arch	2	
3	35"x29" Arch	2	
4	42"x29" Arch	2	
5	28"x20" Arch	2	
6	28"x20" Arch	2	
7	28"x20" Arch	2	
8	28"x20" Arch	2	
9	28"x20" Arch	3	
10	28"x20" Arch	2	
11	28"x20" Arch	2	
12	28"x20" Arch	2	
13	28"x20" Arch	2	

Field Notes & Photos

Location #1 at mile post 0.60 – single 28" X 20" Pipe Arch Shape

Pipe Rating – Unknown 0 (Not able to rate, not visible). Most of the pipe was submerged with beaver dam on the downstream end. The top of the culvert was visible and looked in good condition.



Location #2 at mile post 2.60 – 35" X 29" Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound) Site was wet with some standing water in the pipe culvert. The outlet end required cleaning. The galvanized end section was rusted through. The polymer culvert was in good shape with minor delamination at a few riveted seams.



Location #3 at mile post 2.61 – 35" X 29" Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). The site was wet with some standing water in the pipe culverts. The galvanized end section was rusted through. The polymer culvert was in good shape with minor delamination on the inlet end.



Location #4 at mile post 2.73 – 42" X 29" Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). The pipe appeared to be in good shape with minor delamination at a few riveted seams. The galvanized end section was rusted through.



Location #4 continued



Location #5 at mile post 12.81 – 28” X 20” Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). There was delamination throughout the culvert, however no perforations were in the base steel of the culvert. The galvanized end section did show corrosion with pitting through the steel.



Location #6 at mile post 17.55 – 28” X 20” Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). The pipe had standing water on the outlet end. The pipe coating was in good condition. The polymer coating is adding service life to the culvert based on the condition of the galvanized end section.



Location #7 at mile post 18.48 – 28” X 20” Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). The pipe was in good shape with minor delamination on the inlet end and at a few seams. The galvanized end section was rusty through.



Location #7 continued



Location #8 at mile post 18.83 – 28" X 20" Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). There was sediment in the outlet of the pipe with a boulder resting in the invert. The outlet had sediment which needed to be cleaned for observation of the invert. The polymer coated pipe is in good shape. The galvanized end section is showing corrosion. Most of the culvert was dry at time of inspection.



Location #9 at mile post 19.11 – 28” X 20” Pipe Arch Shape

Pipe Rating – Fix in project 3 (Poor – deteriorated, consider for repair or replacement). The polymer coating on the inlet end did show some delamination. The polymer coating on the remainder of the pipe was in good shape. There was a bump in the road over the culvert. This bump is believed to be from freeze thaw issues which led to the overall pipe rating.



Location #10 at mile post 19.27 – 28” X 20” Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). Partially submerged with beaver dam on the outlet end. The polymer coating appeared to be in good shape in the invert when reaching through the water.



Location #10 Continued



Location #11 at mile post 21.84 – 28” X 20” Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). There was sediment in the outlet end. Most of the pipe was free of sediment. The polymer coating was in good shape.



Location #12 at mile post 23.68 – 28” X 20” Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). The culvert was mostly dry with sand in the outlet and some leaves on the inlet end. The polymer coating was in good condition.



Location #13 at mile post 29.13 – 28” X 20” Pipe Arch Shape

Pipe Rating – Still Okay 2 (Fair - some wear, but structurally sound). Dry with moist sediment on outlet end. The polymer coating was in good condition. The end section shows corrosion with high water line.



Conclusions:

After approximately 39 years of in-ground performance, 11 of the 13 Polymer Coated CSP culverts had a rating of 2 (fair with some wear, but structurally sound). One of the culvert inverts could not be observed and one of the culverts observed had a rating of 3.

When comparing the current condition of the polymer coated CMP to the plain galvanized end sections used on the inlet and outlet of the pipes, it is apparent the polymer coating has helped significantly increased the service life of the galvanized culverts. If these culverts were made of galvanized steel they would have probably already been replaced.

It would be a good best practice to use Polymer Coated CSP in highly corrosive areas outside the environment range of plain galvanized steel pipe.

Observation Participants:

Bonnie Peterson – Minnesota DOT
Roy Peterson – Minnesota DOT
Justin Van Hall – Metal Culverts
Bill Spenser – Metal Culverts
Brandon Scherber – True North Steel
Bob Moore - CONTECH

References:

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The report was written by Bob Moore with the help of Bonnie Peterson at the Minnesota DOT who provided culvert ratings. Report completed December 18, 2016.