

Using Metalized Thermal Spray Coatings on Reclamation's Infrastructure

Evaluating corrosion protection for Reclamation equipment

Bottom Line

Metalizing may provide a coating that will protect infrastructure such as intake structures, canal gates, and trashracks from corrosion in environments with changing levels of freshwater.

Better, Faster, Cheaper

Although metallizing has an initial cost premium over a comparable polymer coating system, life-cycle costs may be substantially lower.

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Problem

Many of the coating systems that Reclamation has used in the past to prevent corrosion of its water control infrastructure (such as vinyl resins, lead-based paint, or coal tar enamel) can no longer be used due to stricter environmental and health regulations. However, many of the modern coatings systems are more expensive to apply and, if applied incorrectly, are prone to premature failure. Furthermore, modern coating systems have expected service lives of 15 to 20 years in contrast to the older coatings, which had over 50 years.

Solution

We continue to evaluate many kinds of coatings as we search for economical and effective means of corrosion protection. One alternative approach is to coat structures with a very thin layer of metal (metalizing). This study compares polymer coatings, metalized coatings, and metalized coatings with a polymer topcoat.



Figure 1: Unsealed aluminum thermal spray systems tested after 5,040 hours under different conditions: (a) a dilute Harrison solution, (b) accelerated weathering test (QUV) and salt fog test chambers (Prohesion cycle), and (c) QUV, salt fog, and immersion testing (Reclamation cycle). The "Xs" show bare metal exposure, and the panels show how well the metalized spray coatings worked.

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Our results suggest the best use of metalizing at Reclamation is on radial gates, stoplogs, partially exposed trashracks and other equipment subjected to fluctuating water immersion. Furthermore, metalizing can be applied under a variety of environmental conditions, whereas other types of coatings specify a narrow range of humidity and temperature for proper curing. Although metalizing has an initial cost premium over a comparable polymer coating system, life cycle costs may be substantially lower. Other applications where metalizing should be considered include severe atmospheric service environments such as bridges and above-ground piping.

While metalizing is not a new technology, technological advances have increased reliability and spray rates.

Advantages include:

- No cure time. The structure can be placed in service immediately following the conclusion of the application.
- No production of volatile organic compounds (VOC).
- Good impact resistance (compared with epoxy).
- Good ultraviolet (UV) light resistance (compared with epoxy).
- No temperature restrictions for application.
- No humidity restrictions for application.
- Increased service life (up to two times), with less downtime for coating maintenance.
- Passive cathodic protection when substrates are coated with metals that are more active on the galvanic series (aluminum, zinc, and magnesium in the case of steel).

Disadvantages include:

- Not compatible with impressed current cathodic protection systems found on many structures such as buried pipe.
- Initial costs are 15 to 40 percent higher, depending on the system specified.
- Metalizing heats the substrate, which may be unacceptable in certain situations.
- Fast-flowing water can decrease coating life.
- Service life in immersion can vary significantly depending on water chemistry and coating material.

Testing revealed that alloy composition and exposure condition significantly affect corrosion protection performance. Of the systems tested, the pure aluminum system is believed to offer the best combination of corrosion protection and expected service life in immersion or fluctuating immersion. The system works well if the water has a pH between 4.0 and 8.5. In addition, aluminum is easy to apply, relatively low in cost, and exhibit greater adhesion strengths compared to the other alloy systems. Aluminum-sprayed panels tested under several conditions are shown on the figure.

“Metalized coatings provide an alternative to polymer coatings in fluctuating immersion environments when a rapid return to service is needed, during cold weather applications, or where VOC emissions are restricted.”

Reclamation, 2012

More Information

Reclamation, 2012 Laboratory Evaluation of Metalized Coatings for Use on Reclamation Infrastructure. Technical Memorandum No. MERL-2012-14

Future Plans

Further research and evaluation is needed to determine an expected service life, determine ease to repair defects, and a method to deal with crevice corrosion. Because the service life of metalizing coatings depends highly on localized conditions such as water chemistry, it is recommended to perform a small field trial using the results from the current study as a basis.

