RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

# Finding a Green Alternative to Vinyl Resin Coatings

An in-depth look into replacing a legacy coating material with decades of proven corrosion protection, with a low solvent “green” alternative

**Research Bulletin**
**Science and Technology Program**
8835

This research study showed that some modern coating systems can perform on par with legacy vinyl resin systems in laboratory testing. The data obtained will be used to guide additional laboratory and field testing in future studies.

### Mission Issue

Modern coating systems contain less solvent which makes them safer for applicators and the environment. The lower solvent content also allows the material to be applied at a greater film thickness while requiring fewer coats. Modern resins are more widely available for purchase whereas solution vinyl resins are projected to become more difficult to purchase in the coming years.


### Principal Investigator

Dave Tordonato
Materials Engineer
Materials and Corrosion Laboratory
Technical Service Center
dtordonato@usbr.gov

### Research Office Contact

Erin Foraker
Renewable Energy and Infrastructure
Research Coordinator
eforaker@usbr.gov

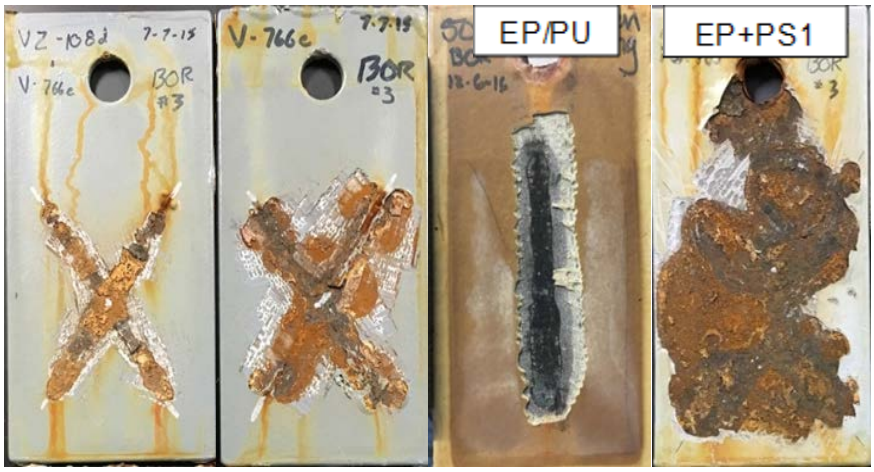
Bobbi Jo Merten
S&T POC for Water Infrastructure
bmerten@usbr.gov


## Problem

Legacy coatings used by the Bureau of Reclamation to protect the metalwork associated with water infrastructure often had service lives of 30 to 50 years or more. Vinyl resins, however, contain large amounts of solvents and production of these materials has decreased significantly over the past 25 years with the introduction of VOC regulations. As such, these materials are now limited to production for impacted immersion service and materials may soon become unavailable for purchase as manufacturers phase them out in the coming years. The currently specified coating systems, such as epoxies and polyurethanes, have service lives of only 20–25 years, which results in extra costs incurred by Reclamation to recoat structures more frequently. In addition, Reclamation has experienced failures with polyurethanes in penstocks.

## Solution

Vinyl resins including their history, use, and formulation. An initial long term evaluation consisting of immersion testing was undertaken. This was followed up by a benchmark study which included an array of laboratory tests. The goal of these initial studies gain an understanding of vinyl’s strengths in the field and in laboratory testing. The final phase of the testing was a comprehensive laboratory evaluation program which included a variety of product chemistries.




*Cyclic test panels shown post-test after coating removal. Rust creep measured following 5040 hrs of cyclic exposure testing. The best (epoxy/polyurethane hybrid) and worst (epoxy primer & polysiloxane topcoat) performing materials and compared with vinyl resins V-766e and VZ-108d+V-766e.*

***"Not all epoxy or polyurethane formulations are created equal. Our results suggest that long-term service life is achievable but there are significant variations in performance that make testing each product worthwhile."***

Dave Tordonato
Materials Engineer
Reclamation

### Collaborators

North Dakota State University

U.S. Army Corps of Engineers Paint Technology Center

### More Information

https://www.usbr.gov/research/projects/detail.cfm?id=8835

https://www.usbr.gov/research/projects/researcher.cfm?id=1957

## Application and Results

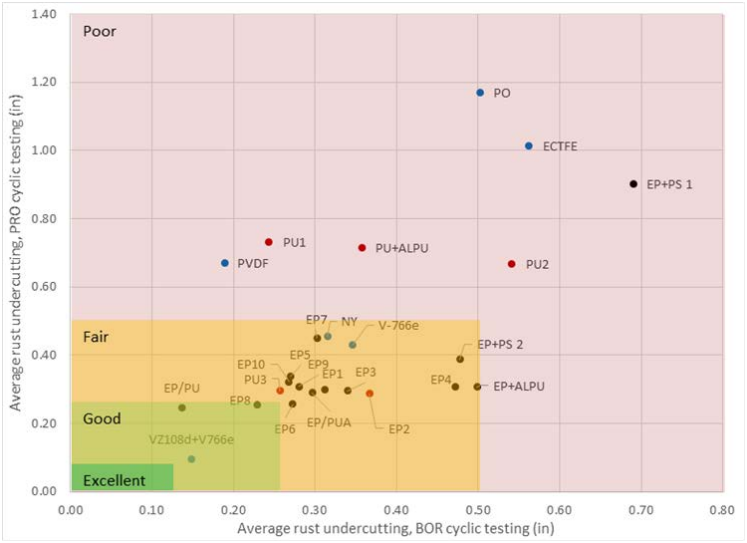
This research examined the history of solution vinyl coatings and formulation as well as results and discussion of initial laboratory immersion testing. Corrosion performance and material properties using modern laboratory techniques were then used to provide a benchmark for the evaluation of next generation polymer coatings. Additional products were then subsequently tested at Reclamation's Materials and Corrosion Laboratory. In total, twenty (20) commercially available coating systems and three (3) experimental were also tested side-by-side for comparison including thermoplastic and thermoset materials. Each system was subjected to a series of accelerated weathering laboratory and durability tests. While no single coating system matched the performance in every test, several promising candidates emerged, and additional laboratory and field tests are recommended. Solution vinyl coating systems have a history of longevity and extreme durability in freshwater service as experienced throughout Reclamation and USACE. Their ability to provide long-term corrosion protection in field service while withstanding impact and abrasion damage in service has been unmatched by modern coating systems at Reclamation. Long-term laboratory EIS data correlates well with this field experience, which indicates this may be a good benchmark for evaluating replacement candidates. The solution vinyl coating formulation V-766e showed no degradation during a nine year exposure period.

Additional benchmark and comparison testing identified multiple thermoset and thermoplastic materials which retained excellent barrier testing over a shorter 8 month period. This test duration was sufficient to see significant degradation in many of the epoxy materials. A suite of other tests highlighted the strengths and weaknesses of solution vinyl resins and provided a comparison with modern materials. Two products (EP8 and EP/PU) seem to provide performance that is on par with vinyls in most situations however, a UV protective topcoat is required for atmospheric exposure. Additional products may also benefit from the addition of a zinc-rich primer to help curb rust creep when a defect in the coating is created.

## Future Plans

Future plans include the following:

- Retest EP8 in DI immersion with additional replicates.
- Test EP8 and EP/PU with a UV resistant top coat for fluctuating immersion
- Test one or more of the following with a zinc-rich primer: EP+PS1, EP+PS2, EP/PUA, EP+ALPU PU+ALPU.
- Field scale-up of successful products.




*Plot of all products tested in two cyclic exposure test programs compared to vinyl materials V766e (standard) and VZ-108d+V766e (zinc-rich primer).*