Extending Infrastructure Durability with Ultra-Weatherable FEVE Technology

Webinar for
Roads & Bridges Magazine

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Summary of Webinar

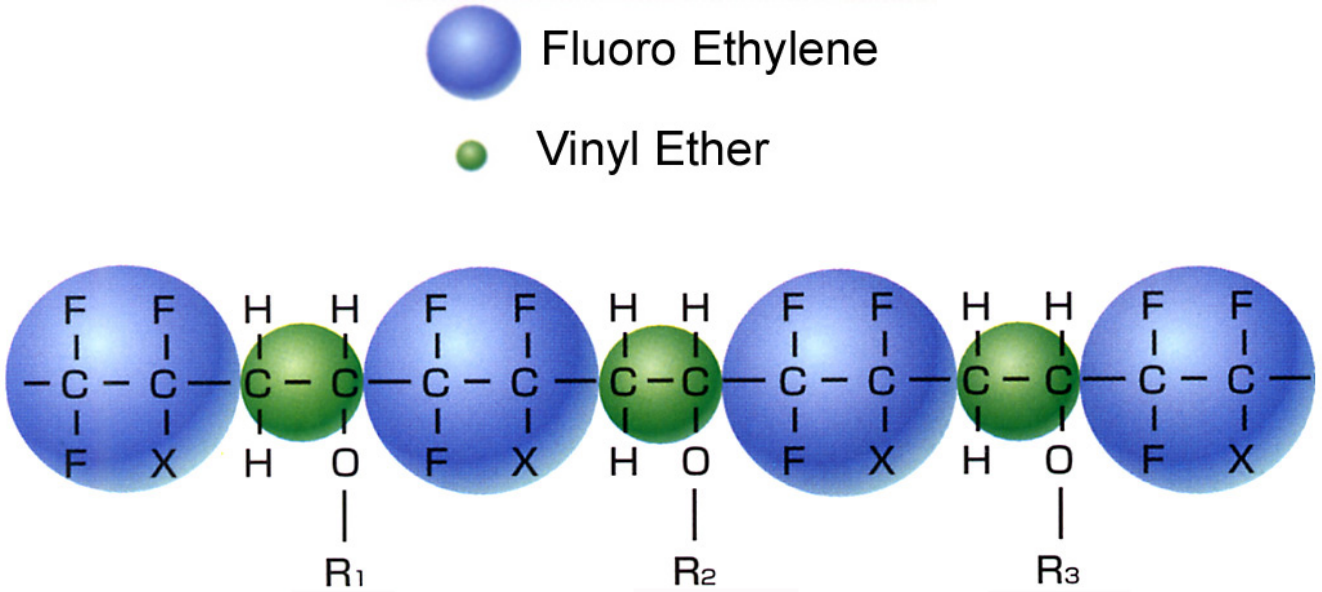
- Explanation of FEVE technology
- Discussion of markets for FEVE technology
- Presentation of performance in exposure testing
- Life cycle cost advantages
- Examples of applied FEVE coatings

What is an FEVE Fluoropolymer?

1. A hybrid fluoropolymer resin with the ability to be used in standard coatings formulations like any other conventional coating resin

2. A high-performance resin that can withstand severe ultraviolet light exposure 2-3 times longer than conventional coatings resins

Fluoroethylene Vinyl Ether (FEVE) Resins



FLUORINATED SEGMENTS: Weatherability • Chemical • Resistance

VINYL ETHER SEGMENTS: Gloss • Solubility • Crosslinking

Advantages of FEVE Fluoropolymer Resins

- **Ambient Cure**
  - Field application
- **OH Functional**
  - Crosslinkable with isocyanates
- **Solvent Soluble**
  - Conventional application techniques (airless spray)
  - Wide range of gloss (90@60º)
- **Fluoropolymer Segments**
  - UV Resistance
  - Corrosion resistance

Markets for FEVE Resin-Containing Coatings

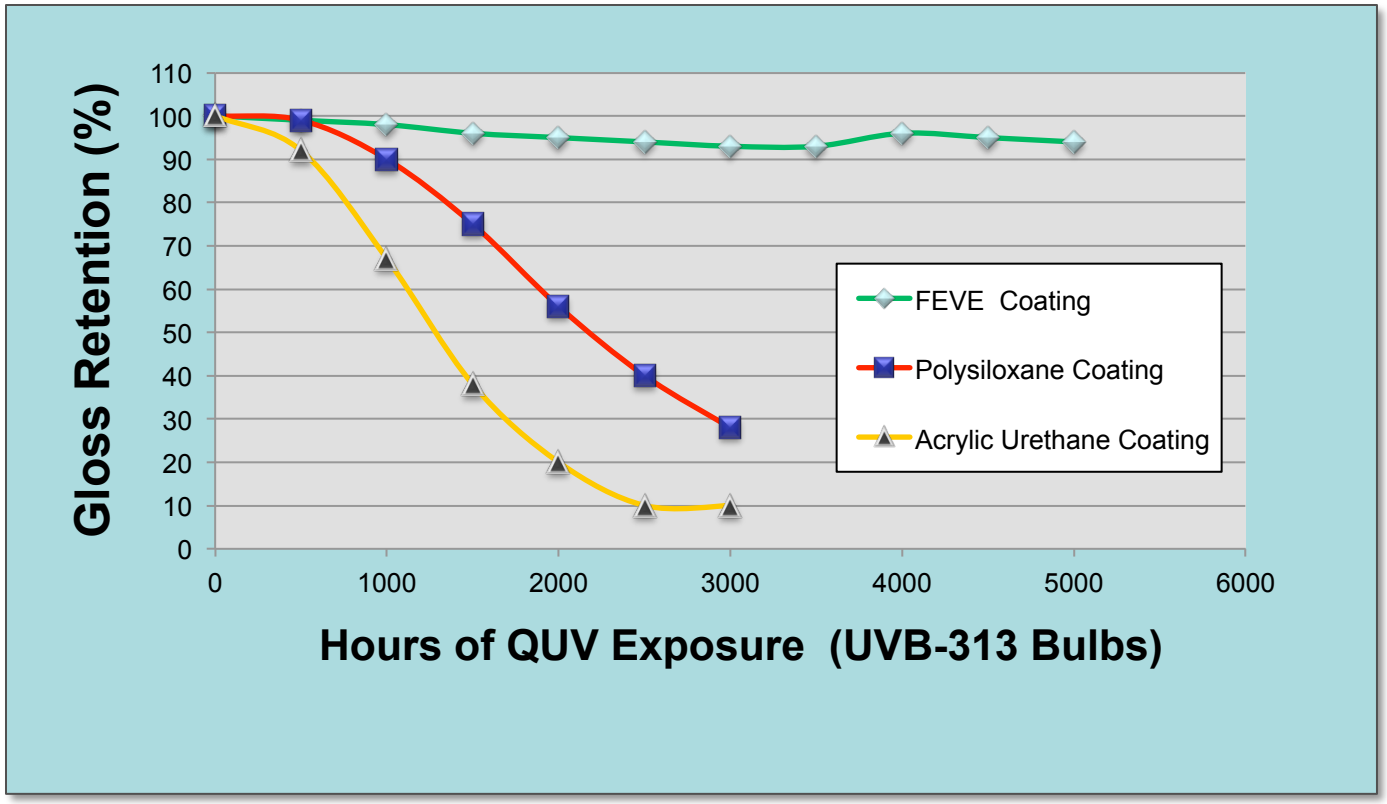
1. Architectural coatings for commercial buildings

2. Industrial maintenance coatings for water towers, bridges, assorted metal and concrete structures

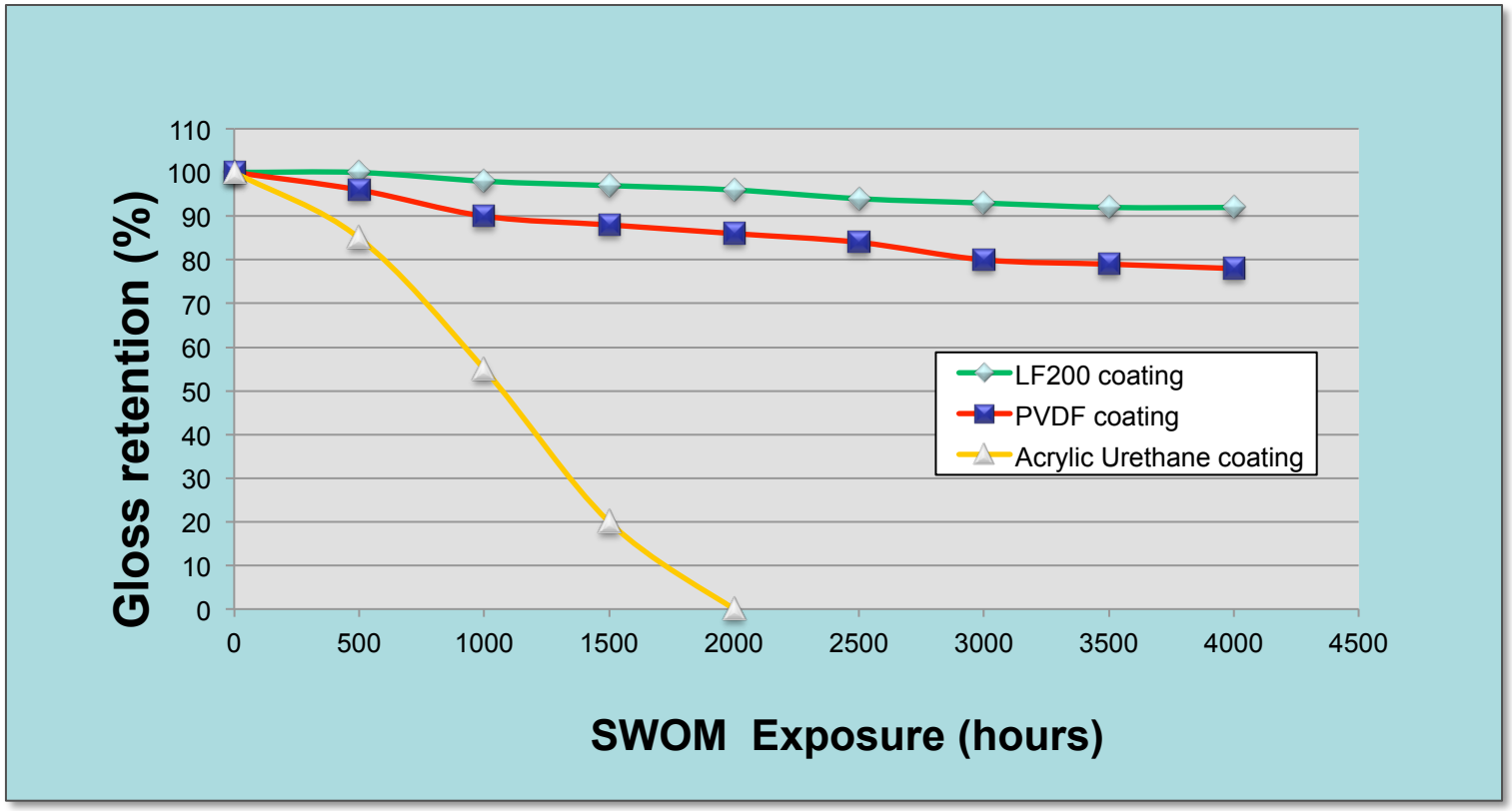
3. Aerospace coatings

4. Applications in marine environments

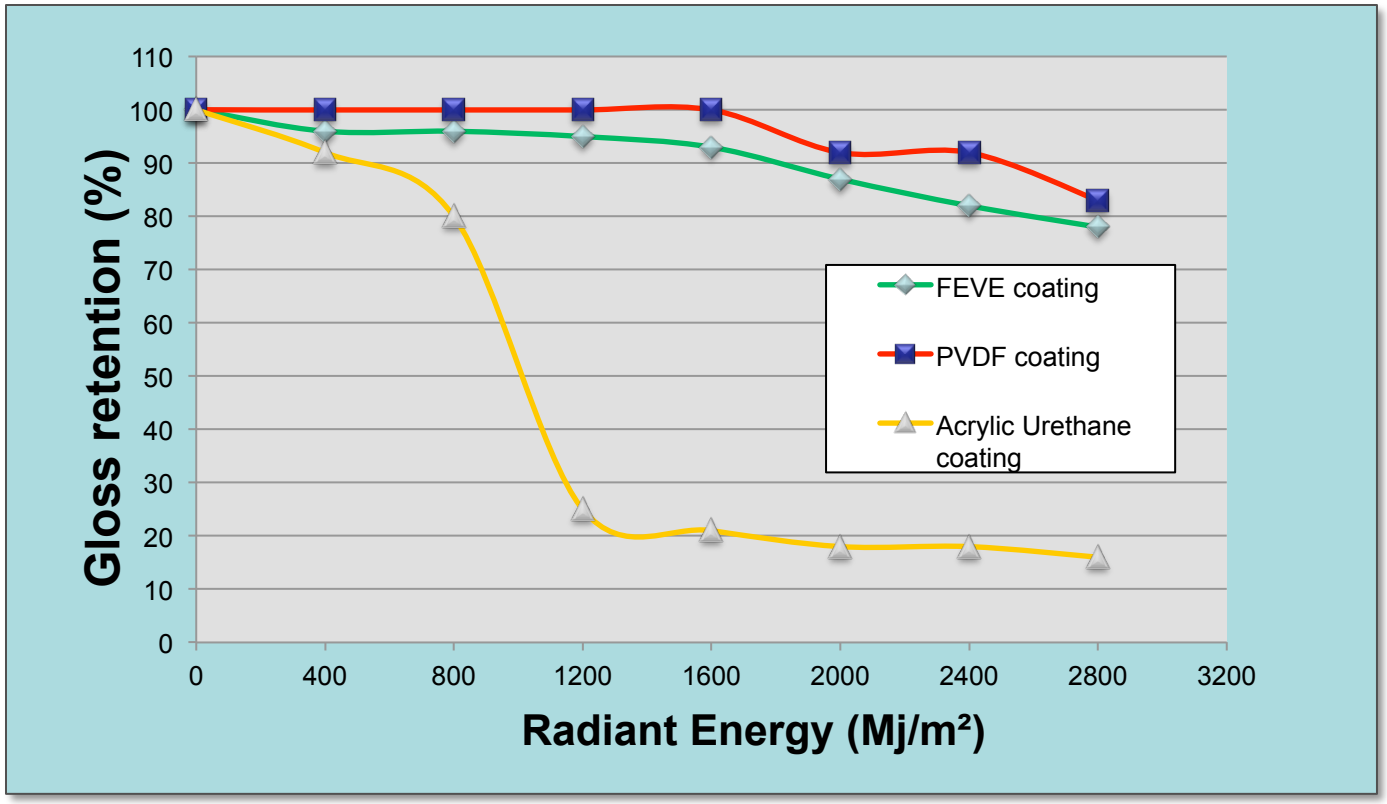
QUV Weatherometer Exposure Testing



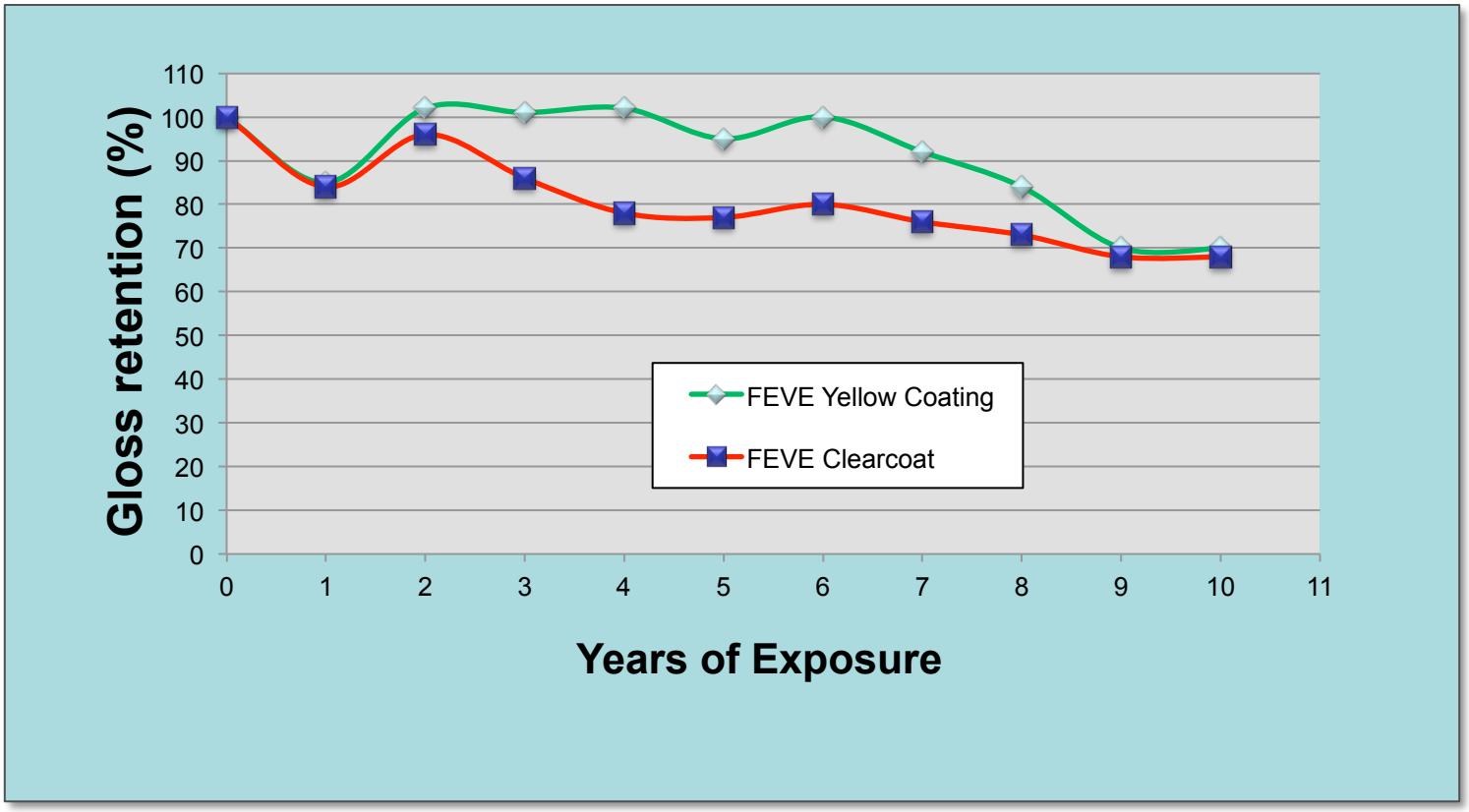
Sunshine Weatherometer Exposure Testing (Carbon Arc)



EMMAQUA Testing (Outside Test Fence in Arizona)



South Florida Test Fence Exposure



Corrosion Resistance Test of FEVE Coatings

- **Location**: Suruga Bay Marine Test Station (offshore)

- **Length of Test**: 16 years

- **Coatings Systems on Test**:
  - Zinc-rich primer, epoxy midcoat, acrylic urethane topcoat
  - Zinc-rich primer, epoxy midcoat, fluorourethane topcoat

- **Thickness of Coating**:
  - Primer: 3 mils
  - Midcoat: 6 mils
  - Topcoat: 1 mil (25 microns)

Measurement of Total Erosion of the Topcoat

	ACRYLIC URETHANE TOPCOAT	*FLUOROURETHANE TOPCOAT*
INITIAL MEASUREMENT (microns)	25	25
FINAL MEASUREMENT (microns)	0 (after 13 years)	21

Life Cycle Cost Advantages - Part I

- **Initial Cost of FEVE-based Topcoat**:
  - 5% to 10% higher than standard polyurethane topcoat

- **FEVE-Based Topcoat Life Expectation**: 30 to 60 years

- **Expected Repaints of Std. Polyurethane Topcoat (30 to 60 years)**:
  - 2 to 3 (based on topcoat erosion data from offshore test)

- **Additional Costs of Repaints**:
  - Facility downtime
  - Lodging of paint crew on offshore platform

Breakdown of Total Cost of Recoating a Bridge*		
	3 Coat Epoxy, 2 Coat Polyurethane System	3 Coat Epoxy, 2 Coat FEVE Urethane System
Staging Costs	$38.96 / m²	$38.96 / m²
Surface Preparation	$8.44 / m²	$8.44 / m²
Labor Cost For Paint Application	$26.22 / m²	$26.22 / m²
Total Cost of Coatings	$12.03 / m²	$15.96 / m²
Total Repainting Cost	$85.65 / m²	$89.87 / m²

* *"Prices of Construction Materials and Wages"* October 2006 (Published in Japan)

Estimation of Total Applied Cost Per Year (Coating System)			
Coating System	**Total Repainting Cost**	**Estimated Life of Coating System**	**Total Applied Cost per year of Service**
Polyurethane Topcoat System	$85.65	18	$4.76
FEVE Urethane Topcoat System	$89.87	30	$3.00
FEVE Urethane Topcoat System	$89.87	60	$1.50
FEVE Urethane Topcoat System	$94.21 (estimated)	30	$3.14
FEVE Urethane Topcoat System	$94.21 (estimated)	60	$1.57

Life Cycle Cost Advantages - Part II

- **Initial Cost of FEVE-Modified Topcoat**:
  - Depends on the level of modification. Will be 2% to 5% higher than standard polyurethane topcoat.

- **FEVE-Modified Topcoat Life Expectation**:
  - Will depend on the level of modification. Coatings can be fine tuned to last as long as necessary to meet both short-term objectives (cost constraints) and long-term objectives (elimination of one recoat with an improved aesthetic appearance).

Projects

Project Update: Tokiwa Bridge

- **Original coating scheme**:
  - 1 coat of lead-based primer
  - 2 coats of chlorinated rubber

- **Repainted with fluorourethane in 1986**:
  - Surface prepared to SSPC SP2/SP3
  - 2 coats of epoxy primer
  - 2 coats of fluorourethane

Projects

Project Update: Tokiwa Bridge

October 1988

April 1993

April 2007

Initial Gloss	Final Gloss	Gloss Retention	Color Change
75	69	91%	ΔE=3.5

Projects

Project: Shelby Street Bridge, Nashville TN

- **Coated in 2004**

- **3 coat system on steel**:
  - Zinc-rich primer
  - Epoxy midcoat
  - Fluorourethane topcoat

Projects

Project: Gateway Bridge, Nashville TN

- **Coated in 2004**
- **Red support girder coated with FEVE-containing coating**

Projects

Project: Akashi-Kaikyo Ohashi Road & Train Bridge

- **Coated in 1997**
- **Constructed as 100-year bridge**
- **Expectation is one recoat only**

Projects

Project Update: Katsushika Harp Bridge

- **Construction completed in 1986 (shop coating began in 1982)**
- **3 coat system**
- **Concrete bridge piers**
  - Elastic primer
  - 2 fluorourethane topcoats
- **Steel encasement for earthquakes in 2007**

New Steel Encasement:
Coated 2007

Original Concrete Foot:
Coated 1987

Conclusion

For 32 years, FEVE resins have been included in exterior coatings for multiple end uses. Their excellent weatherability and corrosion resistance make them attractive for inclusion in topcoats for steel and concrete surfaces.

Acknowledgements

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