Protective and Marine Coatings

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Epoxy vs Cement-based PFP

Assessing cementitious & concrete PFP problems & why choose epoxy intumescent instead

An update about the traps of cementitious Passive Fire Protection and how Sherwin-Williams epoxy intumescent technology will avoid the problem and deliver both fire protection and corrosion for the life of the asset.

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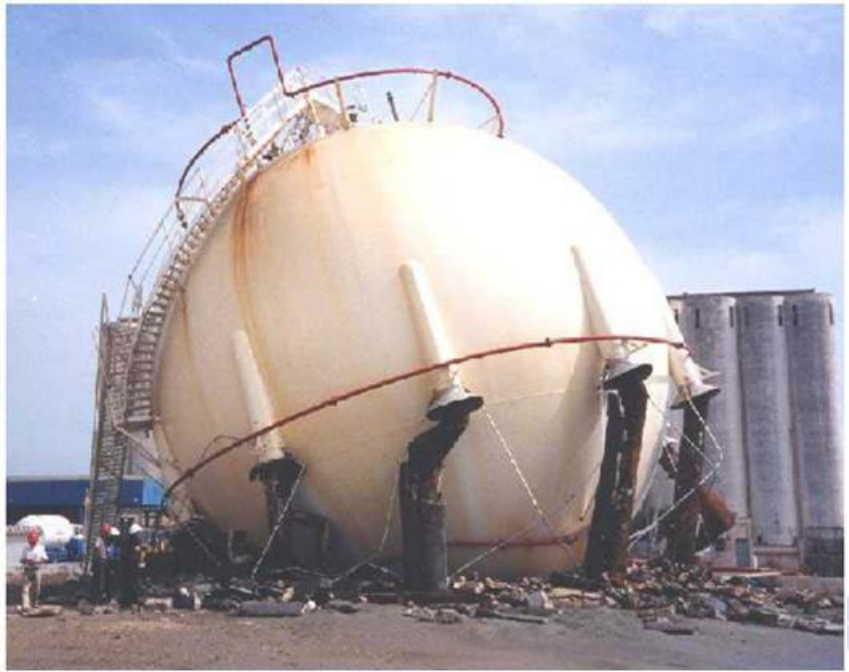
Cementitious PFP: corrosion

- Cementitious Fire Proofing does not protect against corrosion



Cementitious PFP: corrosion

- Corrosion Under Fireproofing (CUF) is very common with Cementitious PFP because:
  - It absorbs moisture and contaminants providing an electrolyte to the corrosion cell
  - It expands differently than steel leading to cracks

Cementitious PFP: corrosion

- Underneath corrosion can go undetected until it spalls the cementitious layer

Cementitious PFP: integrity issues

- Cementitious fire proofing is prone to mechanical damage

Cementitious PFP: integrity issues

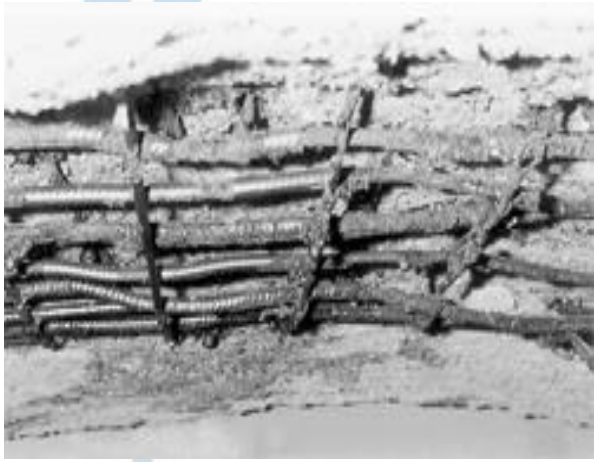
- Structural movement damages cementitious fire proofing

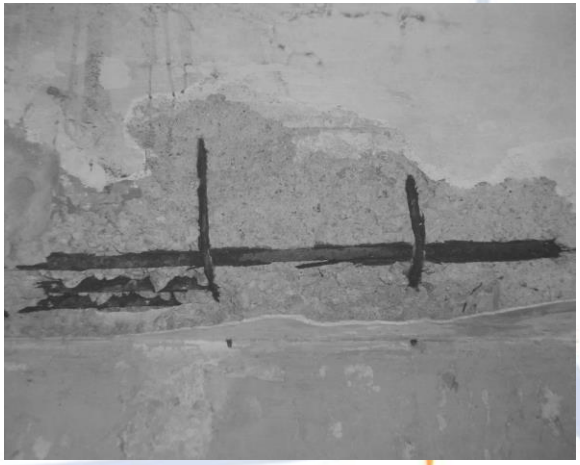
Cementitious PFP: unsafe

- Cementitious Fireproofing is a drop hazard!
  - Below photos: 30 m high...

Cementitious PFP: fire issues

- Concrete exposed to fire: moisture converted to steam (x1700 expansion) may lead to explosive spalling of concrete pieces (video available)





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Cementitious PFP: fire issues

- Concrete, dense or lightweight, when exposed to fire will not intumesce to close cracks allowing rapid rise of structure temperature
- When temperature rise is too fast, then concrete may experience explosive spalling.
- Pieces leave at high velocity – risk to personnel, plant & equipment and emergency services.

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Cementitious PFP: fire issues

- Hydrocarbon fires often begin with an **Explosion**
- To protect the steel structure the fire protection must remain intact after the blast.
- Cementitious fireproofing can easily be blasted away.

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Cementitious PFP: costs

- NACE MP Materials Performance Supplement, October 2012

Industrial PFP System Comparison (Typical Values)				
Material Type	Dense Concrete	Medium-Density Cementitious PFP	High-Density Cementitious PFP	Epoxy PFP
Density	135 PCF (2.1 g/cm³)	40 PCF (0.6 g/cm³)	55 PCF (0.8 g/cm³)	62-74 PCF (1.0-1.2 g/cm³)[A]
Weight per rating	High	Medium	Medium	Low
Shipping cost	Highest	Lower	Lower	Lowest
Shop applied cost/ ft²[F]	$8-10	$15-25	$15-25	$35-50
Field blockout cost/ ft²[F]	$115-120[G]	$30-40	$30-40	$50-60
Chemical resistance	Low[D]	Low[D]	Low[D]	High

[A] Spray-applied density can vary with material temperature, pressure, and application technique.

[G] Concrete field costs are extremely high due to the high cost of constructing the forms in place to pour the connection points.

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Cementitious PFP: costs

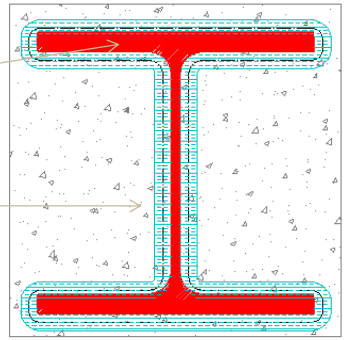
- Much higher weight compared with epoxy PFP => transportation costs

(below: example using concrete)

Cross section of W10x49

Epoxy application (13mm / 0.511inch)

Concrete application (51mm / 2.0 inch)



Comparison Summary

	Concrete	Epoxy
Thickness (2 hour rating)	2.0" / 51mm	0.51" / 13mm
Cross-section of material	129in^2/83,275mm^2	35in^2/ 22,645 mm^2
Weight of FP on 20'	2630 lbs. / 1193kg	310 lbs. / 140.5 kg

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Cementitious PFP: costs

- Much higher application costs on site
- 40% of the cementitious PFP needs repair on site due to transport damage

<u>Epoxy Intumescent</u>

- More work off site
  - 90% shop
  - 5% module yard
  - 5% field
- Reduced site congestion
- Safer and lower costs

<u>Cast Concrete/Cementitious</u>

- Less work off site
  - 50% shop
  - 30% module yard
  - 20% field
- Increased site congestion
- Higher safety risk and costs

Cementitious PFP: costs

- Large blockout areas
- One truck for seven beams…
  - Epoxy PFP: blockouts are small, allowing quick instalation

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Cementitious PFP: costs

Much higher lifetime costs: need maintenance every 3 – 5 years

- Crack Repairs
- Caulking
- Finish Coats

Concealed Heavy Corrosion

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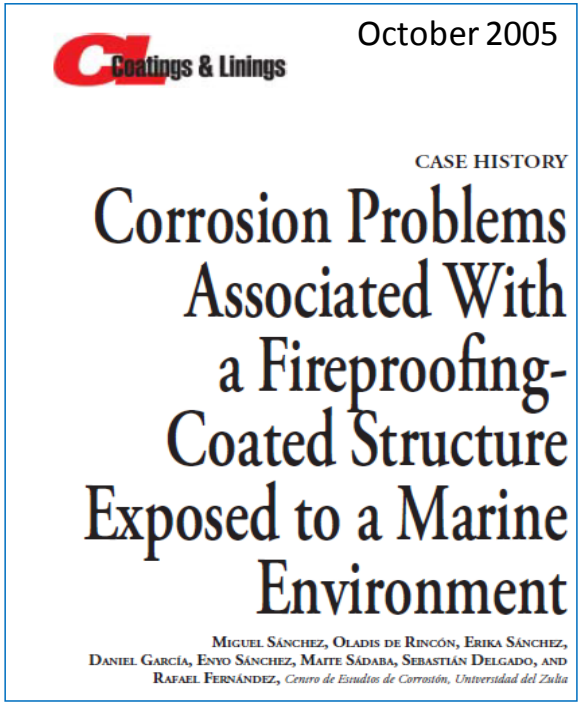
Cementitious PFP reality moment

Industry is now recognizing the problem



October 2005

Coatings & Linings

CASE HISTORY

Corrosion Problems Associated With a Fireproofing-Coated Structure Exposed to a Marine Environment

Miguel Sánchez, Oladis de Rincón, Erika Sánchez, Daniel García, Envo Sánchez, Maite Sádaba, Sebastián Delgado, and Rafael Fernández, *Centro de Estudios de Corrosión, Universidad del Zulia*

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Cementitious PFP reality moment

- API 2218 "Fireproofing Practices in Petroleum and Petrochemical Processing Plants":

7.3.2 Lightweight Concrete

Disadvantages of lightweight concrete materials include:

a. Porosity, which can allow penetration by water or leaked hydrocarbons.

b. Moisture absorption can lead to cracking and spalling in freezing climates.

c. The need to maintain a top coating (and possible shielding or caulking) to prevent moisture or hydrocarbons from penetrating.

d. Lightweight concrete is more susceptible to mechanical damage than dense concrete materials (but can be shielded if mechanical damage is a threat).

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Comparing with epoxy PFP

Sherwin-Williams Firetex Epoxy PFP	Lightweight cementitious PFP
Polymeric barrier & rust inhibitors: protection from CUF	CUF Surface defects and absence of finish coats allow moisture and contaminants to penetrate the cement and promote corrosion
Resists absorption of moisture and chemical attack	
15-year sea water immersion tests, coating retains properties	

Comparing with epoxy PFP

Sherwin-Williams Firetex Epoxy PFP	Lightweight cementitious PFP
Very low maintenance.	Cracking and spalling as a result of corrosion, mechanical damage, freeze-thaw, expansion-contraction, vibration and/or flexing. Continual inspection and maintenance required. Core samples must be taken to check the corrosion level in any specific location
Full performance against fire and corrosion without a finish coat.	
Expands and contracts with the steel structure.	
Top coat only required for UV resistance.	

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Comparing with epoxy PFP

Sherwin-Williams Firetex Epoxy PFP	Lightweight cementitious PFP
Excellent adhesion and resistance to blast, jet fire and hose stream	Can crack or disbond depending on installation design, lath, and the degree of CUF present.
	Can be removed by explosions.

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Comparing with epoxy PFP

Sherwin-Williams Firetex Epoxy PFP	Lightweight cementitious PFP
Lower applied weight per sq mt: reduced transport costs for prefabricated structures.	One load of bare steel I-beams delivered to contractor yard to be fireproofed = 5-7 truckloads to job site
Easy in both shop and field application	More site congestion to build forms
Reduced transportation damage from shop.	More transportation damage, more significant repair work at the job site.
Block-out areas are smaller & more fireproofing can be applied in the shop.	Larger blockouts allowance implies more field work will be required, increasing the overall installed cost

Conclusion

- Cementitious PFP materials tend to be phased out by the Oil & Gas industry
- Firetex epoxy intumescent PFP alternative:
  - Provides durability
  - Resistant to absorption and chemical attack
  - Provides corrosion protection
  - Lightweight saving structural design and shipping costs
  - Long service life with little to no maintenance

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Any Questions?

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