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.
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)
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.
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.
## Cementitious PFP: costs

NACE MP Materials Performance Supplement, October 2012

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Dense Concrete</th>
<th>Medium-Density Cementitious PFP</th>
<th>High-Density Cementitious PFP</th>
<th>Epoxy PFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>135 PCF (2.1 g/cm³)</td>
<td>40 PCF (0.6 g/cm³)</td>
<td>55 PCF (0.8 g/cm³)</td>
<td>62-74 PCF (1.0-1.2 g/cm³)</td>
</tr>
<tr>
<td>Weight per rating</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Shipping cost</td>
<td>Highest</td>
<td>Lower</td>
<td>Lower</td>
<td>Lowest</td>
</tr>
<tr>
<td>Shop applied cost/ ft²</td>
<td>$8-10</td>
<td>$15-25</td>
<td>$15-25</td>
<td>$35-50</td>
</tr>
<tr>
<td>Field blockout cost/ ft²</td>
<td>$115-120(G)</td>
<td>$30-40</td>
<td>$30-40</td>
<td>$50-60</td>
</tr>
<tr>
<td>Chemical resistance</td>
<td>Low(D)</td>
<td>Low(D)</td>
<td>Low(D)</td>
<td>High</td>
</tr>
</tbody>
</table>

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

(D) Concrete field costs are extremely high due to the high cost of constructing the forms in place to pour the connection points.
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

<table>
<thead>
<tr>
<th></th>
<th>Concrete</th>
<th>Epoxy</th>
</tr>
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<tbody>
<tr>
<td>Thickness (2 hour rating)</td>
<td>2.0” / 51mm</td>
<td>0.51” / 13mm</td>
</tr>
<tr>
<td>Cross-section of material</td>
<td>129in²/83,275mm²</td>
<td>35in²/22,645mm²</td>
</tr>
<tr>
<td>Weight of FP on 20’</td>
<td>2630 lbs. / 1193kg</td>
<td>310 lbs. / 140.5 kg</td>
</tr>
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</table>
Cementitious PFP: costs

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

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

**Cast Concrete/Cementitious**
- 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 installation
Cementitious PFP: costs

Much higher lifetime costs: need maintenance every 3 – 5 years
- Crack Repairs
- Caulking
- Finish Coats

Concealed
Heavy
Corrosion
Cementitious PFP reality moment

 mükemmel

Industry is now recognizing the problem
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).
Comparing with epoxy PFP

<table>
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<tr>
<th>Sherwin-Williams Firetex Epoxy PFP</th>
<th>Lightweight cementitious PFP</th>
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<tbody>
<tr>
<td>Polymeric barrier &amp; rust inhibitors: protection from CUF</td>
<td>CUF</td>
</tr>
<tr>
<td>Resists absorption of moisture and chemical attack</td>
<td>Surface defects and absence of finish coats allow moisture and contaminants to penetrate the cement and promote corrosion</td>
</tr>
<tr>
<td>15-year sea water immersion tests, coating retains properties</td>
<td></td>
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<tr>
<td>Very low maintenance.</td>
<td>Cracking and spalling as a result of corrosion, mechanical damage, freeze-thaw, expansion-contraction, vibration and/or flexing.</td>
</tr>
<tr>
<td>Full performance against fire and corrosion without a finish coat.</td>
<td>Continual inspection and maintenance required. Core samples must be taken to check the corrosion level in any specific location</td>
</tr>
<tr>
<td>Expands and contracts with the steel structure.</td>
<td></td>
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<tr>
<td>Top coat only required for UV resistance.</td>
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<tr>
<td>Excellent adhesion and resistance to blast, jet fire and hose stream</td>
<td>Can crack or disbond depending on installation design, lath, and the degree of CUF present.</td>
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<td>Can be removed by explosions.</td>
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<td>Lower applied weight per sq mt: reduced transport costs for prefabricated structures.</td>
<td>One load of bare steel I-beams delivered to contractor yard to be fireproofed = 5-7 truckloads to job site</td>
</tr>
<tr>
<td>Easy in both shop and field application</td>
<td>More site congestion to build forms</td>
</tr>
<tr>
<td>Reduced transportation damage from shop.</td>
<td>More transportation damage, more significant repair work at the job site.</td>
</tr>
<tr>
<td>Block-out areas are smaller &amp; more fireproofing can be applied in the shop.</td>
<td>Larger blockouts allowance implies more field work will be required, increasing the overall installed cost</td>
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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
Any Questions?