LIFE CYCLE COST

Prospective water tank owners have a multitude of options and details when planning the construction of a new storage tank. The following Comparison illustrates the differences between both Bolted Steel (Fusion Bonded Epoxy) and Bolted Steel (Glass/Vitreous) water storage tanks. The best storage tanks are designed, manufactured and installed as major infrastructure projects. As a starting point, the minimum service life of a storage tank use to be considered 40 years. Today’s storage industry, we find tanks that are being introduced into the market that will provide less than a 10 to 20 year service life and other products that will provide service in excess of 60 to 80 years. All of these products have an initial investment by construction type, but when the life cycle costs are added, the quality of the products will reflect the true value of the tank.

The measurement of coating performance must be viewed from two perspectives – Laboratory Conditions versus Real World Conditions.

Laboratory conditions using performance attributes such as hardness, thickness, film continuity, abrasion resistance, impact strength, elasticity, flexibility and adhesion strength are measured through the use of testing protocol as specified in various ASTM standards. These standards are established to quantify each physical characteristic of the coating system but do not establish a correlation between the physical characteristic and its ability to contribute to the long term serviceability of the coating system in a specific service environment. By looking at a comparison of some of the physical characteristics of fusion bonded epoxy coatings and glass linings it becomes obvious that these materials are drastically different. (See Chart Below)

**Compare The Facts (Bolted Fusion Bonded Epoxy vs. Bolted Glass/Vitreous Enamel)**

<table>
<thead>
<tr>
<th>Tank Type</th>
<th>Vertical Rolled, Flanged panel</th>
<th>Horizontal Rolled, Tapered Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel Size</td>
<td>8.5’ tall x 5’ long</td>
<td>4.5’ tall x 9’ long</td>
</tr>
<tr>
<td>Plate Design</td>
<td>30 +</td>
<td>30 +</td>
</tr>
<tr>
<td>Service Life</td>
<td>40+ years</td>
<td>30 - 40 years</td>
</tr>
<tr>
<td>Edge Protection</td>
<td>Complete edge coverage</td>
<td>Poor and inconsistent</td>
</tr>
<tr>
<td>Bolt Holes</td>
<td>Complete hole coverage</td>
<td>Covered with sealant in the field</td>
</tr>
<tr>
<td>Coating Thickness</td>
<td>7 - 11 mils</td>
<td>8 - 13 mils (due to high shop defect)</td>
</tr>
<tr>
<td>Temp. Tolerance</td>
<td>200° F water, Dry 300° F</td>
<td>140° F water, Dry N/A</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Passes 1/8” mandrel test</td>
<td>None (cannot be field repaired)</td>
</tr>
<tr>
<td>Impact</td>
<td>160 in/lbs</td>
<td>4 in/lbs</td>
</tr>
<tr>
<td>Salt Spray</td>
<td>Passes 7500 hours</td>
<td>Passes 7500 hours</td>
</tr>
<tr>
<td>Sealant</td>
<td>Vulkem</td>
<td>Mastic</td>
</tr>
<tr>
<td>Gasket</td>
<td>EPDM &amp; BUNA</td>
<td>None</td>
</tr>
</tbody>
</table>

*superiortank.com*
Glass linings are over twice as thick and are significantly harder and more abrasion resistant in comparison to fusion bonded epoxy coatings. Glass linings also possess adhesive and cohesive tensile strengths that significantly exceed fusion bonded epoxy systems. A laboratory performance comparison using the appropriate ASTM testing methods would certainly suggest that the fusion bonded epoxy was inferior to the glass lining system in these areas. Conversely the fusion bonded epoxy coatings are significantly more flexible and elastic but this is the only performance category that promotes the use of fusion bonded epoxy in place of glass linings.

In the real world, where performance is judged by service life expectations within a specific service environment, the glass lining and fusion bonded epoxy comparison must be judged from a water immersion perspective. In this type of service environment, the vast majority of superior physical characteristics associated with glass linings are underutilized. The water immersion service environment does not subject the coating system to erosion or abrasion sources or impacts originating from the interior of the tank therefore superior coating thickness, hardness, adhesion and impact strength are of minimal importance once a minimum performance baseline has been established and exceeded. If the performance baseline is predicated on the performance levels of the various coating systems approved for use in the AWWA D.102-06 Standard, both glass linings and fusion bonded epoxy systems far exceed these criterion. When physical performance characteristics that directly align with a water immersion environment (within a tank) are compiled and evaluated, characteristics such as water permeability, flexibility, elasticity and film continuity become critically important. These attributes are individually reviewed as follows:

- Water permeability resistance with either system is similar and is considered to be far superior to the coating systems recommended in the AWWA D.102-06.

- Film continuity and/or the absence of localized coating voids is achieved in the glass lining process through the use of thicker lining material with special provisions employed of plate edges and holes. The fusion bonded epoxy coatings use electrostatic spray operations to oppositely charge the substrate and coating to electrically attract the coating to the substrate and achieve 100% coverage. In both cases, holiday detection equipment is used in accordance with NACE RPO 188 to insure a complete and discontinuity free coating system. On this basis, both systems will uncompromisingly achieve a continuous film capable of achieving barrier protection.

- Flexibility and elasticity capabilities allow the coating to move in conjunction with the natural flexing and movement of the steel plates. This capability is vital during tank filling and draining cycles but is also applicable to localized deformations resulting from rock throwing, bullet impacts or other damage to the tank. Additionally, temperature variations and the associated expansion and contraction of the tank and its contents further emphasize the importance of using a flexible coating system. The flexibility and elasticity of the thinner fusion bonded coating system is unquestionably significantly superior to the rigid glass liner.

On this basis, the fusion bonded epoxy coating system exceeds each physical performance criterion deemed necessary to maximize service life expectations in a water immersion environment. When additional “real world” conditions are included such as the potential for corrosion to undercut the glass lining, the difficulty associated with detecting the undercutting and the potential for structural compromises in cases of serious corrosion degradation, the service life expectations are dramatically reduced when glass lining is involved.
1.052 MG, 86.00’D x 24.00’H

Fusion Bonded Epoxy Future Costs - Bolted Steel Tank

Initial Cost
$300,000

Yr15: Interior/Exterior Renovation
$15,000 ($315,000)

Yr30: Interior/Exterior Renovation
$15,000 ($330,000)

Yr45: Interior/Exterior Renovation
$15,000 ($345,000)

Yr60: Interior/Exterior Renovation
$15,000 ($360,000)

Yr70: New Tank Replacement (If Req’d)
$350,000 ($720,000)

Yr90: Interior/Exterior Renovation
$15,000 ($735,000)

Yr95: Interior/Exterior Renovation
$5,000 ($740,000)

100 Yrs: $740,000
1.052 MG, 86.00'D x 24.00'H

Glass/Vitreous Future Costs - Bolted Steel Tank

- **Initial Cost:** *$760,000*
- **Yr15:** Interior Touchup (5.0%) / Exterior Topcoat (100.0%) *$203,552 ($963,552)*
- **Yr30:** Interior/Exterior Renovation *$303,947 ($1,267,499)*
- **Yr45:** Interior Touchup (5.0%) / Exterior Topcoat (100.0%) *$114,316 ($1,381,815)*
- **Yr50:** New Tank Replacement $696,409 ($2,078,224)
- **Yr65:** Interior Touchup (5.0%) / Exterior Topcoat (100.0%) *$77,816 ($2,156,040)*
- **Yr80:** Interior/Exterior Renovation *$116,194 ($2,272,234)*
- **Yr95:** Interior Touchup (5.0%) / Exterior Topcoat (100.0%) *$43,702 ($2,315,936)*

**100 Yrs:** $2,315,936

*In reference to STI/SPFA “Water Storage Tank Total Cost of Ownership” © 2006-2011, STI/SPFA All Rights Reserved.*
Field Applied Coatings Future Costs - Welded Steel Tank

Initial Cost: $600,000

- Yr10: Interior/Exterior Renovation $100,000 ($700,000)
- Yr20: Interior/Exterior Renovation $100,000 ($800,000)
- Yr30: Interior/Exterior Renovation $100,000 ($900,000)
- Yr40: Interior/Exterior Renovation $100,000 ($1,000,000)
- Yr50: Interior/Exterior Renovation $100,000 ($1,100,000)
- Yr60: Interior/Exterior Renovation $100,000 ($1,200,000)
- Yr70: Interior/Exterior Renovation $100,000 ($1,300,000)
- Yr80: Interior/Exterior Renovation $100,000 ($1,400,000)
- Yr90: Interior/Exterior Renovation $10,000 ($1,500,000)

100 Yrs: $1,500,000