Corrosion Avoidance with New Wood Preservatives
By Samuel L. Zelinka and Douglas R. Rammer

The increased use of Alkaline Copper Quaternary (ACQ) and Copper Azole (CuAz) as preservatives for wood used in residential construction has led to concerns about the corrosion performance of fasteners. Information on the effects of these preservatives on fastener corrosion rate is limited, although Simpson Strong Tie has published a technical bulletin indicating that both ACQ and CuAz are roughly twice as corrosive as Chromate Copper Arsenate (CCA) and recommends fastener types for a given environment and preservative (Simpson Strong Tie, 2005). It is believed that ACQ and CuAz are more corrosive than CCA due to the higher percentage of copper in these preservatives, and absence of chromium and arsenic; both are known as corrosion inhibitors. While accelerated tests exist for estimating the corrosiveness of new wood preservatives, currently there is no consensus on how to relate the results of these tests to in-service performance. For information about the effect of new wood preservatives on corrosion, and a critical review of test methods used to measure corrosion in wood, see Zelinka and Rammer (2005) (references available in the online version of this article, www.STRUCTUREmag.org).

This article focuses on considerations that need to be made when choosing products, other than stainless steel, to minimize corrosion of metals in contact with treated wood. With so many “corrosion-resistant” alternative products on the market, it is important to know the fundamental principles of corrosion protection to make informed decisions when designing structures.

Protective Coatings
For steel fasteners, one of the most popular approaches is coating the fastener with either zinc galvanizing or a non-metallic coating. Although coatings are a cost effective way of increasing the corrosion resistance of fasteners in treated wood, caution is still needed when specifying their use. The overall corrosion performance of a coated fastener is dependent on properties and thickness of the coating, the size and quantity of defects in the coating, and the adhesion between the coating and fastener. Furthermore, coatings that perform well in certain environments perform poorly in other environments. For example, zinc coatings perform better than cadmium coatings in industrial environments, while the reverse is true in marine environments (Mooney, 2003). It is imperative that fasteners be tested in treated wood so that test results are not erroneously applied.

Metallic/Galvanized Coatings
Metallic coatings, such as galvanizing (zinc plating), work by applying an envelope layer of metal that corrodes at a slower rate in a certain environment over the substrate metal that corrodes faster. It is important to stress that the lower corrosion rate of the coating gives it improved service life, which is independent of its ranking on the galvanic series for the specific environment.

Metallic coatings can be further subdivided into two categories, depending on the relative positions on the galvanic series of the coating and the substrate metal. If the coating is more anodic on the galvanic series than the substrate, the coating will corrode to the benefit of the substrate; that is, the coating galvanically protects the substrate. The advantage of these anodic coatings is that the substrate is protected from defects in the coating (such as pores and cracks) because of the galvanic protection. However, the anodic coating is only beneficial if the corrosion rate of the coating material is slower than that of the substrate. Common anodic coatings for steel fasteners, one of the most popular approaches is coating the fastener with either zinc galvanizing or a non-metallic coating. Although coatings are a cost effective way of increasing the corrosion resistance of fasteners in treated wood, caution is still needed when specifying their use. The overall corrosion performance of a coated fastener is dependent on properties and thickness of the coating, the size and quantity of defects in the coating, and the adhesion between the coating and fastener. Furthermore, coatings that perform well in certain environments perform poorly in other environments. For example, zinc coatings perform better than cadmium coatings in industrial environments, while the reverse is true in marine environments (Mooney, 2003). It is imperative that fasteners be tested in treated wood so that test results are not erroneously applied.

Mechanism of crevice corrosion of fasteners in wood, originally proposed by A.J. Baker of the USDA Forest Products Laboratory (FPL) in 1978.
Barriers

Currently, there is at least one manufacturer who is marketing a barrier intended to go between treated wood and deck hangers to prevent corrosion. Similar to ceramic and organic coatings, barriers try to isolate the metal from the corrosive environment, and are only as effective as the number and type of defects they contain. Fasteners inserted through the barrier into the wood penetrate the barrier, and corrosion can occur in this area.

Dissimilar Metals

A condition that is sometimes overlooked is the combination of different metals; for example, using a stainless steel fastener to connect a hot-dip galvanized joist hanger to a deck. Galvanic corrosion occurs when dissimilar metals are placed in “electrical contact” in a corrosive environment, and the less noble metal corrodes at the expense of the more noble metal. Even if metals are protected by paint or another barrier, galvanic corrosion can still occur through defects in the barrier. The anodic (less noble) metal should never be coated with defects, as the coating exacerbates the effect of galvanic corrosion by localizing it to the small surface area (Elliott 2003).

Conclusions

With the introduction of new wood preservatives, the concern for corrosion protection has increased. When considering alternatives to stainless steel for fasteners and connectors, the designer should understand the methods by which these alternatives work. Coatings inhibit corrosion by isolating the metal from corrosive conditions. For isolation to be successful, the barrier or coating must not be compromised, with the exception of metallic anodic coatings. Finally, combining dissimilar metals can increase the corrosion rate because of galvanic action. This information is summarized in Table I.

Table I: Products available for use with treated wood, and possible design concerns

<table>
<thead>
<tr>
<th>Product</th>
<th>Design Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>Combining with a different metal</td>
</tr>
<tr>
<td>Metallic Coatings (anodic)</td>
<td>Combining with a different metal, Corrosion rate of coating</td>
</tr>
<tr>
<td>Metallic Coatings (cathodic)</td>
<td>Combining with a different metal, Defects in coating, Construction damage to coatings</td>
</tr>
<tr>
<td>Organic/Ceramic Coatings</td>
<td>Defects in coating, Construction damage to coatings</td>
</tr>
<tr>
<td>Barriers</td>
<td>Defects in barrier, Damage to barrier during construction</td>
</tr>
</tbody>
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References


