SIMPSON Strong-Tie™

TECHNICAL BULLETIN

PRESERVATIVE TREATED WOOD

The following information is a summary of the testing and analysis that Simpson Strong-Tie has performed related to the Pressure-Treated Wood industry's voluntary transition away from the use of CCA-C treated wood for residential and general consumer use. The information is intended to help aid in selection of coatings provided on connectors that are in contact with preservative-treated wood.

UNDERSTANDING THE ISSUES

Metal connectors, anchors, and fasteners will corrode and lose load carrying capacity when installed in corrosive environments or exposed to corrosive materials. There are many environments and materials which may cause corrosion including:

- Ocean salt air
- Preservative-treated wood
- Fumes
- Fire-retardants
- Dissimilar metals
- Fertilizers

The many variables present in a single building environment make it impossible to accurately predict if, or when, significant corrosion will begin or reach a critical level. This relative uncertainty makes it crucial that the specifiers be knowledgeable of the potential risks and select a product coating or metal that is suitable for the intended use.

Changes in the preservative-treated wood industry have created additional concerns. Effective December 31, 2003, the preservative-treated wood industry voluntarily transitioned from Chromated Copper Arsenate (CCA-C) used in residential applications to alternative treatments. Testing has shown that certain alternative replacement treatments are generally more corrosive than CCA-C.

The treated wood industry has recommended the use of stainless steel or hot-dip galvanized fasteners and connectors for years. This recommendation is still the same for use with the alternative treatments but additional clarification is needed to insure that adequate corrosion protection is provided. Specifying hot-dipped galvanized products is often very generic, as steel products can be considered hot-dip galvanized while having various thickness levels. Failure to be specific regarding the amount of hot-dip galvanizing protection can lead to use of products which may not be sufficient for the intended use.

There are two primary processes used to hot-dip galvanize (HDG) products –"continuous" hot-dip galvanizing and "batch" or "post" hot-dip galvanizing. Continuous hot-dip galvanizing is a process completed at the steel manufacturing facility where a continuous sheet of light gauge steel is "dipped" into a zinc bath and a protective HDG coating is applied to a specified thickness. The steel is then shipped as a coil and used to manufacture many of the products produced by Simpson Strong-Tie. (The required minimum levels of galvanizing provided by this process are covered by ASTM A653.) Batch or "post" hot-dip galvanizing is generally used on heavier individual products not capable of being fabricated from galvanized steel coils and can also be used to galvanize some fasteners and anchors. Products are fabricated then shipped out to be "dipped" into a molten zinc bath to provide protection against corrosion. (The required minimum levels of galvanizing provided by this process are covered by ASTM A123 for individual connectors and by ASTM A153 for fasteners.)

The corrosion performance of a hot-dip galvanized product is a function of the amount of zinc on it's surface. Simply put, more zinc means better performance. Historically the connector industry has used products manufactured with a G60 coating which means 0.60 oz/ft^2 of zinc was continuously applied to the steel coil. In recent years, Simpson made the decision to increase the minimum standard amount of zinc protection to a G90 coating, 0.90 oz/ft^2. This represents a 50 percent increase in protection versus the industry standard and is the minimum level of galvanizing provided on all Simpson galvanized products. Simpson also offers many products with ZMAX™ which is a G185 coating, 1.85 oz/ft^2.

Testing has shown that type 304 and 316 stainless steel products corrode substantially less than other alternatives when used with the alternative wood treatments. Simpson has a number of stainless steel products available and recommends the use of stainless steel when possible. Stainless steel products have significantly higher costs than standard coated products.

Due to the wide variety of steel and fastener coatings available and the number of possibilities of pressure treatment chemicals which may be used, Simpson Strong-Tie has conducted a series of tests to assess the relative corrosive impact of various pressure-treated woods on connectors and fasteners. These independently witnessed tests were performed in compliance with the American Wood-Preservers' Association Standard E12-94 "Standard Method of Determining Corrosion of Metal in Contact With Treated Wood." Relative corrosion based on quantitative measurements, visual observation, and calculations indicate the new / alternative wood preservatives tested are generally more corrosive than CCA-C. The number of variables that affect the rate of corrosion make it impossible to apply these test results to all product combinations, installations, and environmental conditions. These results cannot be correlated to service life.

SCOPE OF TESTING

Testing was performed by Simpson Strong-Tie on 1,760 steel coupons per the E12-94 test procedure summarized as follows:

- 1"x2" steel coupon samples were prepared by thoroughly cleaning and weighing the sample.
- The samples were then sandwiched between two 1½"x3"x ¾" pressure treated wood blocks.
- A ¼" diameter nylon bolt was used on each end to clamp the samples together to provide uniform contact on the coupon.
- Samples were then placed in an environmental chamber held at 120°F and 90% humidity.
- The samples were removed from the chamber, cleaned and weighed.
- The standard provides an equation which was then used to determine the corrosion rate in mils per year. The corrosion rate was used for comparison purposes only and does not correlate to any life expectancy.

Fastener tests were also performed on over 3,000 samples using a procedure similar to the E12-94 summarized as follows:

- The fasteners were thoroughly cleaned and weighed.
- Six fasteners were installed into the narrow face of a 2x4 pressure-treated wood block 6" to 9" long.
- Each block was placed in the environmental chamber.
- Fasteners were removed from the wood block using a chisel instead of withdrawing the fasteners from the wood.
- Fasteners were cleaned, weighed, and calculations were performed to determine the percentage weight loss as an average of the six fasteners.

The following tables indicate the items examined in the testing. Note that there are test results on all of these items; however, this bulletin only reviews the performance of hot-dip galvanizing with the treated woods.

Wood Treatment
CCA-C
Copper Azole (CBA-A, CA-B)
ACQ-C, ACQ-D (Carbonate)[1]
Sodium Borate (SBX/DOT)
ACZA[2]
Untreated
Borate (Other)

Fasteners
N8, N10, 10d, 16d
Various other nails
SDS, Lag screws, & Bolts
SD8's
WA's, THD's, PDP's
A307, B7, & ATR
Misc. Others

Fastener Coatings
HDG, Dbl. HDG
EP, Zinc Dich.
Uncoated
Mech. Galv.
Misc. Others

Metal Coatings
Uncoated
G90
ZMAX™
Batch HDG
304 & 316 SS
SST Grey Paint
Misc. Others

[1] ACQ-D (Carbonate) is a carbonate version of Type D which is expected to be available in 2004.
[2] With the exception of ACZA, treatments with ammonia carriers were not included in this testing.

TEST RESULTS

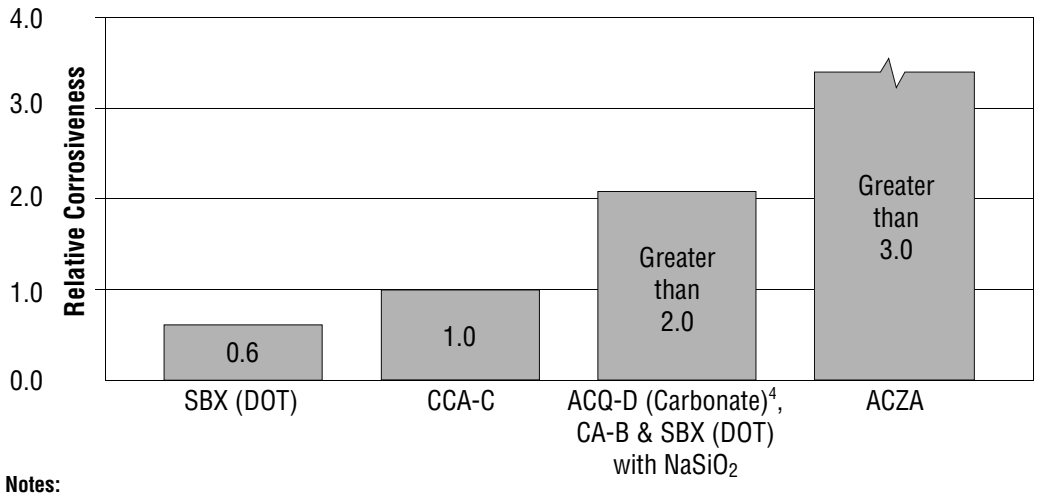
A detailed analysis was performed on the data accumulated from the 1,760 steel coupon samples and over 3,000 fastener samples. The following figure represents a general summary of some of the results. All information is based on observations of the relatively limited number of tests performed on the samples obtained.

It is important to note that even within a specific treatment chemical (CCA-C, ACQ-D (Carbonate), CA-B, etc.) there can be a number of variations in the formulation which can affect the results. These variations are controlled by the chemical supplier and the wood treater so care must be exercised when specifying the treated wood to be used. Formulations may be modified in attempts to provide better performance in penetrating the wood, improving water repellancy, providing short term improvements in corrosion performance, etc. It is possible that a slight modification in the formulation of a treatment can have an effect on the corrosion potential.

Figure 1 compares the average tested relative corrosiveness of the alternative treatments to the corrosion which occurred with CCA-C treated wood. The numbers shown are an average of the results of G90 & G185 continuous hot-dipped galvanized steel samples.

Recommendations shown are based on accelerated testing per AWPA Standard E12-94, and may or may not have a relation to actual service life.

Figure 1



Notes:

1. CCA-C, ACQ-D (Carbonate), CA-B, SBX (DOT), and SBX (DOT) with $NaSiO_2$ pressure treatment formulations were used for this analysis.
2. The relative corrosion rates of ACQ-D (Carbonate) and CA-B treated wood on hot-dip galvanized steel were grouped and analyzed together.
3. During the testing, types 304 and 316 Stainless Steel samples did not show any signs of significant corrosion when exposed to the pressure treated woods tested.
4. ACQ-D (Carbonate) is a carbonate version of Type D which is expected to be available in 2004.

From this figure the following observations are made:

- ACQ-D (Carbonate), CA-B, and SBX (DOT) with $NaSiO_2$ treated wood is on the average approximately two times more corrosive than CCA-C treated wood. Note that the standard galvanized coating for years on Simpson connectors was G60 which has proven over time to perform well on CCA-C wood. Thus, it could be reasoned that there needs to be at least two times the coating protection when used in conjunction with the tested ACQ-D (Carbonate), CA-B, and SBX (DOT) with $NaSiO_2$ treatments. Thus, it is Simpson's recommendation that at a minimum a ZMAX™ coating, which provides approximately 3 times the corrosion protection of G60, should be applied to meet the potential demand from these treated woods.
- Testing on Sodium Borate (DOT-Disodium Octaborate Tetrahydrate) treated wood generally indicates corrosion rates less than seen with CCA-C treated wood.

CONCLUSION AND RECOMMENDATIONS

- Based on testing results it is known that certain types of ACQ, Copper Azole and SBX (DOT) with $NaSiO_2$ treated woods are more corrosive than CCA-C.
- Thicker galvanizing generally extends service life of a product. The treated wood industry recommends use of Stainless Steel and hot-dip galvanized connectors and fasteners with treated wood.
- Due to the uncertainties, which are out of the specifiers control, in regard to the chemicals used in pressure treated wood, Simpson recommends the use of stainless steel fasteners, anchors and connectors with treated wood when possible. At a minimum, customers should use ZMAX™ (G185 HDG per ATSM A653), Batch/Post Hot-Dip Galvanized (per ASTM A123 for connectors and ASTM A153 for fasteners), or mechanically galvanized fasteners (per ASTM B695, Class 55 or greater), product with the newer alternative treated woods. Due to the many variables involved, many of which are controlled by the chemical supplier and the wood treater, Simpson cannot make an unqualified recommendation of any galvanized or other coating for use with treated wood. Additionally, because of the many variables involved, Simpson cannot provide estimates on service life of connectors, anchors or fasteners. We suggest that all users and specifiers obtain recommendations for Batch/Post HDG, G185 HDG, mechanically galvanized, or other coatings from their treated wood supplier. (Some treated wood chemical suppliers have clarified their hot-dip galvanized recommendation and do include G185 HDG in their recommendation.) Contact Simpson for availability of ZMAX™, Batch / Post Hot-Dip Galvanized, and Stainless Steel products.
- G60 galvanized products should not be used with treated woods.
- G90 galvanized connectors can be used with Sodium Borate (DOT - Disodium Octaborate Tetrahydrate) treated woods. Sodium Borate treated woods are not suitable for applications where moisture exposure is likely. They are suitable for mudsill applications when transported, stored, and installed appropriately.
- With the exception of ACZA, treatments with ammonia carriers were not included in this testing. Preservatives with an ammonia base (carrier) are generally known to be more corrosive.
- Uncoated and painted products should not be used with treated woods.
- When using Stainless Steel or hot-dip galvanized connectors, the connectors and fasteners should be made of the same material.

The following chart was created based on testing performed by Simpson Strong-Tie.
If a pressure treated wood product is not identified on the chart, Simpson has not evaluated test results regarding such product and therefore cannot make any recommendation other than the use of Stainless Steel with that product. There may be products not identified on the chart that do not require the use of Stainless Steel. Manufacturers may independently provide test results or other product use information; Simpson expresses no opinion regarding any such information. (Note: ACQ-D (Carbonate), ACQ-D and CBA-A treatments are currently not available in Canada).

Simpson Strong-Tie Product Finishes ▼	Untreated Wood	Chromated Copper Arsenate (CCA-C)	DOT Sodium Borate (SBX)	Alkaline Copper Quat ACQ-C and ACQ-D (Carbonate)	Copper Azole (CBA-A and CA-B)	SBX (DOT) with $NaSiO_2$	Ammoniacal Copper Zinc Arsenate (ACZA)	Other Pressure-Treated Woods
Standard *(G90)*	✓	✓	✓					
ZMAX™ *(G185)*	ZMAX G185	ZMAX G185	ZMAX G185	ZMAX G185	ZMAX G185	ZMAX G185		
Post Hot-Dip Galvanized *(HDG)*	✓	✓	✓	✓	✓	✓		
SST300™ *(Stainless Steel)*	✓	✓	✓	✓	✓	✓	✓	✓

Recommendations shown are based on accelerated testing per AWPA Standard E12-94, and may or may not have a relation to actual service life.

See **www.strongtie.com/info** for additional critical information and for updates of this bulletin.

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