



## ACQ PRESSURE TREATED LUMBER EFFECT ON SHEET STEEL

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### PRESSURE TREATED LUMBER

Wood, as a building material, is often pressure treated by forcing preservatives into wood cells to provide protection against decay from insects, fungi, microorganisms, and moisture. Chromated Copper Arsenate (CCA) has been used as one of the most common preservatives for pressure treated lumber since the 1940's. This treatment can extend the service life of the wood from years to decades<sup>1</sup>. However, as a result of increasing environmental concerns, the Environmental Protection Agency (EPA) worked with the wood preservative industry to voluntarily phase out the use of CCA as the primary wood preservative for most residential and general consumer construction by December 31, 2003<sup>2, 3</sup>. CCA treated wood will not be available for most residential applications with some exceptions<sup>4</sup>, but is still approved for commercial applications<sup>2</sup>. The alternatives to CCA, such as Alkaline Copper Quaternary (ACQ) and Copper Azoles (CA), do not contain arsenic.

### WHAT IS ACQ?

Alkaline Copper Quaternary (ACQ) is the most common alternative treatment for pressure treated wood, which consists of copper oxide (67%) as fungicides and quaternary ammonium compound (quat, 33%) as insecticides and fungicidal treatment. There are four types of ACQ that have been formulated for different wood species and applications: ACQ-A, ACQ-B, ACQ-C and ACQ-D. The minimum retention of ACQ in the treated wood is 0.25 lb/ft<sup>2</sup> for above-ground applications and 0.5 lb/ft<sup>2</sup> for in-ground contact applications<sup>4</sup>.

ACQ treated lumber is reportedly more corrosive to steel and coated steel than CCA treated lumber<sup>3</sup>. This has raised concerns regarding the corrosion of Structural Galvanized Steel Sheets typically used in bracketry or similar hardware, Architectural Steel Sheets used in roofing and siding product, and fasteners.

### HOW ACQ AFFECTS METAL

U. S. Steel conducted a study in order to understand the corrosion behavior of steel products in contact with ACQ treated lumber. The study included ACQ-D treated lumber, CCA treated lumber, Structural Galvanized Steel sheets, Architectural Steel Sheets, and fasteners.

#### Structural Galvanized Steels

The Structural Galvanized Steels were exposed to an accelerated cyclic corrosion test that simulates the environment of structures (such as decks, barns, etc.) exposed to humidity and frequent rainfall. The samples include chemically treated (CT) G90<sup>5</sup> and G165<sup>5</sup> hot-dip

<sup>1</sup> Western Wood Preservers Institute, Wood that Works, Wood that Lasts, [www.wwpinstitute.org](http://www.wwpinstitute.org)

<sup>2</sup> American Wood-Preservers' Association Standard, [www.epa.gov/oppad001/reregistration/cca/awpa\\_table.htm](http://www.epa.gov/oppad001/reregistration/cca/awpa_table.htm)

<sup>3</sup> EPA web site, [www.epa.gov/oppad001/reregistration/cca/alternativestocca.htm](http://www.epa.gov/oppad001/reregistration/cca/alternativestocca.htm)

<sup>4</sup> Forest Products Laboratory, USDA, "Changes in Pressure-Treated Wood for Residential Construction", TechLine, June 2004.

<sup>5</sup> Hot-dip galvanized product with zinc coating weight as designated by ASTM A653.

galvanized steel (HDG), and G90 ACRYZINC<sup>®</sup> Coated Sheet Steel<sup>6</sup>. Because structural failure is a primary concern, the samples were exposed until significant red rusting had progressed. Figure 1 shows the percent average weight loss of the Structural Steel samples after more than three months of cyclic testing, which suggests that the CCA is somewhat less corrosive than ACQ-D in a cyclic rainfall environment. The benefits of increased zinc coating weight or acrylic passivation appear rather modest because the weight loss data includes a significant loss of steel mass to rust. The results showed that the steel samples in contact with ACQ-D lumber developed more-easily dissolved oxide corrosion products that provided less protection to the steel against further corrosion. In comparison, CCA is less corrosive and permits the formation of more-protective oxides on the surface of HDG.

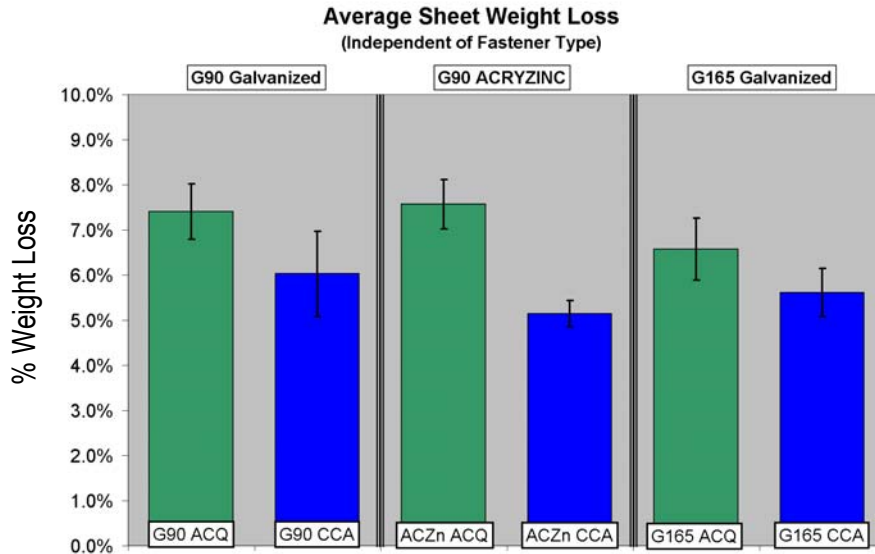


Figure 1. Results of cyclical rainfall/humidity test.

### Architectural Sheet Steel

The Architectural Sheet Steels (for metal roofing and siding applications) were exposed to an aggressive accelerated corrosion test that simulates sheets in near contact with standing water. The samples included chemically treated G90 HDG, chemically treated GALVALUME<sup>®</sup> Coated Sheet Steel, ACRYLUME<sup>®</sup> Coated Sheet Steel, prepainted HDG, and prepainted GALVALUME<sup>®</sup> samples. Commercially available barrier films were also used in this study. Figure 2 shows that ACQ-D treated wood is more corrosive than the CCA treated wood to the coated sheet materials. The continuously damp environment highlights performance differences between different coatings, paints, and barriers.

For the prepainted products in Figure 3, ACQ-D treated wood is generally more corrosive than the CCA treated wood. The prepainted GALVALUME<sup>®</sup> materials appear to be more susceptible to the increased corrosivity of ACQ-D than the prepainted HDG materials. In comparison, the severe corrosion of the unpainted chemical treated G90 HDG materials in Figure 2 illustrates the effectiveness of paint films. Similarly, commercially available barrier films between the treated wood and coated steel sheet products significantly reduce the corrosion on the coated sheet products. Figure 4 shows the dramatic improvement in corrosion performance of CT G90 HDG installed with a protective barrier film applied to the ACQ-D treated wood.

<sup>6</sup> ACRYZINC<sup>®</sup> is a registered trademark of the United States Steel Corporation.

<sup>7</sup> GALVALUME<sup>®</sup> is an internationally registered trademark of BIEC International, Inc. and some of its licensed producers

<sup>8</sup> ACRYLUME<sup>®</sup> is a registered trademark of the United States Steel Corporation.

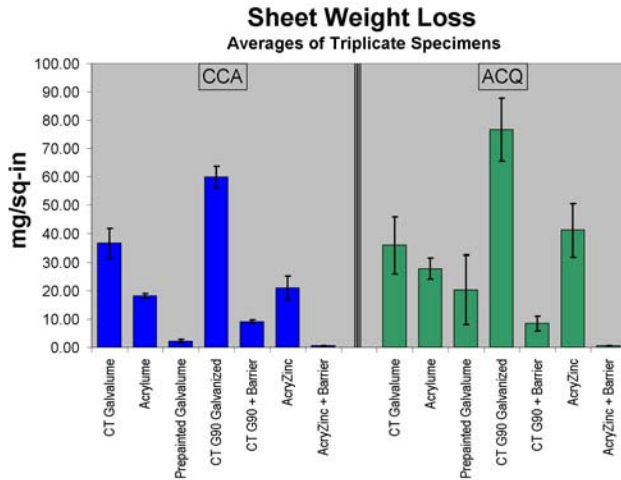


Figure 2. Weight loss of the sheet products with and without barrier protection.

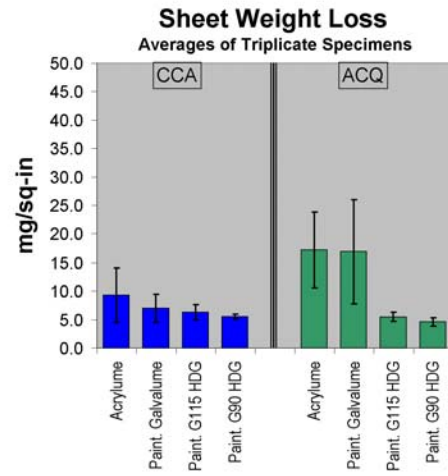


Figure 3. Weight loss of pre-painted sheets.

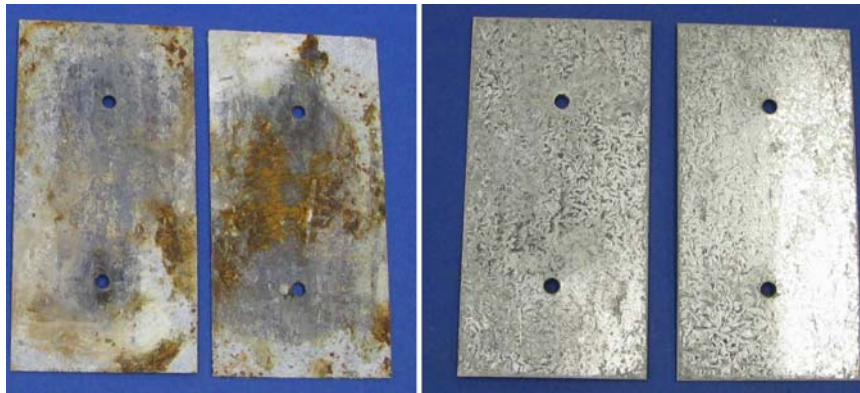


Figure 4. Corrosion of CT G90 with (right) and without (left) the use of barrier protection.

### Fasteners in Contact with Steel Sheets

In an effort to analyze any potential increased galvanic corrosion of the structural steel sheets resulting from the contact with fasteners of dissimilar metals, four types of fasteners were investigated: HDG Nails, Aluminum Nails, Stainless Steel Screws, and Nylon Bolts. The results indicate that the fastener type does not strongly affect the corrosion rate of the steel sheet near the holes. The comparison of the four types of fasteners showed that the HDG Nails were the most heavily corroded while stainless steel nails performed best.

### CONCLUSIONS AND RECOMMENDATIONS

1. The ACQ-D pressure treatment formulation is generally more corrosive to most coated steel products. Some products are more susceptible than others. Since corrosion requires water and contact with the preservatives, designs should focus on eliminating wetness and direct contact with the wood.
2. Isolating the steel from the wood with water resistant barrier materials is an extremely effective way to minimize corrosion issues with the ACQ-D treated wood. Such materials would include ice and water shield, polymer tapes, masking, and lining materials. Conversely, materials with a paper or felt component should be avoided as they can hold moisture and increase corrosion.

3. The ACQ-D treatment caused significant corrosion of the HDG Nails, while the stainless steel screws performed well. The investigation of galvanic corrosion effects of different fastener types shows that there is very little effect of fasteners on the corrosion of the steel sheet.
4. A recommended structural installation practice could combine the following steps:  
(1). Structural Galvanized steel sheet, (2). Commercially available barrier films isolating the steel, and (3). Stainless steel fasteners.
5. Every effort should be made to avoid standing water. Avoiding continual wetness is the most effective way to avoid premature corrosion failures.
6. The results of the Architectural Sheet Steel testing shows that ACRYZINC® and GALVALUME® perform better in contact with ACQ-D than chemically treated (CT) HDG and GLAVALUME® products in contact with CCA.
7. Pre-painted HDG appears to be less sensitive to the ACQ-D treated wood than prepainted GALVALUME®. However, it should be noted that unpainted materials such as G90 + CT and ACRYZINC® appear to corrode more quickly in contact with ACQ-D than with CCA.

U. S. Steel is working closely with treated lumber, fastener and steel industries to establish corrosion test methods for future evaluation. Further measurement of performance of pressure treated lumber formulations, including ACQ, CA and others, will continue to be addressed.

#### **DISCLAIMER**

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