

BUILDER INSIGHT



Compatibility of Fasteners and Connectors with Residential Pressure Treated Wood

Builder Insight is a series of bulletins and companion videos designed to provide practical information about new and emerging technologies, best practices and current issues in residential construction to Licensed Residential Builders and others in the industry. Produced by BC Housing, this bulletin was prepared by Mychem Wood Protection Consultants and Richard Kadulski Architect in collaboration with industry and research experts.

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Overview

Currently there are two alkaline copper preservatives available for commercial use in Canada. They are alkaline copper quat (ACQ) and copper azole (CA).

Wood is a natural, biodegradable material that can be attacked by fungi and insects. When used properly in protected end-uses, the wood remains dry and decay can be avoided. When used in a wet application, such as outdoors or where it may be at risk of insect attack and fungi, preservative treated wood should be used to prevent premature deterioration. Pressure treated wood is commonly used and preferred for residential decks, fences and landscaping.

In 2003, the preservative formulations used for residential wood treatment were changed to those based on copper dissolved in an alkaline organic solvent. Co-biocides were included to enhance the protection against a wide range of wood rotting fungi. This type of wood treatment requires more attention when selecting fasteners, connectors and anchors to avoid premature corrosion of the metal components and to ensure proper performance and carrying capacity. During the past seven years, several studies have been conducted to examine recommendations for the treated wood used in residential construction and the type of fasteners that should be used. Some of the most relevant reports are identified in this bulletin for easy reference.



Current Wood Treatments

Treated wood for industrial uses has largely remained unchanged, and includes creosote, pentachlorophenol and chromated copper arsenate (CCA) formulations. However, for most exterior residential structures exposed to moisture, only alkaline copper preservatives are approved by Canada's Pest Management Regulatory Agency (PMRA) and standardized by the Canadian Standards Association (CSA).

Currently, two alkaline copper preservative formulations are available for the production of residential treated wood, each with its own brand name. Since they differ mainly in the co-biocide added to enhance the degree of decay protection, the general requirements for use are similar for both. They are considered to be equally effective and there is no difference in their corrosiveness, so no preference is indicated in this bulletin. For residential construction, the choice of which of the two treatments to use, will be governed either by personal preference or by which of the two treated products are available to the builder.

In Canada, only two treatments are allowed for residential construction wood: alkaline copper quat (ACQ) and copper azole (CA).

Observations from builders and fastener manufacturers have noted variations in wood treatment formulations, resulting in significant differences in the corrosion of

fasteners and connectors, between batches of treated wood.

Alkaline copper wood treatment preservatives fix or stabilize in the wood after the treatment process and can withstand direct wetting when used in exterior applications, such as decks or in direct ground contact.

Where treated lumber and plywood may be needed for interior applications, in addition to the two preservatives identified above, borate (SBX) treated lumber and plywood may also be used. Borate treated wood is similar to untreated wood in terms of corrosivity. However, it is not suitable for locations exposed to direct wetting.

Understanding Corrosion Potential

Moisture and air are both necessary for corrosion to occur. Wood, when wet, will corrode common iron fasteners and connectors. In wood treated with a copper based preservative, the risk of corrosion is increased because the copper reacts with iron, causing it to rust. Because the copper content in ACQ and CA preservatives is much greater than in CCA, the risk of corrosion is much greater, so the use of proper fasteners with the treated wood is required.

Moderate fastener corrosion has been observed on some hot-dipped galvanized fasteners and connectors as early as four months after installation, when in contact with alkaline copper treated wood that has not been stabilized and dried prior to use.



Only fasteners and connectors that are specifically recommended by manufacturers for use with alkaline copper treated wood should be used.

Factors that Influence the Corrosion of Metal in Contact with ACQ and CA Treated Wood

Corrosion is somewhat greater in wood treated with high retention of alkaline copper preservative. Higher chemical loading would be expected in large timbers, as well as wood that may be used in ground contact (fence posts for example).

Research also shows that timber with a large amount of sapwood or treatable heartwood, that is well penetrated with preservative, can cause increased corrosion. Accelerated testing using well treated sapwood has shown that even fasteners or connectors galvanized to the requirements of ASTM-A153 (fasteners) or ASTM-A653 G185 (connectors) can suffer moderate corrosion when subjected to a severe testing regime. Under the same testing conditions, a newer type of fastener in which a

light galvanized coating is supplemented by a polymer coating (organic top coated galvanized fasteners) was as corrosion resistant as hot-dipped galvanized fasteners.

One strategy which has been proposed for reducing corrosion in alkaline copper treated wood is to stabilize the preservative after treatment. This can be done by a post-treatment process at the pressure treating plant, and is designed to maximize the chemical reaction between the wood and the preservative. Research failed to confirm that a post-treatment process reduces corrosion in all alkaline copper treated wood. However, in some treatments reduced corrosion was observed. Alkaline copper treated wood that had been stored for several months had less corrosion than freshly treated wood. Purchasing pressure treated wood from sources that use treated wood that has been stabilized before shipping to the distributor is recommended. Alternatively, where appropriate, builders should use residential wood that has been stored for two to three months to minimize the potential for corrosion.

The application of an effective water repellent on the treated wood should also reduce the corrosion potential for metal by reducing the moisture content at the wood surface. Research has shown that water repellents do not always provide the expected benefit, particularly if the corrosion potential of the treated wood is relatively low. A greater benefit may be in reducing the corrosion potential of connectors.

GALVANIZING

Connectors used for ACQ or CA treated wood should be galvanized in accordance with ASTM-A653 (G185 continuously galvanized sheet metal) or ASTM-A123 (batch galvanizing after fabrication).

Batch galvanizing typically results in heavier zinc coating with no uncoated areas due to cutting/fabrication. However, both processes produce acceptable hot-dipped galvanized products. The corrosion protection of a hot-dipped galvanized product is a function of the amount of zinc on its surface.

More zinc usually means better performance. Historically the connector industry has used products manufactured with a G60 coating, which means 0.60 oz/ft² of zinc applied to the steel. A G90 coating has 0.90 oz/ft² while a G185 coating has 1.85 oz/ft².



Recommended Fasteners and Connectors for ACQ and CA Treated Wood

It is recommended that builders ask suppliers to provide documentation supporting the use of their fastener and connector products with alkaline copper treated wood, with the end-use being specified. Training of all on-site workers to help them understand the importance of using the correct fasteners with alkaline copper treated wood is essential. The following fasteners and connectors are recommended for use with ACQ and CA treated wood:

1) Hot-dipped Galvanized

For non-critical structures (for example fences, etc.) the minimum acceptable fasteners and connectors are hot-dipped galvanized products that comply with ASTM standards: ASTM-A153 Class D (for hot-dipped fastener products) and ASTM-A653 (coating designation G185 for hot-dipped connector and sheet products) or ASTM-A123 (batch galvanizing after fabrication).

G185 hot-dipped galvanized connectors can be used in protected areas with dry lumber or wood that is subjected to normal wetting and drying. Hot-dipped galvanized connectors should not be considered for use in areas subject to extended periods of wetting, such as freshwater or saltwater exposure.

2) Stainless Steel

Stainless steel (Type 304 and 316) fasteners and connectors are recommended for connecting structural timbers or timbers where a long service life is demanded. Stainless steel fasteners are also recommended where the treated wood is exposed to a more severe environment, such as swimming pools, near saltwater exposure, or in severe weather exposure locations.

3) Other

New proprietary fasteners and connectors have been developed for use with alkaline copper treated wood. They are coated with an organic polymeric coating that is designed to prevent the iron from contacting the

treated wood. There is some concern that the coating on such fasteners or connectors could be damaged during storage or use. An improved coated product is available in which the iron is first galvanized and then coated with the polymer. This type of fastener has been shown to perform extremely well when in contact with alkaline copper treated wood. Supportive test data should be requested from the manufacturer.

Incompatible Fasteners for ACQ and CA Treated Wood

1) Aluminum Building Components

The use of aluminum building components in contact with alkaline copper treated wood is not recommended. When aluminum is used for flashings or door and window frames, a physical barrier or spacer material should be added to prevent direct contact of alkaline copper treated wood and aluminum products. If using spacers, a minimum 2 inch spacing is recommended. If a continuous barrier is used, (such as polyethylene) it should be thick enough to minimize damage during installation.

2) Electroplated Galvanized Fasteners

Electroplated galvanized fasteners and connectors should not be used with alkaline copper treated wood. They do not provide sufficient protection against corrosion.



Training of all on-site workers to help them understand the importance of using the correct fasteners with alkaline copper treated wood is essential.



Choosing Fasteners and Connectors

Selecting fasteners and connectors for use with residential treated wood requires attention. Although several different preservative treatments are available, for all copper-based treated wood used in residential construction, the minimum requirement is the use of hot-dipped galvanized fasteners or G185 connectors rated for use with alkaline copper treated wood by the manufacturer. Fasteners with thinner zinc coatings are not suitable and should not be used.

It is important to note that galvanizing is a sacrificial coating. The presence of some white corrosion products on the fastener or connector surface is normal, but the presence of red rust is an indication of coating failure.

When choosing fasteners and connectors, the choice will depend on their anticipated exposure to wetting and the timber treatment. Timbers with a high preservative retention will require a more corrosion resistant product in wet environments.

Only fasteners and connectors that are specifically recommended by manufacturers for use with alkaline copper treated wood should be used.

For structural components, stainless steel fasteners and connectors are recommended. Examples of structural components include: a balcony, a support post in a structure, and an exposed beam supporting an upper floor of a structure. Stainless steel connectors (Type 304 or 316) are always recommended for maximum service life or use in severe exposure applications. Type 316 is recommended for ocean-salt air environments.

CORROSION

Metal connectors, fasteners and anchors lose their load carrying capacity when they corrode. Use of incorrect fasteners will limit the service life of the treated wood, and can cause safety concerns in critical structural components. Corrosion of metal connectors and fasteners can be caused or accelerated by preservative treated wood, exposure to ocean-salt air, fire protection treatments for wood, fertilizers, and when two dissimilar metals (for example, galvanized and stainless steel) are brought into contact. Moisture is required for corrosion to occur.

Avoiding Incompatibility Problems

Fasteners, metal connectors and anchors used in the same connection must be the same type of metal to avoid galvanic corrosion caused by dissimilar metals. For example, stainless steel fasteners must not be used in combination with galvanized connectors.

Ensuring Performance

When selecting treated wood, the supplier should provide all the information needed about the wood being used. This includes the type of wood treatment as well as a recommended connector coating or material. It is advisable to request treated wood that has been stabilized and dried to less than 25% moisture content for sapwood species such as red pine or ponderosa pine, or if a higher chemical loading is needed for wood to be used in ground contact (according to the CSA Wood Preservation Use Category System).

Key Points to Remember

- ❑ Speak with the building materials supplier for information about the treated wood being used and the compatible fastener, connector or anchor. Further information can be obtained directly from treated wood and fastener manufacturers.
- ❑ Where pressure treated wood is being used in a project, only ACQ and CA treated wood can be used for most exterior residential applications.
- ❑ The main ingredient in ACQ and CA – copper – is safe for human exposure, but the high concentration of copper increases the risk of corrosion on metal fasteners and connectors.
- ❑ Stainless steel is the most effective solution to corrosion risk. Stainless steel fasteners and connectors are recommended for use with ACQ and CA treated wood in severe exposure applications to avoid premature corrosion. Examples of severe corrosion include saltwater exposure, wood subject to wetting with little opportunity for drying, and wood used in preserved wood foundations where extended periods of wetting are coupled with a need for extended service life.
- ❑ ASTM-A153 Class D hot-dipped galvanized fasteners and ASTM-A653 G185 connectors can be used with treated wood in above ground end-uses or where wood is subjected to occasional wetting and drying. The use of hot-dipped galvanized products is not recommended for timber products subject to extended periods of wetting (for example, lake dock, connection to post at grade, pin used to locate support post in shoe, etc.).
- ❑ Fasteners, connectors and flashings made of aluminum should not come into contact with ACQ and CA treated wood, including railings and door thresholds.
- ❑ For borate treated wood used inside buildings, where regular wetting is not likely, the same connectors can be used as for untreated wood.
- ❑ If significant corrosion has occurred, fasteners and connectors should be inspected and replaced if necessary.



For structural components, stainless steel fasteners and connectors are recommended.



As new research and findings on this topic continue to evolve, it is important to obtain the latest information on wood treatments and proper use of fasteners, connectors and anchors.

More Information

- › Choi and Ruddick, 2007 International Research Group on Wood Protection (IRG) Document No. 07-20370, www.irg-wp.com
- › Cooper, 2008. Proceedings. Canadian Wood Preservation Association, 124 – 137
- › Cooper and Ung, 2009, Value to Wood Report UT03 › Koefoed and Ruddick, 2010 International Research Group on Wood Protection (IRG) Document No. 10-40515
- › Ruddick, Ashari, and Solodkin, 2004. Proceedings, Annual Meeting, American Wood-Preservers' Association, 100:156-157
- › Ruddick, 2006. Field Investigations on the Application of ACQ Treated Wood and Use of Metal Fasteners and Connectors in Residential Construction, BC Housing Report
- › Ruddick, 2008. International Research Group on Wood Protection (IRG) Document No. 08-40-4037
- › Ruddick, 2009. Conference Proceedings, Canadian Wood Preservation Association, 30:142-149
- › Canadian Wood Council
www.cwc.ca
- › Osmose Nature Wood®
www.osmose.com
- › Preserve® or Preserve Plus®
www.treatedwood.com
- › Wolmanized® Residential Outdoor® Wood
www.wolmanizedwood.com
- › Tim-bor® Industrial
www.borax.com
- › Simpson Strong Tie
www.strongtie.com
- › International Staple, Nail, and Tool Association
www.isanta.org
- › USP Structural Connectors
www.uspconnectors.com
- › Canadian Wood Preservation Association
www.cwpa.ca
- › International Research Group on Wood Protection
www.irg-wp.com
- › American Wood Protection Association
awpa.com

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