

THE BENEFITS OF ACETYLATED WOOD



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INTRODUCTION

Whether you're a property owner, architect, or designer, searching for natural, high-performance materials for outdoor use can become challenging—especially when you need materials that offer a relatively long service life. Any wood product you specify must resist rot and maintain its beauty with minimal maintenance.

Some woods are easily susceptible to rot, swelling, and shrinkage, and can become a feeding ground for termites and other insects. Often, designers turn to tropical woods for their natural rot and termite resistance, but the sustainability of those materials is questionable. If you're in the market for high-quality wood with the best environmental credentials that also stands the test of time, acetylated wood may be your ideal solution.

WHAT IS ACETYLATED WOOD?

Acetylated wood is wood grown from sustainable sources that becomes modified through a process called acetylation. Acetylation modifies the balance of naturally occurring compounds in wood to improve its durability, stability, and overall lifespan.

Woods that haven't been through the acetylation process contain "free hydroxyls," which absorb and release water, and cause the wood to shrink and swell as a result. But during the acetylation process, these hydroxyl groups are converted into acetyl molecules, which reduce water absorption, improve dimensional stability, and improve the wood's durability, making it long-lasting and resistant to termites and insect decay.

Acetylated wood is non-toxic, fully recyclable, and contains only naturally occurring wood compounds. Additionally, the acetylation process changes wood on a molecular level, which means the wood offers no inconsistencies in profile or performance. This means that the wood is 100 percent modified all the way through, and can be cut or profiled as needed without exposing any unprotected surfaces.

Acetylated wood is suitable for use outdoors in any climate. Acetylated wood is commonly used in the construction of windows, doors, cladding, decking, landscapes, garden furniture, and much more.

In this e-book, we'll review the performance benefits of acetylated wood, as well as the best ways to use this wood in your projects. Structura is a proud partner of Accsys Group, the maker of Accoya® acetylated wood. Accsys Group is the world leader in acetylated wood technology. Accoya wood provides Structura with the beauty of wood that you desire, and the performance that you demand for public outdoor lighting and furniture.

Villa Bie // www.accoya.com

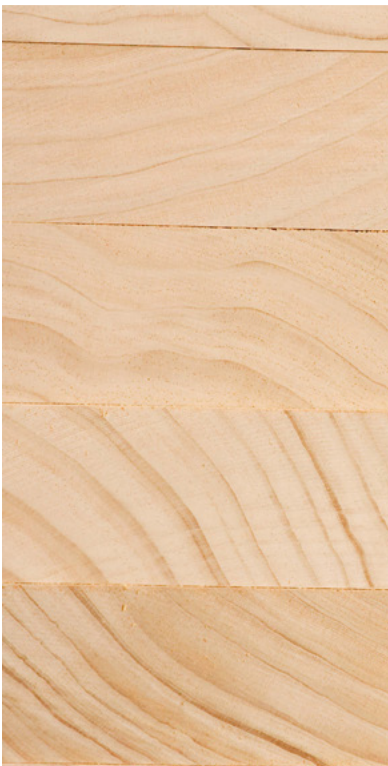


HISTORY AND PROCESS

The technique of acetylating wood has been studied by scientists around the world since the 1920s so why haven't you heard much about it until now? There are three main reasons: First, while the process has been studied in laboratories for years, only in the last few decades have companies like Accsys Group have figured out how to reproduce acetylated wood on an industrial level. Second, the use of naturally durable, tropical woods prevailed for years. The effects of deforestation and reduction of supply forced suppliers to look for other alternatives. Third, those other alternatives included woods that have undergone chemical treatments using copper chromium arsenic, formaldehyde, and creosote. Society has placed more importance on the environmental impact of building

materials, making these techniques highly undesirable. These factors have all led to the need for a better solution with acetylated wood.

So how is wood acetylated? First, trees are harvested from FSC certified forests. The wood is sawn into planks and carefully dried to a low moisture content. The dried wood is then exposed to acetic anhydride, a chemical that is simply vinegar without water. The chemical reacts with the wood molecule, transforming the woods into a material that won't rot. The byproduct from the chemical reaction is harmless vinegar. Before acetylated wood is released for sale, it goes through a careful quality control process to ensure the wood is fully modified to it's core. Each batch that passes its quality control test becomes released for sale with a factory warranty for rot resistance and dimensional stability.



PERFORMANCE BENEFITS OF ACETYLATED WOOD

Here's a close look at the many performance benefits offered by acetylated wood:

DURABILITY

Acetylated Accoya wood comes with a 25-year warranty from in-ground rot, and an amazing 50-year warranty above ground, even when continually exposed to freshwater. During the acetylation process, the cellulose in wood is modified to make the wood rot-proof and resistant to wood-destroying fungi.

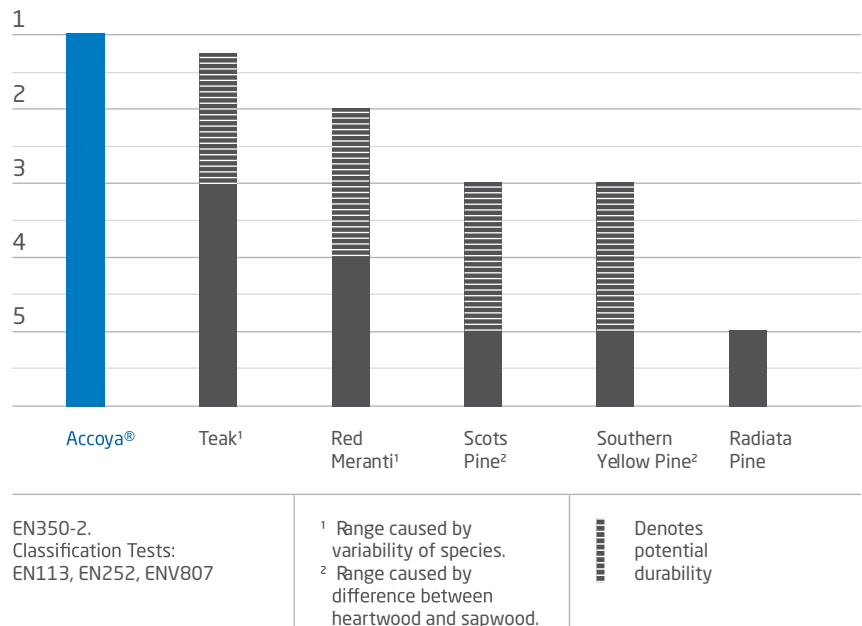
In non-acetylated wood, cellulose is the main food source for insects and decay fungi, which increases the risk for rotting while also decreasing the wood's service life. While tropical woods offer natural resistance to decay, performance is not consistent or guaranteed. Acetylated wood boasts consistent, reliable performance.

The durability of Accoya wood has made it ideal for heavy-traffic road bridges, canal linings, and decking. The wood continues to undergo laboratory and service tests around the world that prove its performance.

For one durability test in particular, Accoya wood was placed in the walls of several canals throughout the Netherlands. The wood was removed and examined 13 years later, and was found to have experienced minimal UV damage and biological degradation.



DURABILITY COMPARISON



WOOD SPECIES	DURABILITY CLASS ¹ [1=highest]	JANKA HARDNESS ² [N/mm ²]	BENDING STRENGTH ² [N/mm ²]	RADIAL SHRINKAGE [60-90% RH]	TANGENTIAL SHRINKAGE [60-90% RH]
Accoya® wood	1	3950	80	0.40	.7
Radiata Pine	5	3850	80	1.22	.2
Scots Pine	3/4	2900	80	1.02	.4
Beech (not steamed)	5	7100	115	1.22	.5
Western Red Cedar	2	1450	55	0.51	.2
Meranti (DRM)	2/3	4300	90	0.91	.8
Sapele Mahogany	3	6700	105	0.91	.2
Ponderosa Pine ³	/4	3000	80	1.12	.1

Comparison of the technical specifications of different wood species and Accoya® using various source species. Accoya® wood based on a radiata pine source material.

¹ Based upon classification by EN350. Durability Class 1 corresponds to a 60-year service life in applications such as windows, doors, balconies and cladding in the British Standard recommendation BS8417.

² Janka Hardness and Bending Strength are based on wood conditioned at 65% RH and 20°C. Values are heavily influenced by local growth conditions.

DIMENSIONAL STABILITY

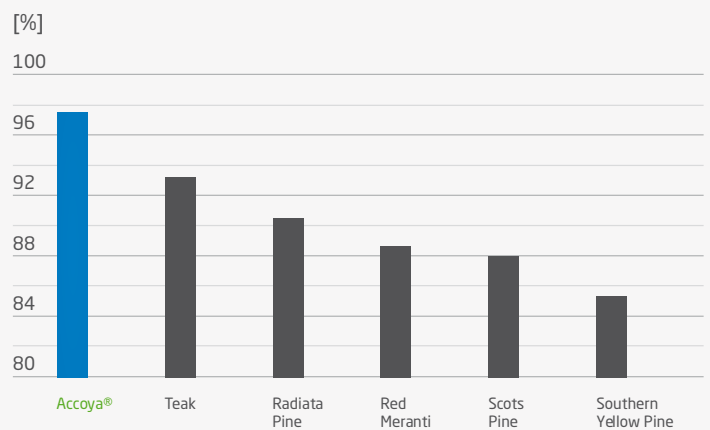
Dimensional stability is also known as the degree to which a material or structure maintains its original dimensions when subjected to natural elements, or environmental changes. Humidity levels, temperature changes, rain, and other weather conditions are factors that can often lead to instability in wood.

Since the acetylation process reduces swelling and shrinkage, achieving optimal dimensional stability is not difficult with acetylated wood. In most cases, swelling and shrinkage is minimal, and is reduced by more than 75 percent upon the wood's exposure to moisture, compared to non-acetylated woods.

The reduction of swelling and shrinkage has the following benefits:

- Fewer finish maintenance cycles.
- Floors and decks that stay level without warping or cupping.
- Cladding that doesn't cup or require frequent coating maintenance.
- Better-fitting windows and doors that open and close easily all year long.
- Improved stability in all weather conditions — above ground, below ground, and in freshwater.
- Wood joints that retains their strength
- Increased adhesive performance

Compared to woods such as Pine, Siberian Larch, and European Larch, acetylated wood experiences little to no cupping and twisting, becoming up to 80% more stable.



	Accoya®	Teak	Radiata Pine	Red Meranti	Scots Pine	Southern Yellow Pine
DIMENSIONAL STABILITY	97,7	93,5	90,5	88,6	88,0	85,4
TANGENTIAL SHRINKAGE	1,5	4,26	,0	7,3	7,78	,0
RADIAL SHRINKAGE	0,8	2,23	,3	3,8	4,06	,1
VOLUME SHRINKAGE	2,3	6,59	,5	11,4	12,0	14,6

N.B. This graph shows the dimensional stability (volume metric) from fully soaked to oven dry (the most extreme laboratory test). Where a material is unaffected by moisture changes the dimensional stability would be 100%. The table above does not show changes due to temperature conditions (wood is very stable). The table to the right shows the shrinkage in more normal weather conditions (with simulated humidity varying between 60 and 90%).



SUSTAINABILITY

Environmental sustainability is no longer an option, but a requirement for responsible design. Acetylated wood maintains the highest environmental credentials, since nearly any tree species can be successfully acetylated. Fast-growth, low-value species from responsibly managed forests are transformed into the highest quality materials. The acetylation process is non-toxic, and will not leach into surrounding soil. The byproduct, vinegar, is recycled back into the process.

COATINGS

Acetylated wood improves the life of coatings due to its reduced swelling and shrinkage. In many cases, non-acetylated woods with poor dimensional stability require frequent coating maintenance due to constant sizing fluctuations. On acetylated wood, coatings can last up to two or three times longer on behalf of improved stability. This wood also requires less sanding and less preparation due to its consistent quality from surface to core.

Using acetylated wood leads to cost savings and time savings that would otherwise be spent on coatings and on maintaining the wood repeatedly. Acetylated wood is also compatible with all coatings systems, from penetrating oils, stains, and film finishes like varnish and lacquer. Even painted surfaces can benefit from acetylated wood since paints exhibit less peeling and cracking over time.



6.5 years outside

BEST WAYS TO USE ACETYLATED WOOD

Any application where wood is used outdoors can benefit from Accoya wood. Since the acetylation process doesn't interfere with the wood's final appearance, it offers a natural, beautiful look. Acetylated wood also offers superior resistance to the sun's UV rays, meaning it can withstand heat and sunshine without having its appearance compromised.

Take a look at how acetylated wood can be used in various outdoor projects—from windows, to doors, to decking, and more.

WINDOWS AND DOORS

Acetylated wood is ideal for windows and doors thanks to its durability, dimensional stability, and natural insulating properties. With acetylated wood, you won't have to worry about windows and doors becoming warped over time, or becoming too difficult to open and close due to changing temperatures. Coatings last longer, and windows and doors will require far less maintenance than those made with non-acetylated wood.



FagelCats - Accoya Structural used for apartments and care complex for elderly people in Amsterdam // www.accoya.com



SIDING, FACADES, SHUTTERS, AND LOUVRES

When used for cladding, siding, and facades, acetylated wood requires less maintenance and fewer coatings due to its long service life and durability. When the natural beauty of real wood is desired, acetylated wood is the best choice.

Factors such as stability, durability, and coating performance are important when designing shutters, louvres, and solar shading—especially when your goal is to achieve an elevated aesthetic. Plus, the flat look most people try to achieve with wooden slats in shutters will hold up well considering acetylated wood won't warp, bow, or split under the worst of weather conditions.



DECKING

When creating decking for a home, garden, or pathway, acetylated wood feels comfortable on bare feet, and is unlikely to produce splinters. Wood also has a low thermal gain, meaning it won't heat up to be uncomfortable on bare feet like plastic composite alternatives do. Decking made with acetylated wood offers beauty, strength, and durability in all weather conditions.

CANALS, MARINAS, AND BRIDGES

Thanks to its ability to withstand direct ground and freshwater contact, acetylated wood is ideal for canals, retaining walls, and bridges. Some creative uses in this application include the “floating bridge”, and the “moses bridge” that goes through the water instead of over it.



The Haven, Norfolk, UK // www.accoya.com



LANDSCAPE ARCHITECTURE

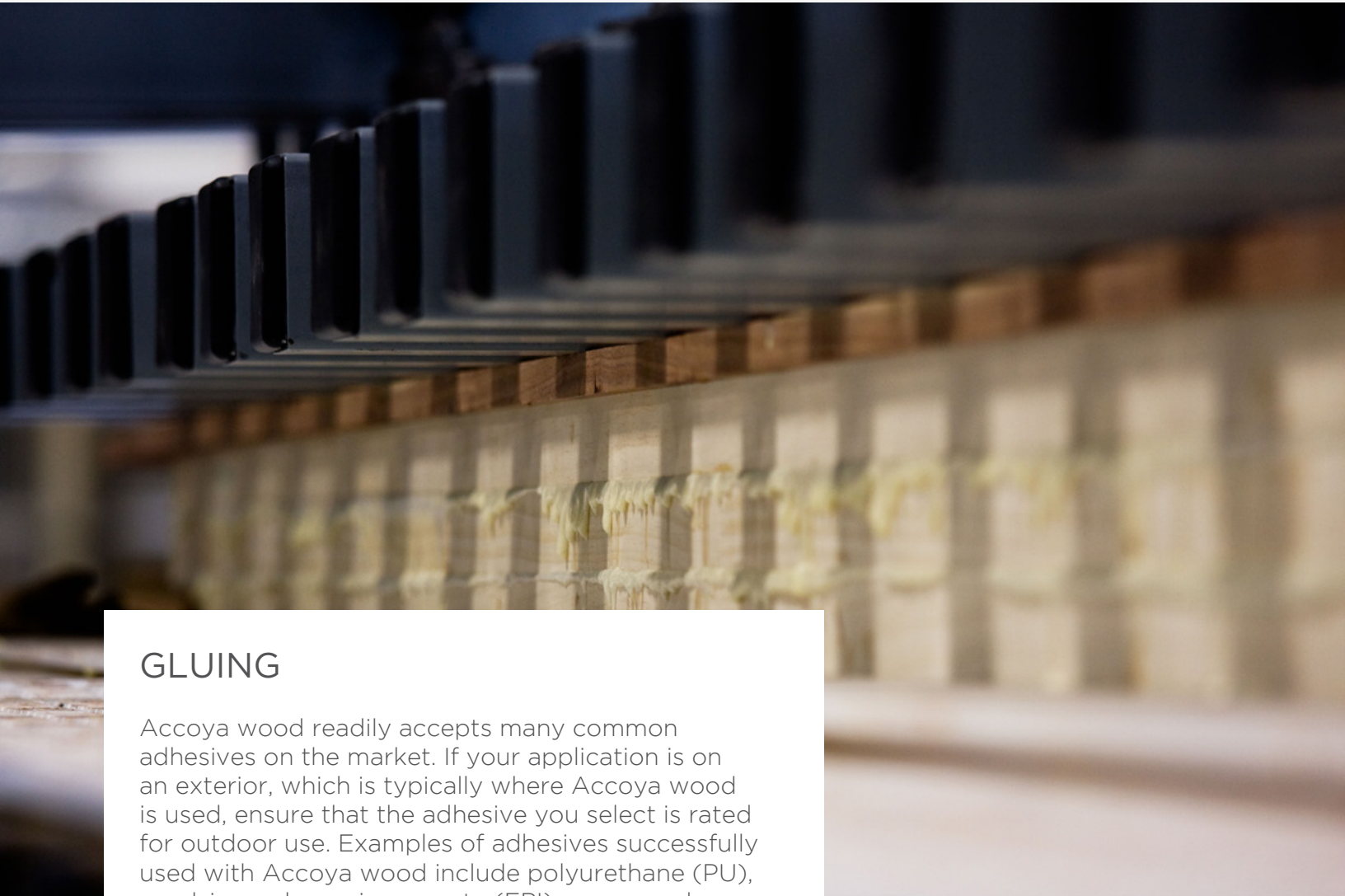
Maintenance is a big concern for outdoor public projects. Accoya wood’s ability to slow the effects of weather on finishes makes it the ideal choice for these applications. Accoya wood can also be made into large beams and timbers by glue laminating planks together to form a larger, and longer, piece. This is useful when designing trellis structures, urban furniture, wood light poles, and screen walls.

BEST DESIGN PRACTICES

Accoya wood offers many advantages over unmodified wood. Here are a few best practices to keep in mind to ensure peak performance:

CONTACT WITH METALS

The acetylation process of Accoya wood lowers the PH of the wood slightly. For this reason, it is a best practice to use hardware, bolts, and screws that are either stainless steel, painted, or anodized. Brass too exhibits excellent performance. Galvanized or unfinished steel and aluminum is discouraged since these materials exhibit corrosion. If these materials must be used, they should be separated so they don't have direct contact with wood.



GLUING

Accoya wood readily accepts many common adhesives on the market. If your application is on an exterior, which is typically where Accoya wood is used, ensure that the adhesive you select is rated for outdoor use. Examples of adhesives successfully used with Accoya wood include polyurethane (PU), emulsion polymer isocyanate (EPI), epoxy and phenol resorcinol formaldehyde (PRF) adhesives. PVA and MUF results vary. We recommend always testing your specific adhesive with Accoya wood for its long-term weatherability. At Structura, to ensure compatibility, we put our adhesives and wood through industry standardized cyclic delamination tests that replicate a 25-year weathering cycle.



COATINGS AND FINISHES

There is no need to finish Accoya wood with respect to its durability and dimensional stability. The wood is, however, still susceptible to natural weathering. Wood, including Accoya, when left unfinished outside will weather to grey. Accoya wood can exhibit staining from mildew, molds, and blue-stain fungi. Greying is often a desired look, but be aware of the consistency of natural greying depending on site conditions. Many finishes can be applied to color acetylated wood or bring out the richness of its grain. It is recommended that all sides of the wood are coated when finishing with a film finish. Special attention should be given to the end grain since this is where moisture most easily enters wood.

At Structura, we have developed finishes that provide the appearance of weathered grey wood, but with a film finish on top that inhibits unsightly mildew growth. Simple annual washing of dirt and debris off the finish is all that is needed to keep wood looking its best.



CONCLUSION

Structura uses acetylated wood by Accoya because the designers and property owners who use our products demand the very best performance. Choosing Accoya wood helps ensure your next project requires less maintenance and experiences a longer service life. Contact Structura, or search for your local Structura representative in your area for more information. We'll help you find appropriate solutions for your next project, and do what it takes to bring new life to your projects using acetylated wood.

