

Introduction of Accoya[®] Wood on the Market – Technical Aspects

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Keywords: Accoya[®] wood, acetylation, certification, material testing, product testing, quality control, wood modification

ABSTRACT

Utilizing proprietary acetylation technology, Titan Wood operates the first large-scale commercial wood acetylation plant. Prior to the introduction and commercialization of Accoya[®] wood, a considerable amount of testing on the material properties of this “new wood species” was performed. Furthermore, testing procedures to assure the quality of the acetylation process and the product itself were developed. To successfully introduce Accoya[®] wood on the market, customers have been given technical support to further process the modified wood into end products such as window frames and cladding. Currently, the first big projects have been completed and are regularly inspected. This paper will focus on testing, quality control and the certification of modified wood performances in various applications. An overview will be given on the structure of testing, the testing itself and the results of the tests to obtain certification according to the norms for wood modification. Besides various material properties tests (for example, resistance to wood-degrading fungi or paint performance), additional testing has been performed on the final product such as windows, doors and cladding.

INTRODUCTION

Acetylation

Acetylation has been studied extensively and is shown to be one of the most promising methods to improve the technical properties of low-durable wood species. The first wood acetylation trial was done in 1928 by Fuchs. Since then, many others have researched the acetylation of wood, in respect to the process as well as the material properties of acetylated wood. A comprehensive background of acetylation and wood modification in general is given by Hill (2006), Homan and Jorissen (2004), Jones (2007) and Rowell (1983, 2006).

In the last decade most work has been done with uncatalysed acetic anhydride (Beckers and Militz 1994, Goldstein *et al.* 1961, Larsson and Tillmann 1989, Singh *et al.* 1992) which demonstrates that the acetylation of wood can significantly improve dimensional stability (swelling due to moisture), UV stability and durability (resistance against brown-, white- and soft rot fungi).

Commercial production

Titan Wood (www.titanwood.com) has been working on the commercialization of acetylated wood since 2003. After a period of research on pilot plant scale, a commercial production plant for approximately 30,000 m³ per annum was designed and built in Arnhem, the Netherlands. There, Titan Wood developed an acetylation process for radiata pine (*Pinus radiata* D. Don) lumber up to 100 mm thickness and subsequently launched the product on the market as Accoya[®] wood (www.accoya.info). Another production facility with a capacity of 300,000 m³ per annum is currently being built by Diamond Wood in Asia. Manufacturing and distribution agreements have been signed for several other geographies.



Figure 1: Commercial acetylation plant of Titan Wood

Market introduction

There is considerable risk when introducing any new product or technology to the market. Each phase of product introduction brings new commercial and technical challenges. In order to minimize this risk, Titan Wood has developed an overall strategy to address commercial and technical issues (Kattenbroek 2005, 2007). Key areas of the successful market introduction included: ensuring good product differentiation; having technical control of product development, quality, testing, certification, and use; establishment of technical customer support; and development of reference projects to showcase Accoya[®] wood. In order to make the new product recognizable, i.e. to differentiate the new product from other products in the same market, Titan Wood has developed the brand Accoya[®]. Accoya[®] wood represents stability, reliability and durability. To enhance the green image of Accoya[®], the product is supplied with FSC (www.fsc.org) or PEFC (www.pefc.org) chain of custody certification. Considerable work has also been done or is underway to independently analyze the environmentally

responsible manner in which production is performed and total lifecycle advantages of Accoya® wood including its carbon sequestration advantages.

In order to create technical control, Titan Wood has spent several years testing with a small group of joinery producers, suppliers to the joinery industry and research institutes before market introduction. Further, various tests have been performed to certify the product for different applications in key markets. For example, the production process is certified according to the KOMO® certification scheme for modified timber (BRL 0605). After the market introduction of Accoya® wood, a huge emphasis has been placed on project initiations, realisation and monitoring.

Currently, Accoya® wood is a well-established name for applications such as joinery, cladding, decking and civil works in the Dutch market. Due to collaboration with BSW Timber (www.bsw.co.uk) and Enno-Roggemann (www.roggemann.de), Accoya® wood is also well-known in the UK and German markets. Alexander (2007) reported on the potential for Accoya® wood in the UK market.

The success of the overall strategy is copied into other market segments and new geographies. The strategy is customised for each application and country in respect to factors such as market size, level of vertical integration, typical manufacturer characteristics, required certifications and building codes.

TESTING AND CERTIFICATION

Certification schemes

For market introduction, the building product has to at least comply with the building codes and regulations for the applicable market. In addition to these minimum requirements, certifications may be demanded or strongly desired by the market. Certification can be divided into three categories: certification of the acetylation process, certification of the acetylated wood and certification of the final product. In most countries, certification is concentrated on the final product, for instance windows and doors. In some countries such as the Netherlands and Germany, certification programs are available to evaluate the suitability of a “new wood species” and/or modified wood species for a certain application (SKH-Publicatie 97-04, VFF Merkblatt HO.06-1). In respect to certification of the modification process, a certification scheme is not available in most countries and modified wood is evaluated as if it were a preservative treatment.

In the Netherlands, a National Assessment Directive was established to certify modification processes (BRL 0605, Homan and Tjeerdsma 2005). Part of the certification consists of the production process and part is related to the properties of the modified wood. With the cooperation of the certification body SKH and the independent research institute SHR Timber Research (www.shr.nl), Titan Wood set up a research program and achieved the certification in May 2007.

Material properties testing

In the past few decades, extensive research has shown that acetylation significantly increases wood's resistance to brown-, white- and soft rot fungi and the dimensional

stability (in changing relative humidity) of non-durable wood species (Beckers *et al.* 1994, Hill *et al.* 2007, Larsson-Brelid *et al.* 2000, Larsson-Brelid and Westin 2007, Militz 1991). The improvement of these properties has a direct correlation with the degree of acetylation. Many other material properties have been tested in the past. For example Bongers *et al.* 2005 report on the results of a 10-year field test with coated acetylated and unmodified wood samples. The acetylated wood showed a considerable improvement in coating performance. Due to the improved stability of the acetylated wood, the stress on the coating was reduced compared to unmodified wood during climatic changes.

As part of the certification program according to BRL 0605, the material properties such as durability, dimensional stability, mechanical properties, workability, glueability and finishing of Accoya® wood have been determined. Part of the test results have been reported by Kattenbroek (2007). The results show that Accoya® wood meets the requirements for use in KOMO® certified joinery and façade cladding.

Processing of Accoya® wood and product testing

Titan Wood has chosen to closely cooperate with the wood industry for the introduction of Accoya® wood into the market. Before the commercial introduction, Titan Wood tested the industry to identify optimal process parameters for Accoya® wood in the production of doors, windows, cladding, decking, etc. A technical committee was formed containing experts from different disciplines in the industry to guide and advise on testing. This committee consisted of experts from the wood industry, testing institutes and experts involved with inspecting and maintaining wood products in buildings. Critical aspects of processing Accoya® wood, such as end product performance and installation were identified and discussed within the technical committee and shared with the wood industry.

Testing with suppliers to wood working industry

While testing of the wood industry was being conducted, testing of other wood-related industries was also in progress. Among the most important tested were the coating and adhesive industries. With these and the other wood-related industries, the Accoya® product has been researched in depth.

PRODUCTION CONTROL

The plant, including all installations and process technology, is subject to regular inspections, certifications and quality assurance. The production process of Accoya® wood is certified according to the KOMO® certification scheme for modified timber (BRL 0605) and is inspected several times each year by the notified certification body SKH (www.skh.org). Within this scheme, uniformity and reproducibility of the production process on commercial scale, as well as a quality control management system are key. In this regard, Titan Wood has developed a management quality control system which includes the quality control of the product. What is unique about the acetylation process is that the quality of the treatment can be determined with chemical analysis. The degree of acetylation is measured by the acetyl content of the wood. Titan Wood has developed specific methods to determine the acetyl content of wood based on

the work reported by Beckers *et al.* (2003). Using these methods, the degree of acetylation can be determined for each board. Since dimensional stability and resistance to wood-degrading fungi is strongly correlated with the degree of acetylation, Accoya® wood can be produced with very high performance reliability.

Titan Wood assigns a unique number to each batch in order to trace all production steps. During the stacking of a batch, the bundle numbers of the raw material are recorded. This batch stack successively undergoes all production steps and is sampled to determine the “quality” of the acetylation treatment. If the degree of acetylation (acetyl content) and the residual acetic acid content meet Accoya® wood specifications then the batch stack is de-stacked into Accoya® wood packages. Each Accoya® wood package is uniquely coded and can be traced back to the batch number.

TECHNICAL CUSTOMER SUPPORT

Due to the very close cooperation with the wood industry in the testing phase prior to market introduction, many technical aspects of processing Accoya® wood were known. Further, it created a large network with which problems could be quickly resolved.

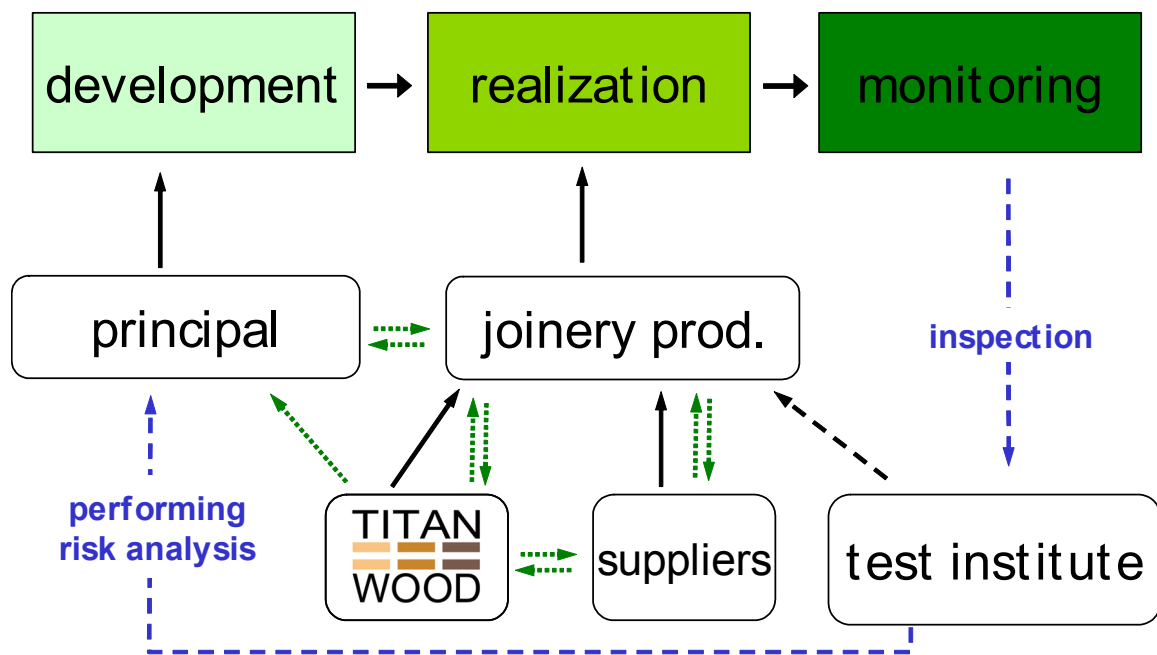


Figure 2: Project support and monitoring

Technical Information Guide

Based on testing by official test institutes, experiences of the technical committee and testing performed by suppliers to the wood industry, a comprehensive Accoya® Technical Information Guide was compiled. This guide covers subjects ranging from storing Accoya® wood in the warehouse to maintaining the final product and all of the production steps in between, such as processing, gluing and coating.

Project support and monitoring

To develop, realize and monitor Accoya® projects, Titan Wood operates as a hub in its extensive network with suppliers to the wood working industry, testing and certification bodies and the customers. Titan Wood supports its direct customers in selling joinery projects by convincing important segments such as architects, building companies and housing corporations of the performance of Accoya® wood. During the project realization phase, technical support is given to the customer. Then, by monitoring projects, direct feedback is received. Additionally, some projects are monitored by independent research institutes.

REFERENCE PROJECTS

The enhanced durability and dimensional stability resulting from acetylation makes acetylated wood highly suitable for demanding applications such as joinery, cladding, decking and other outdoor applications. Below, a selection of projects is shown.

Joinery

Project sizes in the Netherlands have ranged from one house to 300 houses and apartments. The first large project with Accoya® wood has been extensively monitored by the independent research institute TNO. The project contains 51 houses and 119 apartments. TNO was involved in the design phase of the project in which a risk assessment was performed. At the request of Titan Wood, TNO has monitored the acetylation process, the production of the Accoya® wood joinery and the installation of the joinery product on the building site. Finally, TNO will inspect the project on a regular basis in the next period to determine maintenance schedules.



Figure 3: Joinery project Den Haag (NL)

Cladding

In the UK, private houses have been installed with Accoya® cladding. By close cooperation with the coating supplier, a ten-year guarantee is offered on the coating.



Figure 4: Cladding project Fife (UK)

Accoya® bridge (Sneek, NL)

One project of particular importance is the production of a heavy duty (60 ton class) wooden bridge of 40 meter span. Acetylated radiata pine was selected as the building material of choice due to its superior strength-to-weight ratio, durability, dimensional stability and low maintenance costs. The major carbon sequestration advantages of using Accoya® wood versus alternative high energy input building materials was also a major advantage. In this project, many research companies and test institutes have been involved to create a complex technical structure. A detailed description of all test and research is presented in Tjeerdsma *et al.* (2007). The bridge was built in Sneek (NL) and was installed November 2008.



Figure 5: Accoya® bridge Sneek (NL)

CONCLUSIONS

There is considerable risk when introducing a modified wood to the market. Each phase of introduction brings new commercial and technical challenges. In order to

minimise the risk, Titan Wood has chosen to bring Accoya® wood on the market with an extensive amount of technical support and close cooperation with the wood industry and its suppliers. Using this approach, a large network has been established for information sharing. The network expands as Titan Wood's involvement in the development, realization and monitoring of projects continues. With this strategy Accoya® wood has been very well accepted in the market. Further, due to joint marketing efforts, the launch of Accoya® wood can be classified as a success.

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