

16 February 2011

Our Ref. 269-201

Properties of Medite Tricoya® and its possible application for use

We understand that you are conducting technical due diligence on the in-development product Medite Tricoya® which is a medium density fibreboard (MDF) manufactured using acetylated wood fibres using the patented Titan wood process. We have conducted several pieces of work for you including indicative testing of properties of the Medite Tricoya product and looking at market applications. This letter provides a summary of work on the in-development product Medite Tricoya® considering properties and the suitability for application in construction against a service life criteria.

Specifically you have requested that we provide you with comment regarding:

- The durability class of Medite Tricoya® compared to timber species commonly used
- The relation of durability class to compliance of products for life expectancy

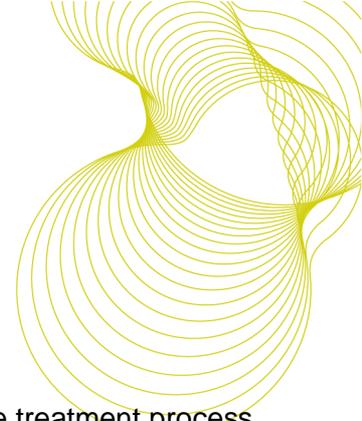
To clarify this the example of exterior wood cladding is used in parts of this letter.

Specification of wood durability

The suitability of a timber species for use in UK construction must first consider the natural durability of the chosen timber species (EN 350-2: 1994) and note the intended end use (EN 335-1: 2007) e.g. Use Class 3 for exterior wood cladding. EN 460 compares the requirements of Use Class with the natural durability and indicates whether natural durability is sufficient for the end use or whether preservative treatment is required. The European Standards related to specifying preservative treated timber, EN351-1 (2007) and EN 351-2



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EN ISO9001:2000,
certificate number LRQ 4001063



(2007) require the specification to be written in terms of the results of the treatment process. The standards for wood durability are typically based on wood preservatives delivering the enhanced protection. A required penetration of the preservative into the wood and the retention (concentration) of preservative within a defined zone (the analytical zone) of the treated timber is specified. EN351-1 (2007) lists options that can be used to specify penetration. The retention is specified in terms of the concentration of preservative formulation found to be effective in a series of standard biological test methods laid down in the European Standard EN599-1 (2009).

BS 8417 (2003) sets out a framework for UK specifiers to interpret the European standards and to base specifications on penetration and retention requirements thought to reflect what the old process specifications actually achieved. Provision is made in the document for the range of traditional preservatives with recommended penetration/retention combinations for different timber types, end uses and service life requirements. Guidance is also given for new preservatives whose performance is demonstrated by testing according to EN599-1 (2009) but which have little or no evidence from longer term tests or service data.

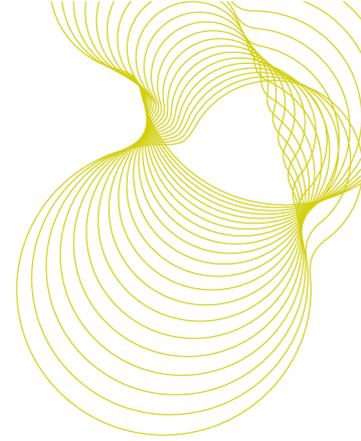
There are no standards specifically written to give guidance on or requirements for specification of acetylated fibre MDF.

Digest 429 or EN 350-2	Durability class
Western red cedar (<i>Thuja plicata</i>) old growth North America	2 (durable)
Siberian larch (<i>Larix siberica</i>)	3 (moderately durable)
Sapele (<i>Entandrophragma cylindricum</i>)	3 (moderately durable)
Scots pine (<i>Pinus sylvestris</i>)	4 (slightly durable)
Medit Tricoya [®] *	1 (very durable)
Preservative-treated wood [†]	1 (very durable)

* Sources of information are considered later in this document

† The preservative treatment of 'not durable' or 'slightly durable' wood to a retention at the critical value (CV) or above derived from BS EN 599-1 enhances the wood to maximum durability as the <3% weight loss criteria in the test is equivalent to delivering durability class 1 'very durable'

Table 1. Examples of natural durability classifications for heartwood



Biological durability

An example is followed in this letter for an exterior wood cladding product.

In BS 8417 (2003) exterior cladding is noted as Use Class 3 (EN 335-1: 2007) application and a 15, 30 or 60 year service life is satisfied by choosing as a minimum a timber of natural durability class 4, 3 or 2 respectively (EN 350-1: 1994). In addition the service factor based on safety and economic factors is Class C where remedial action or replacement would be difficult and expensive thus natural durability or preservative treatment is desirable.

Natural durability refers to the ability of a wood species to endure, or resist deterioration, by virtue of its inherent properties. In the UK this typically refers to the ability to resist attack from wood-destroying fungi. This ability to withstand fungal attack is assessed in laboratory and field experiments in line with European standard tests, which for natural durability include long running ground contact field trials (EN 252: 1990). The assessment classifies each species heartwood into one of five different durability classes depending on their performance. The data is presented in BRE Digest 429 (1998) and examples are presented in Table 1.

Sources of information relating to the durability of Medite Tricoya[®] include:

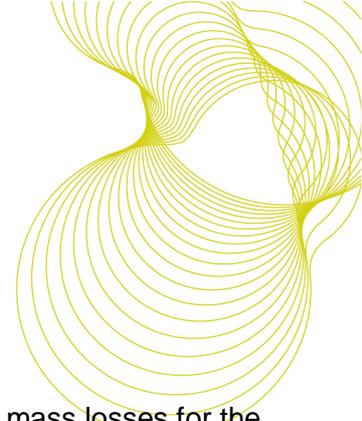
BRE report 266128 (2010) Determining the resistance of Medite Tricoya[®] against wood destroying basidiomycetes DD ENV 12038: 2002. This indicative biological test (Figure 1) has shown that:

- Medite Tricoya[®] is resistant to moisture uptake typically having a moisture content at the end of the test of between 15-30%, compared with 65-100% for Medite Exterior, 85-100% for solid wood and 140-210% for the Medite Premier product.
- Medite Tricoya[®] is fully resistant to decay by basidiomycetes fungi.
- Medite Exterior and Medite Premier are not resistant to decay by basidiomycetes fungi.

The test has shown the in-development product Medite Tricoya[®] is resistant to basidiomycetes fungi (brown and white rot). The acetylation of the fibre prior to MDF production enhances the wood to maximum biological durability. The <3% weight loss criteria in the test standard is equivalent to delivering a durability class 1 'very durable'.

Swedish project P804744 (2011) conducted by SP Wood Technology, Sweden. Durability of boards made from acetylated wood, against bacterial and fungal decay according to ENV 807 (naturally occurring fungi including soft rot).

Whilst it is not recommended in EN 350-1 to use the ENV 807 results for calculation of durability class, the authors note the test data clearly indicates the increased durability gained by acetylation. Mass loss in untreated Scots pine sapwood was found to be 28.8-35.0% whilst mass loss in all the boards made from unmodified wood material, all exceeding



30%, irrespective of soil type and adhesive used. This contrasts with the mass losses for the acetylated boards, they were all less than 3%, irrespective of the adhesive used to manufacture the panel. This work is on-going.

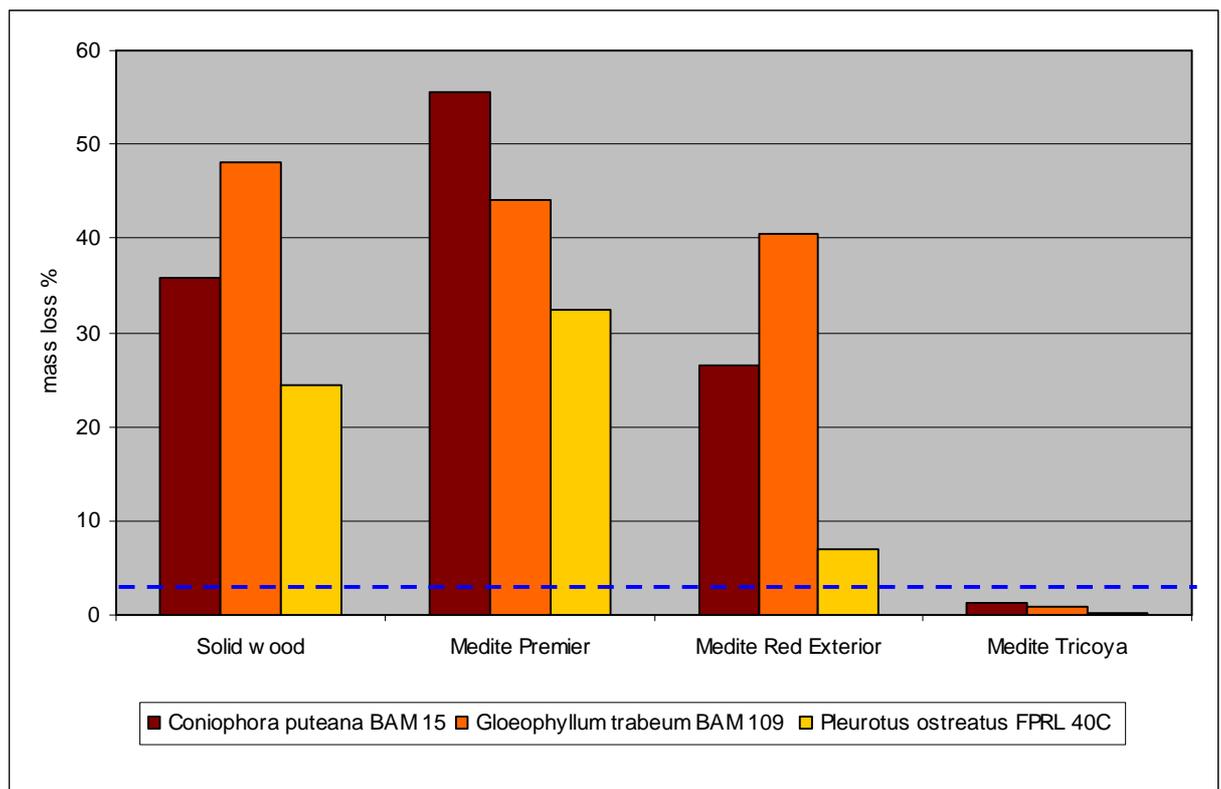


Figure 1. Summary of average mass loss (%) in biological test DD ENV 12038: 2002. A mass loss of less than 3% (below the dashed blue line) indicates a material is fully resistant to decay by basidiomycetes.

Dimensional stability

BS EN 942 (1996) notes in informative annex D dimensional movement as a serviceability aspect (small, medium or large) of timber for joinery and the suitability of timber species for external joinery. There are no specified requirements for dimensional movement of timber species for external cladding.

What is dimensional stability?

Dimensional stability (or anti shrink and swelling efficiency) is the ability of the wood to resist dimensional changes as the moisture conditions change. Data is presented as indicative movement classes in the Handbook of hardwoods (1972) and the Handbook of softwoods (1977) see Table 2.



Handbook of hardwoods Handbook of softwoods	Indicative movement class	Tangential and radial movement from 90%RH and 60%RH
Western red cedar	small	1.9% and 0.8%
Siberian larch	small	1.7% and 0.8% <i>data for Larix decidua</i>
Sapele	medium	1.8% and 1.3%
Douglas fir	small	1.5% and 1.2%
Scots pine	medium	2.1% and 0.9%
Medite Tricoya® *	small	-

* A source of information is considered below

Table 2. Examples of movement classes for wood species.

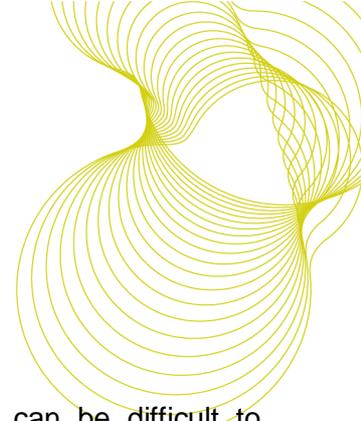
A reference relating to the dimensional stability of Medite Tricoya® is:

WKI Report BauKo-2009-16 (2009) Investigation concerning the durability of different acetylated and non-acetylated boards: Results from exposure tests by WKI Fraunhofer, Braunschweig. WKI produced samples from various combinations of acetylated material (fibres, particles, strands) and adhesive. Tests of thickness swelling, length swelling, water absorption, bending strength, bending modulus of elasticity, internal bond strength and pull out resistance are presented. The exposure tests were based on procedures normally used for fibre-cement panels. WKI also tested the relative performance against commercially available panels for exterior use and conclude the wood based panel products made of acetylated fibre were significantly more stable than the other wood based board products. The authors concluded the acetylated products show great promise as panels in wooden facades for cladding subject to coatings stability tests.

Substrates that are dimensionally stable in changing conditions of relative humidity and moisture availability exert less stress on any applied surface coating which extends the life of the coating and the intervals between necessary maintenance.

Creep and duration of load

BRE Report 266130 (2010) An assessment of the creep and duration of load behaviour of Medite Tricoya®: These tests indicate that Medite Tricoya® is a strong, stable and creep resistant material whose behaviour does not follow that of a normal wood-based MDF type board product. The moisture resistant nature of the product ensures the material shows very little or no reaction to high humidity environments, unlike other MDF type products.



Considering its inert behaviour, the results gained from these tests can be difficult to interpret. However, it is clear that the Medite Tricoya[®] has superior creep resistance properties compared with other MDF type products.

Monitoring of the creep behaviour of the samples continues to gain a greater understanding of long term behaviour.

Resistance to weathering

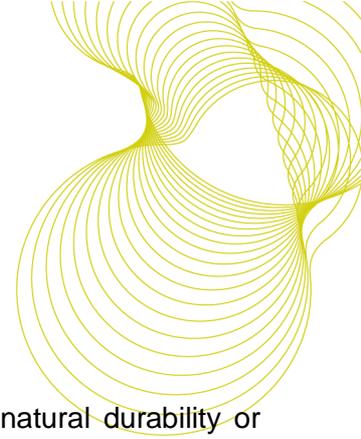
BRE Report 266138 (2010) Accelerated weathering of Medite Tricoya[®]: These tests indicate that Medite Tricoya is a material of good weather resistance whose behaviour does not follow that of a normal wood-based MDF type board product. The moisture resistant nature of the product ensures the material shows reduced reaction to high humidity environments and moisture stress, unlike other MDF type products.

The indicative weathering tests have shown that:

- The overall colour change derived from the differences in the L*a*b* colour space show that the Medite Tricoya[®] samples are more colour stable than the other MDF samples.
- The Medite Tricoya[®] samples showed a noticeable roughening of the surface texture on all of the tests but no micro cracking and no delamination was observed. Medite Tricoya[®] appears more stable than the other MDF samples in this severe exposure environment.
- The MDF samples revealed greater fibre loosening at the surface compared with the Medite Tricoya[®] samples. For both materials the UV and freeze exposed specimens produced the most fibre loosening.
- The internal bond strength of unaged Medite Exterior (1.70 MPa) was greater than the Medite Tricoya[®] (1.35 MPa). The internal bond strength of the Medite Tricoya[®] was less affected (e.g. 14% lower after UV and boil) by the weathering exposure regimes than the Medite Exterior (e.g. 47% lower after UV and boil).

British Standards for life expectancy

As there are no existing standards specifically for acetylated fibre MDF it is reasonable to try and consider the materials natural durability class. This is noted as a departure from established UK custom and practice. BS 8417 (2003) links the durability requirement for external joinery to a service life. For exterior joinery a 15, 30 or 60 year service life is satisfied by choosing as a minimum a timber of natural durability class 4, 3 or 2 respectively. In addition the service factor based on safety and economic factors is Class C where



remedial action or replacement would be difficult and expensive thus natural durability or preservative treatment is desirable.

The indicative evidence shows that the performance of the in-development product Medite Tricoya[®]:

- Is resistant to attack by basidiomycetes – equivalent to durability class 1
- Improves dimensional stability
- Improves creep resistance
- Improves resistance to weathering of the wood surface

Suitable applications for Medite Tricoya

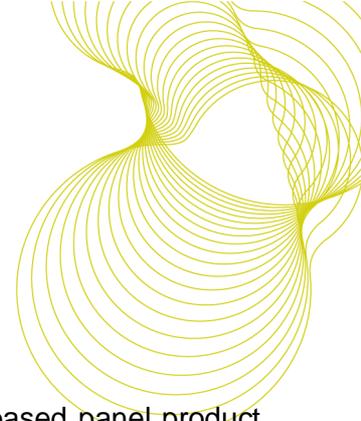
BRE Report 266890 (2010) Pricing overlay for Medite Tricoya[®] end use applications - UK market opportunities report: This report presents the outcome of an evaluation of the influence of price on UK market share for the end use application analysis of Medite Tricoya[®]. The report presented a total of 22 end use applications. The main volume opportunities for Medite Tricoya[®] are considered to be as a multi-functional board, window components, decking, cladding panels, engineered flooring, shop fronts and other end uses that utilise the superior exterior weather performance, stability and durability of the Medite Tricoya[®] product.

Conclusion

An exterior joinery product (such as a cladding panel) prepared from Medite Tricoya[®], is likely to show significantly improved coating performance properties. If the cladding is designed and built to the principles of best practice (to minimise moisture ingress and maximise water shedding), factory finished using quality coatings it will provide exterior joinery of outstanding durability and dimensional stability that would be likely to meet a 60 year service life requirement.

The certified environmental profiles of existing Medite MDF products consider the life cycle impacts of the products from cradle to grave. The green book live lists (www.greenbooklive.com) these products as part of internal and external wall functional units where they meet Green Guide ratings of A or A+. These are amongst the most sustainable functional unit solutions. The stability and durability of Medite Tricoya[®] offers potentially more than this and if commercialised will ensure continuous improvements in sustainability associated with the product.

Future opportunities for Medite Tricoya[®] seem promising. As the construction industry requires materials and products that are robust, reliable and engineered to meet service life demands. The achievement of enhanced service life such as Medite Tricoya[®] seems to offer ensures maximising the sustainability across the life cycle of the construction product. The



proposition of a stable, durable, easy to machine, easy to coat wood based panel product has great opportunity to capture new markets and regain old both from non-wood based competitors as well as substitute old products.

Yours sincerely

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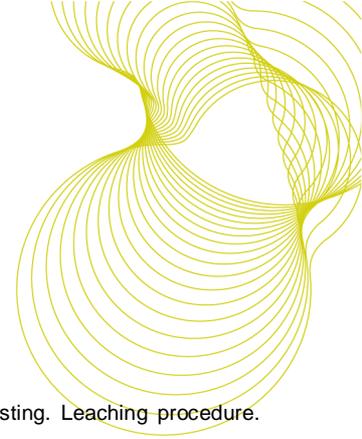
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