Department of **Employment, Economic Development and Innovation**

Cocowood

Properties and processing facts for coconut 'wood'

Revised August 2010

Cocowood properties

Cocowood is the processed stem fibre of the coconut palm (*Cocos nucifera*). The outer, higher density stem fibre has properties similar to many hardwood timbers and is suitable for high value flooring products.

Hardness

Coconut palm fibre or 'wood' density decreases towards the centre and with height. The highest density fibre occurs around the outer periphery of the stem and is suitable for many end-uses requiring a hard 'wood'.

Appearance

The seasoned, high density product colour ranges from medium to dark brown with prominent, darker, quill-like streaks.

Durability

Tested, untreated cocowood had limited natural durability, suggesting it cannot be used in weather-exposed conditions (Keating & Bolza, 1982). However, above-ground durability greater than 10 years has been observed for higher density boards. Standard tests are needed to confirm this.

High density, dry cocowood is not susceptible to powder-post beetle (*Lyctus* species) and is suitable for use in fully protected (hazard 1: H1) applications. Untreated cocowood is not resistant to termite attack.

Using cocowood

High density cocowood can be used for flooring, furniture, joinery, panelling, pallets, plywood and veneers, utility poles (preservative-treated) and feature posts. Lower density material can be used for turnery, insulation, handicrafts and charcoal, firewood and a potting substrate for plants.

The fibre or 'wood' density decreases towards the centre and with height.

Sawing

Cocowood has a high mineral content and large variation in grain angle (caused by the vascular bundle structure), so sharp, specialised tools are needed. High speed steel blades or Stellite-tipped blades and regular sharpening are recommended for breaking down the logs.

For the lower 12 m of the palm stem, the cutting pattern for cocowood debarks and produces 4 high density boards in 8 cuts. Cuts are parallel to the outer surface to minimise density variation within the boards.

Stain-prevention

Freshly sawn boards are prone to mould and staining and should be processed rapidly after harvesting. In humid conditions where adequate pre-drying cannot be guaranteed within 3-4 days, use an appropriate anti-stain dip, followed by the recommended drying schedule.

Drying

Green boards have high moisture content and must be processed quickly to avoid deterioration caused by pests and staining.

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Cocowood stacks are constructed with 'rack-sticks' to minimise the risk of twist, end distortion, and uneven drying. Concrete stack weights are used during drying to minimise distortion.

Cocowood can be kiln-dried at 60–65° (dry bulb) over 10–14 days, depending on the equipment. Drying rate is affected by board thickness, initial moisture content, fibre density, stacking and drying methods and the weather.

The recommended drying schedule and moisture correction factors are given in the properties table below.

The required moisture content for Australian and European markets is 9–14% and 7–11% respectively.

Grading

Key grading parameters for flooring are density (indicating hardness) and straightness (indicating limited spring, twist or bow). The recommended minimum density for flooring is 700 kg/m^3 (Janka hardness threshold >7 kN). Density is graded visually, using vascular bundle patterns as a cue.

Machining

Tungsten-carbide tool edges give the best results at feed-speeds of 12 m/min. At higher speeds, such as 24 m/min, Stellite knives give a better result. Lower feed speeds are recommended for mouldings because the risk of torn grain and soft tissue roughness is greater at high feed-speeds.

Sanding

Cocowood can be sanded to a smooth finish at a range of speeds, although better results are achieved at 12 m/min compared with 18 m/min.

Peeling

Preliminary tests indicate that the relatively brittle 'cocoveneer' will require customised machinery to produce veneer successfully.

Research and development

Cocowood research is co-ordinated by Queensland's Department of Employment, Economic Development and Innovation in a collaborative project supported by the Australian Centre for International Agricultural Research.

An engineered cocowood floor in service.

A sustainable resource

Cocowood has good environmental credentials, because it is sourced from senile plantations, originally planted and managed for coconut and copra crops.

Extensive areas of coconut plantations are grown throughout the Pacific Region and Asia in 60-80 year rotations. Large areas of now senile palms yield only small coconut crops, and replanting is economically sustainable when coconut stems are sold for cocowood processing. High value products like flooring are being developed in a growing international market.

The emerging cocowood harvesting and processing sector provides income for smallholders and employment for regional communities.

Availability

Cocowood availability is tied to the developing harvesting and processing industry across the tropics, particularly the Asia-Pacific region and Africa. Improved processing and products, and growing, international demand, will generate a continuous supply from this resource.

More information

Visit the project website www.cocowood.net.

Physical properties (units)	**Range** =low–high density fibre
Density - basic (kg/m³)	100–1020 [a]
Density - air dry (kg/m³)	200–1170 [a]
Density for flooring products (Janka hardness >7kN) (kg/m³):	>700 [a]
Specific gravity	0.26–0.59 [d]
Shrinkage: tangential, green to dry (%)	3.0–6.0 [b,c,d]
Shrinkage: radial, green to dry (%)	2.7–7.4 [b,c,d]
Unit shrinkage: tangential	0.05–0.42 | high density: 0.32–0.38 [a]
Unit shrinkage: radial	0.05–0.34 | high density: 0.24–0.3 [a]
Workability	Firm to hard; use sharp tools
Mechanical properties (units)	
Modulus of elasticity: dry (GPa)	2–25 [a] | high density:11.4 [c]
Modulus of rupture: dry (GPa)	28–205 [a] | high density: 104 [c]
Maximum crushing strength: dry (MPa)	19–57 [c] | high density: 40 [a]
Janka hardness: dry (kN)	0.7–23.9 [a]
Chemical properties (units)	
Inorganic pure ash (%)	0.75 (0.25–2.4) [a]
Silica (%)	0.07 (0.01–0.2) [a]
Lignin (%)	25.1 [d]
Holocellulose (%)	66.7 [d]
Pentosans (%)	22.9 [d]
Starch (%)	4.3–4.6 [e] (>6 months old; starch reduces with age)
pH	6.2 [e]
Durability, susceptibility to pests and staining	
Natural durability above-ground (averaged over all densities)	Class 4; life expectancy 0–7 years [f]
Natural durability in-ground (averaged over all densities)	Class 4; life expectancy 0–5 years [f]
Susceptibility to *Lyctus*	Not susceptible [b,f]
Termite resistance (averaged over all densities)	Not resistant [a]
Staining	Susceptible to staining [b]

Kiln drying schedule: up to 60–65° C (dry bulb) over 10–14 days.

Moisture content change points (%)	Dry bulb temperature (°C)	Wet bulb temperature (°C)	Relative humidity (%)	Equilibrium moisture content (%)
Green - 85	49.0	44.0	78.0	13.0
85 - 58	53.0	47.0	75.0	11.5
58 - 35	56.0	48.0	64.0	10.0
35 - 28	58.0	49.0	51.0	9.0
28 - 19	62.0	48.0	43.0	6.5
19 - 12	60.0	43.0	40.0	5.5
Equalisation - 48 hrs	60.0	55.0	55.0	8.0

Monitoring moisture content MC. Recommended: use sample boards in the stack and the oven-dry method for monitoring MC during drying. Or, use resistance type meters (accurate only at MC <25%) and moisture correction factors provided:

Moisture correction factors for kiln drying cocowood (for resistance meters calibrated to *Pseudotsuga menziesii*)

Meter reading (% moisture)																			
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Corrected moisture content (% moisture)																		
—	—	—	—	8	8	9	9	10	11	11	12	12	13	13	13	14	14	15

[a]Department of Employment, Economic Development and Innovation (DEEDI), Brisbane, Australia. Unpublished data: Improving the value and marketability of coconut wood. ACIAR project No. FST/2004/054.

[b]Alston, AS (1982) Timbers of Fiji, properties and potential uses. Department of Forestry, Suva, Fiji.

[c]Arancon, RNJ (1997) Asia-Pacific Forestry: Focus on Coconut Wood. Paper No. APFSOS/WP/23. FAO, United Nations, Rome.

[d]Gibe, ZC (1985) The Philippines' recommendations for coconut timber utilisation. Philippine Coconut Authority. PCARRD, Philippines.

[e]Poulter, R & Hopewell, G (2010) Secondary cocowood products. Potting mix. (DEEDI), Brisbane, Australia.

[f]Keating, W & Bolza, E (1982) Characteristics, properties and uses of timbers. South-east Asia, Northern Australia and the Pacific. Inkata Press.