Department of Employment, Economic Development and Innovation

Cocowood processing manual

From coconut wood to quality flooring

Australian Government
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Cocowood processing manual. From coconut wood to quality flooring

An outcome of ACIAR project FST/2004/054: *Improving value and marketability of coconut wood*.

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1. Before you start

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Glossary and abbreviations

bundle pattern	The combined size and surface area of vascular bundles seen in end-sections of cocowood boards. See vascular bundles
cocowood	Palm stem fibre is referred to as 'wood', even though the palm is a herb and not a tree.
Cortex	The 'bark' layer of the coconut palm stem.
end-coat	The ends of sample boards are coated with an impermeable coating such as a wax emulsion product or silicon sealant.
EMC	Equilibrium moisture content
grading tool	A chart constructed with pieces of cocowood end-sections of known density and position in the palm stem. The vascular bundle patterns are displayed as a visual cue for grading density in dried cocowood boards.
high density wood	High density fibre (700+ kg/m^3) towards the outside of the palm stem, harder material is more suitable for flooring products.
MC	moisture content
MC sample sections	Small sections of wood used to calibrate moisture content using the oven-dry method and sample boards placed in the cocowood stack.
moisture or MC sections	See MC sample sections
m/min	metres per minute
OD	oven-dry
sticks	Strips of seasoned wood that are placed between rows of cocowood at right angles to the length of the boards. They allow air circulation between the layers.
racked (stripped)	Cocowood stack that has been built using rack sticks or strips.
sample boards	Short boards inserted in the drying stack, which are used to assess MC accurately from green to dry.
stack 'tops'	Pallet material or iron sheeting placed on the top of the cocowood stack to minimise weathering.
stack weights	Concrete weights are needed to minimise distortion in the boards when drying.
stripping	Building a stack of cocowood with rack sticks to separate and space each layer of boards. This allows air flow between the layers, making drying efficient.
vascular bundles	Groups of cells (for transporting water and food) oriented along the length of the palm stem. They are seen in cross-section as patterns of dots on the end-section of boards. They vary in size and concentration and these patterns are correlated with air dry density of cocowood.

About this manual

This manual describes best practice for producing high-value flooring products from coconut 'wood'—or cocowood. It meets international standards for flooring products and accounts for the recognised, specific, local conditions of the Pacific Islands.

The information is intended for operators skilled in timber processing, who need to work with the unusual properties of cocowood, and specifies where cocowood processes differ from standard practice for timber. For other processes, refer to the relevant standards set by the importing country.

These technical guidelines are based on the research outcomes of the ACIAR project, *Improving value and marketability of coconut wood*.

The manual is divided into three chapters. Each chapter adds to different aspects of primary and secondary processing, which can be downloaded separately as needed.

Chapter 1 provides an overview of the best practice steps for harvesting and processing cocowood. There is also a glossary of terms specifically associated with processing cocowood and a section on managing processing risks.

Chapter 2 covers cocowood's unique properties and how they relate to critical processing techniques. This is followed by sections that set out the processing methods in more detail, explaining why these practices are essential when working with cocowood.

Chapter 3 provides more information, including contacts, current timber standards and some useful publications.

Managing processing risks

The most critical stages of cocowood processing are from sawing to drying the boards.

Cocowood's unique properties expose it to risk from staining organisms after sawing, rapid moisture absorption when kiln dried, and twist while drying.

Good quality boards suitable for flooring products

- have high density wood fibre and even density distribution throughout the board
- are stain-free
- are dried to the required moisture content without causing degrade—twist (distortion), drying-induced stress, end-splitting or surface-cracking (checking).

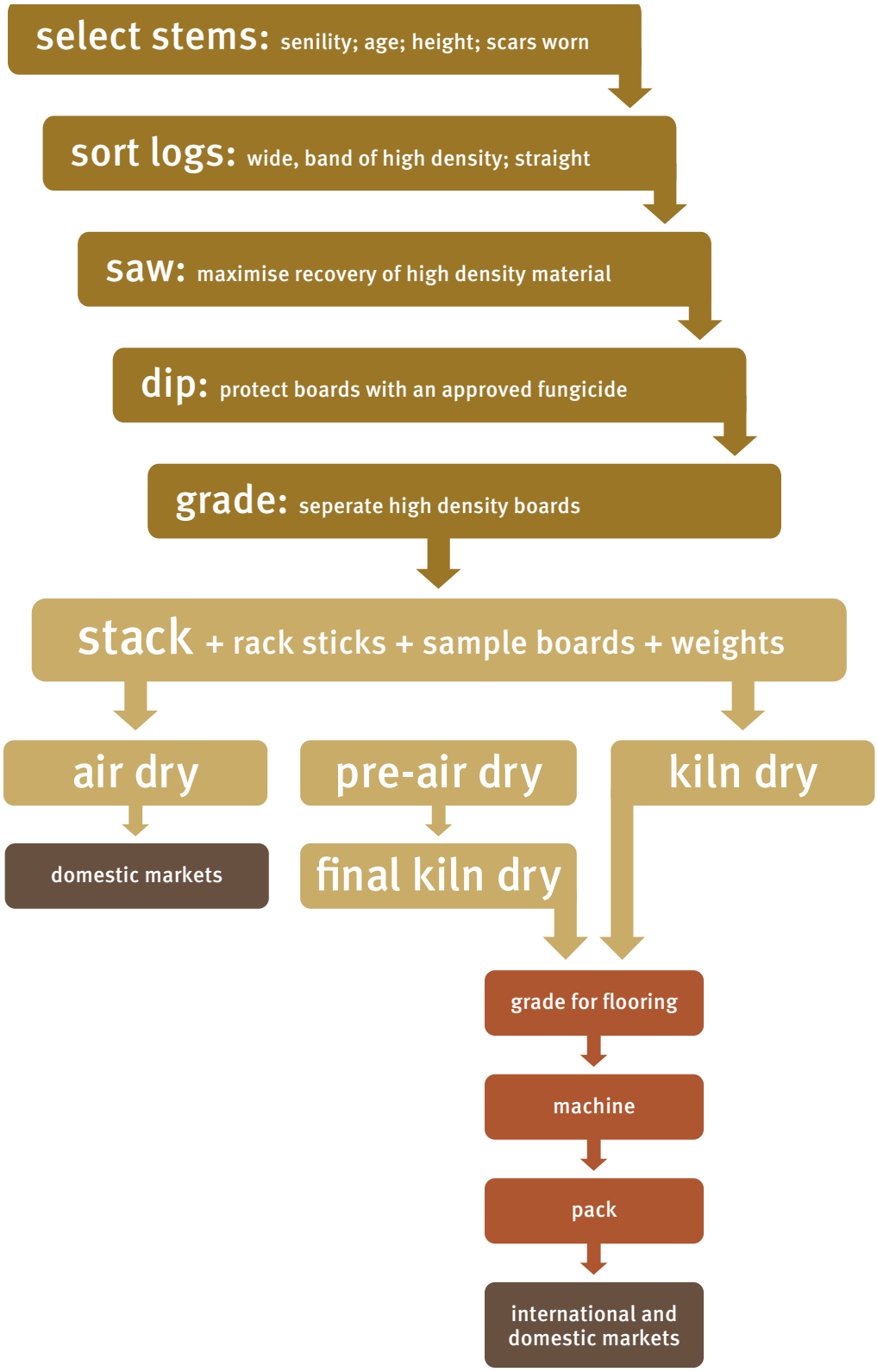
Drying processes are critical

- drying is the most expensive phase of primary processing, representing about 70% of the costs.
- drying is the longest phase, representing about 90% of the processing time.
- drying is the key to controlling wood quality in the final product and so it controls profit margins.

To minimise risks, always plan to

- transport logs to the processing site within three days of felling.
- saw and grade high density boards, dip (if necessary) and stack boards in a single, essential sequence. Full drying processes will be more successful if the green boards are prepared appropriately.
- kiln dry boards correctly for export markets.
- kiln dry boards with the recommended stack design and drying schedule.
- air dry boards (only suitable for domestic markets) in the recommended stack design.

Processing cocowood–in brief



Harvesting, sorting and handling logs

Select stems using:

- **stem age**—tall variety stems older than 60 years have a higher proportion of hard fibre.
- **senility**—stems no longer bearing economically viable coconut crops.
- **absence of scars**—scars left by fallen leaves are worn smooth in older trees and hardly visible.
- **height**—older palms are taller and the tall variety palms generally hold more hard fibre.

Sort and select logs

- select logs that are straight and have a wide, dark band of denser fibre beneath the cortex
- do not store logs in contact with the ground.

Transport logs

- take logs to the primary processing site within three days of felling.

Saw, sort, protect and stack

Steps

1. **Saw** to maximise recovery.
2. Use standard sawmilling equipment but high-speed blades with tungsten-carbide or Stellite-tipped saw blade edges.
3. **Cut parallel** to the outer surface, by raising the thinner end of the log. De-bark and recover the underlying layer of high density wood in 8 sequential cuts in 3, one-quarter turns of the log.
4. **Sort and separate** boards visually, using colour and bundle pattern as a guide to high density fibre.
5. **Dip to protect** against stains and moulds if accelerated drying is not available.
6. **Stack immediately** using the recommended sticker-stack design.

Stacking cocowood

Steps

1. **Position** the stack where conditions are suitable or can be moderated.
2. **Build the stack** using dried rack strips (stripping) to space and aerate the boards.
3. **Cut, process and position sample boards** in the stack.
4. **Weight** the stack to minimise distortion during drying.
5. **Protect** the stack or moderate conditions as necessary.

Drying—overview

Export markets and domestic markets using airconditioning:

- Either kiln dry from green or pre-air dry followed by a final kiln dry.
- Always incorporate correct stacking, using sample boards to monitor changes in moisture content with the oven-dry method.

Domestic markets for use in non-airconditioned situations:

- Either kiln dry from green; pre-air dry followed by final kiln dry or air dry only.
- If an oven and a pan balance are available to monitor moisture content with the oven-dry method, always include sample boards in the stack.

Kiln drying

Steps

1. Build the stack with rack sticks, sample boards and weights.
2. Position the stack in the kiln
3. Attain target **moisture content** (MC) for 25 mm thick boards:
   a. use the **kiln drying schedule** up to 60–65° (dry bulb) over 10–14 days
   b. **monitor moisture content** using sample boards (for the full MC range) or moisture resistance meters and appropriate correction factors (where sample boards are not used because a suitable oven is not available). Note: resistance meters are only accurate for MC ‹ 25%)
   c. **equalise** the MC between boards in the stack.

Pre-air dry followed by final kiln dry

Steps

1. **Build** the stack with rack sticks, sample boards and weights.
2. **Position** the stack where conditions are suitable or can be moderated to optimise drying.
3. **Pre-air dry** the stack of boards (8–11 weeks to reach 17–20% MC)
4. **Monitor moisture content** using sample boards where there is access to:
   a. an oven heating to 103°C+/- 2°C
   b. a balance (e.g. top-pan balance).
5. Kiln dry to achieve target moisture content for export flooring products:
   a. use the kiln drying schedule to optimise drying conditions (6–7 days)
   b. monitor moisture content using sample boards (for the full MC range) or moisture resistance meters and appropriate correction factors (where sample boards are not used because a suitable oven is not available). Note: resistance meters are only accurate for MC ‹ 25%)
   c. equalise the MC between boards in the stack.

Air drying alone

Steps

1. Position the stack where conditions are suitable or can be moderated to optimise drying. Natural conditions experienced by the stacks can be moderated by changing their position and orientation in the open, or their position in buildings or shelters. Protect stacks from adverse drying conditions by positioning them in the yard or drying buildings using the site drying schedule as a guide.
2. Build the stack incorporating:
    a. rack strips to space and aerate the boards
    b. **sample boards** where an oven and balance are available for monitoring MC
    c. **weights** to minimise distortion during drying.
3. Protect the stack or moderate conditions as necessary:
    a. use fabric or other shades and screens on the drying building to reduce air flow, if necessary
    b. place stack 'tops' (pallet material or iron sheeting) on the top to minimise weathering in the top layers of stacks that are air drying outdoors; this will be unnecessary if the stack is weighted, because the weight acts as a shield.
4. Monitor moisture content
    a. using sample boards and the oven-dry method where there is access to an oven (heating to 103°C+/- 2°C), and a balance
    b. using resistance meters weekly, until 25% MC is reached, then twice-weekly until the target MC is reached
    c. a final MC of 17–20% can be expected after 8–11 weeks.

Grading cocowood boards

Steps

1. Understand the visual grading parameters for cocowood: straightness, bundle pattern, density homogeneity / evenness and straight boards.
2. Become skilled in recognising the relationship between cocowood density, bundle patterns and position in the stem. Graders must be experienced in this.
3. Create a cocowood density grading tool and train graders in visual grading parameters
4. Grade cocowood boards using the density grading tool:
    a. density—differentiate between dissimilar bundle patterns and associate with cocowood density
    b. homogeneity—assess density homogeneity within boards (15% variation or less)
    c. grade and sort boards for appropriate flooring markets.

Product specification

General	European market	Australian market
Density (air dry):	700 kg/m^3 or greater	700 kg/m^3 or greater
Discolouration: stain or spots	None	
Distortion: bow, twist, cup	As for EN 13226:2009 Wood Flooring - Solid Parquet Elements with Grooves and/or Tongues. as for EN 13696:2009 Wood Flooring - Test Methods to Determine Elasticity and Resistance to Wear and Impact Resistance	As for AS 2796.1—1999. Australian Standard. Timber—Hardwood—Sawn and milled products. Part 1: Product specification
Moisture content:	All solid wood flooring, 9% (+/- 2%) Parquetry: 9% (+/- 2%) Tongue and groove: 9–12%	Engineered overlay: 9–14% (target 9%) Parquetry: 8–13% (target 9%) Tongue and groove: 9–14% (target 9%)
Colour	High density only: mix lighter and darker shades through the pack	

Product dimensions	European market	Australian market
Engineered overlay flooring	Manufacture a 15 mm overlay board from a laminated beam constructed from 8, 20 mm thick boards that are glued to 12 mm plywood.	Manufacture a 15 mm overlay board from a laminated beam constructed from 8, 20 mm thick boards that are glued to 12 mm plywood.
Tongue and groove	As for EN 13226:2009 Wood Flooring - Solid Parquet Elements with Grooves and/or Tongues: common dimensions - 15 x 90 x 450/990 mm 15 x 100 x 500/800/1000/12000/ 1500/2000 mm	As for AS 2796.1—1999. Australian Standard. Timber—Hardwood—Sawn and milled products. Part 1: Product specification
Parquetry	As for EN 13226:2009 Wood Flooring - Solid Parquet Elements with Grooves and/or Tongues: common dimensions - Piece: 16 x 22 x 160 mm, surfaced 2 sides Bundle: 2x (16 pieces),	As for AS 2796.1—1999. Australian Standard. Timber—Hardwood—Sawn and milled products. Part 1: Product specification

Machining and sanding

- **Tungsten-carbide** tool edges provide the best results at feed-speeds of 12 metres per minute (m/min).
- Tools made from **cobalt-base alloys** strengthened with tungsten and molybdenum (known as stellite alloys) give a better quality result at higher speeds, such as 24 m/min.
- **For mouldings**, lower feed speeds are recommended to reduce the risk of torn grain and soft tissue roughness, which are more likely at higher feed-speeds.
- **When profiling**, for example when producing a tongue and grooved profile, lower feed speeds are recommended. Tear-out occurs where bundles meet the surface at an angle rather than align parallel to the surface.
- If the material is **prone to rough grain or soft tissue**, use lower feed speeds.
- **Cross-cutting** negative cutting angle blades and positive cutting angle blades also provide good results.
- **Rip sawing** straight blades provided a better result than bevelled blades, where the board is cut longitudinally. Straight blades produce fewer splinters and tear-out.
- **Sand** to a smooth finish at 12 m/min.

Storing and packing boards

- Maintain the cocowood in optimal conditions while it is stored; avoid more than 1% variation in moisture content.
- Ensure that the moisture content is appropriate when it is received or dispatched.
- Protect the boards during storage and transport by wrapping individual packs in plastic.