TROPICAL
Forest Products

kebony

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Milling, planing and storing Kebony Wood

1. INTRODUCTION

The Kebony process alter the wood properties. In addition to increasing biological resistance, it also changes chemical and mechanical properties. Both chemical and mechanical properties are important properties and need attention when it comes to profiling this material.

Machining of Kebony is in many ways similar to machining wood. However, wood is not a homogeneous group of materials. The wide variety of wood species provide wood materials with extreme variation in properties, like density, anatomical structure and chemical composition.

In the wood working industry, it is common to group wood in two main groups: Hardwoods and Softwoods (Broadleaf and Conifers). This makes sense as long as the anatomical structures are quite different. Individual fibres in broadleaves are 1 mm and in conifers 4 mm. Even though broadleaves are generally harder and denser than conifers, there are also low-density hardwoods and high-density softwoods. Another distinct difference is the variation in density within annual rings. As an example, the specific gravity within one annual ring in Southern yellow pine, SYP, can range from 0.25 to 1.1.

When milling and planing different wood species, different settings in the milling machines and cutting tools are used. To achieve good results when machining wood, it is essential that the producer has experience in working with a specific wood species, and skilled people to operate the machinery and grinding shop.

This manual will focus on challenges and issues related to milling Kebony SYP and Kebony Radiata products, and define a Kebony quality of the final product, in order to guide producers in the right direction when setting up their machinery and profiling Kebony.

2. SAFETY

An important difference between working with Kebony and other wood species is the altered chemical composition. Kebony sawdust and chips have a higher potential to create self-heating in storage. This fact needs special attention, in order to avoid fires in storage and is specifically addressed in the Material and safety datasheet related to waste from machining Kebony wood. (MSDS-II)

The Product can represent a self-ignition hazard. Dust and chips are reactive even in the absence of air. Laboratory experiments lead to the following precautions for storing the Product (consisting of chips/fibre/dust):

- Should not be stored in piles that exceed 1 meter in height,
- Should not be stored in areas were the surrounding temperatures exceed 30 °C
- Critical temperature for storage of 1 m^3 of wood chips is 45 °C
- Any storage of chips/fibre/dust must not be allowed to reach a core temperature higher than 45 °C

These precautions will prevent uncontrolled temperature increases that may lead to fires.
Wood dust mixed with oxygen represents an explosion hazard when in contact with an ignition source. This is dependent on the humidity and particle size.
Wood dust is not explosion sensitive to mechanical impact or static discharge.
The lower explosion level (LEL) for wood dust is 40 g/m_3.

See the MSDS-II for more information and precautions related to machining and waste from Kebony. Appendix A

3. Wood properties

Wood properties - Kebony SYP				
	Unit	Mean value	5th percentile	Characteristic value
Year ring	mm	4	7	
MOR bending	N/mm^2	82,8	55,5	49,7
MOE	N/mm^2	15 400		15 400
Density	kg/m^3	747	686	693
		Mean value	Stdv.	
Hardness Janka	kN	7,6	1,7	
Hardness Brinell	HB	5,5	2,1	
EMC 20 °C/65 RH	%	< 7,5		

Source: SP report 4P05099A; 2014. EN 408:2010, EN 1534:2010, EN 384:2010, EN 14358:2006, ASTM D143-94

Wood properties - Kebony Radiata				
	Unit	Mean value	5th percentile	Characteristic value
Year ring	mm	9	15	
MOR bending	N/mm^2	68,4	37,9	36,1
MOE	N/mm^2	12 400		12 400
Density	kg/m^3	634	579	587
		Mean value	Stdv.	
Hardness Janka	kN	7,2	1,2	
Hardness Brinell	HB	4,2	1,1	
EMC 20 °C/65 RH	%	< 6,5		

Source: SP report 4P05099B; 2014. EN 408:2010, EN 1534:2010, EN 384:2010, EN 14358:2006, ASTM D143-94

4. WOOD ANATOMY

Both Kebony SYP and Kebony Radiata are “hard and dense” softwoods.

Softwoods have long fibres compared to hardwoods. Kebony treatment results in slightly more brittle material, and the individual fibres tend to break when machined.

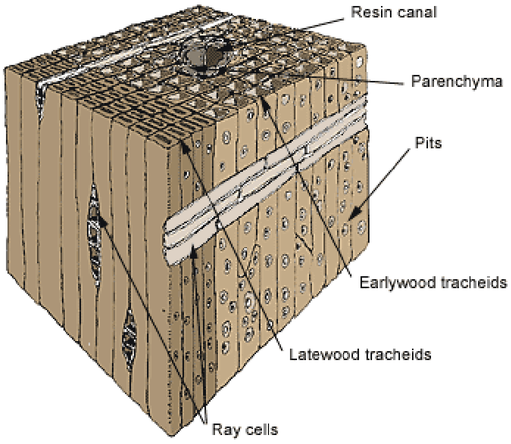


Fig. 1 Softwood

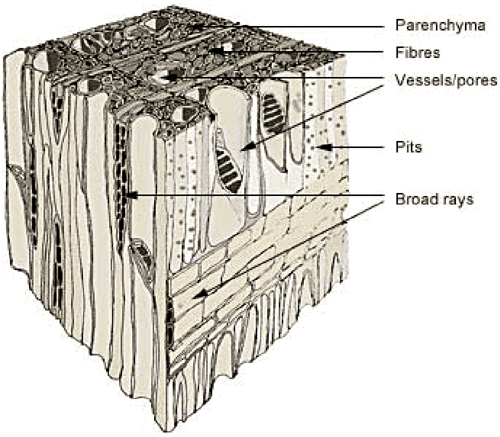
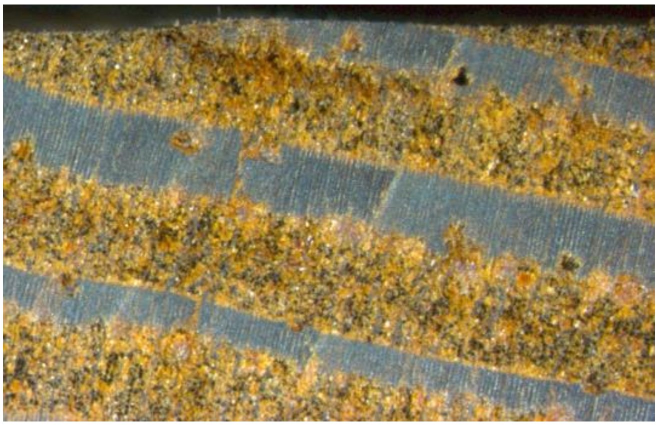


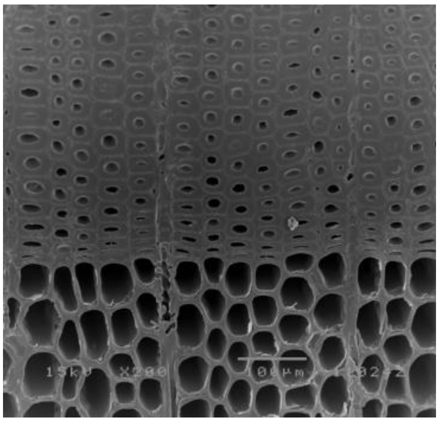
Fig. 2 Hardwood

As seen from pictures 1 and 2, the anatomical structures of softwood and hardwood are quite different.

Picture 1 is a magnified crosscut of Kebony SYP. There is a distinct difference in density between earlywood and latewood. Picture 2 is a SEM picture showing that the latewood is densified by the treatment, resulting in blocked cell lumens in the latewood.



Picture. 1. Cross cut of Kebony SYP



Picture. 2 Annual ring border in Kebony SYP

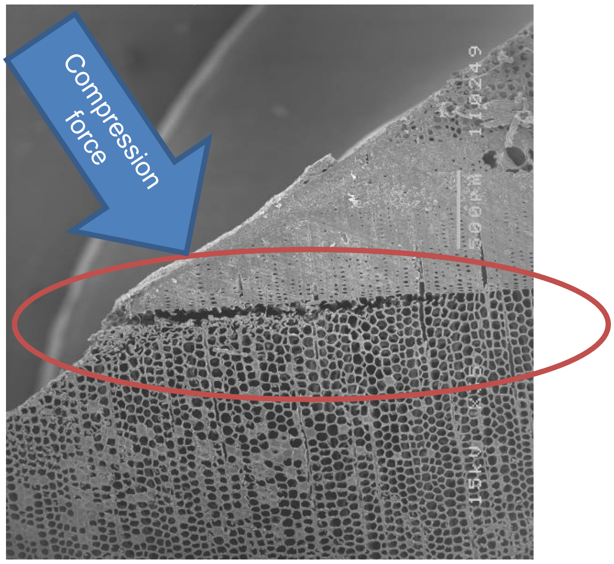
Anatomical structure and density are the two most important factors when milling and planing wood.

A distinct and important difference between softwood and hardwoods is the pronounced different density within annual rings. Early wood and latewood can range from 250-1100 kg/m3 within the same annual ring. These facts makes machining of softwood different from machining hardwoods.

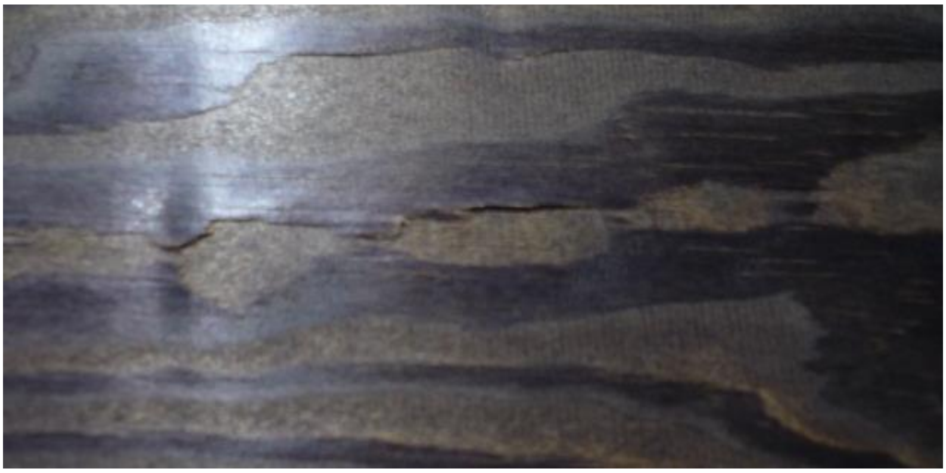
5. Raised grain

The border between latewood and earlywood represents the weakest link when machining wood. Compression forces acting perpendicular to the grain will potentially damage the thin walled cells adjacent to the thick latewood cells. Braking this layer will result in raised grain separation, as seen in pictures 3 and 4.
The raised grain is not easy to detect when machining the surfaces. It will show up later when the materials have been exposed to moisture variations, resulting in swelling and shrinking. Then the grain separation becomes visual.

This phenomenon is more pronounced on the pith side. The reason is how the forces are transferred into the material. Forces acting on the pith side will transfer their full capacity to the week layer, while forces acting from the bark side will be slightly distributed through an annual ring with increasing density.



Picture 3. Microscopy picture showing the grain separation between late- and early-wood as a result of a compression force indicated by the blue arrow.



Picture 4. Surface showing raised grain after planing.

6. Face orientation when planing Kebony wood

1.1. Kebony SYP

Based on the previously described challenges and Kebony experience, all Kebony SYP products shall be machined with the pith side facing downwards or inwards of the final product. The exposed side of the product is always the bark side.

1.2. Kebony RADIATA

Kebony Radiata products shall preferably be machined with the pith side facing downwards or inwards of the final product. In case of defects on the bark side, the pith side may be used as the front side (this only applies to Kebony Radiata, not Kebony SYP).

7. Precautions when planing Kebony wood

Several causes of raised grain separation have been identified:

Causes related to knives and steel (need attention):
- Dull knives
- Too much inline sharpening (jointing)
- Low cutting angle
- Low heal angle

Other potential causes:
- High pressure on feeding rolls
- Groves on feeding rolls
- High pressure on chip breaker
- High pressure on stabilizing steel plates

The most important factors are sharp knives and minimum jointing (inline grinding).

Figure 3 and 4 shows the geometry of a knife tip when honed (Jointed). The green area is removed in order to equal the knives on one rotor. Jointing must be minimized when machining Kebony. The “land” must not exceed 0.1 mm as indicated in Figure 4

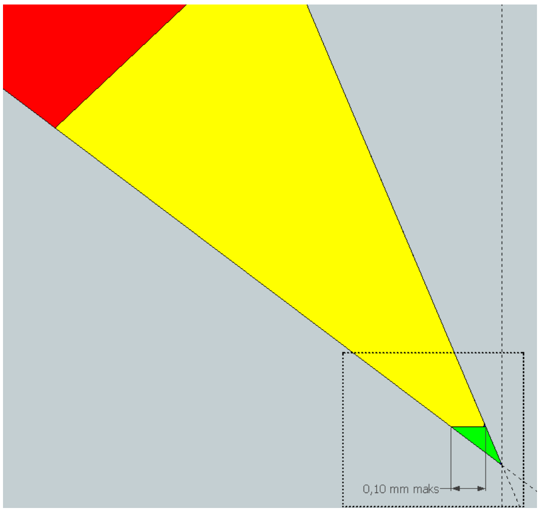


Fig. 3 Tip of a cutting tool

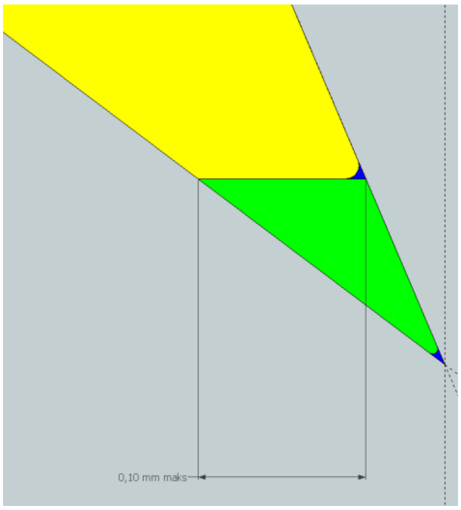


Fig 4. Maximum land size 0.1 mm

8. Example of settings

Kebony have found the following settings to produce surfaces of god quality:

However, other producers might need individual adjustments due to variations in tools and machinery.

Kebony settings for our machinery:

Rotor head: Ø 203
Knives: Z 10
Steel: HW
Cutting angle: 15°
Rotor speed. 6000 rpm
Feeding speed: 80 m/min (8 m/min per knives)

Knives shall be sharpened after running 30.000 lm of Kebony SYP or Kebony Radiata.

9. Surface quality

The planed surface shall be free of mechanical defects of any kind, like indentations and scratches, which would indicate tool damages.

The planed surfaces shall not be glossy, but matte. A glossy (polished) finish indicates that knives are dull and/or excessive jointing in combination with low feeding speed. Glossy surfaces will most likely lead to grain separation or raised grain at a later stage.

Visible cutter marks are acceptable as long as the length is less than 2 mm.

10. Product Quality

General quality of finished products are described in appendix B (Kebony Radiata) and C (Kebony SYP)

***Additional note not part of original text.**

11. Storage

Kebony boards should be stored in their original packaging or completely and tightly covered under a protective wrap (e.g. tarp) up to the time of installation. In addition to keeping Kebony wrapped, we highly recommend dry inside storage to further protect against moisture absorption prior to installation.