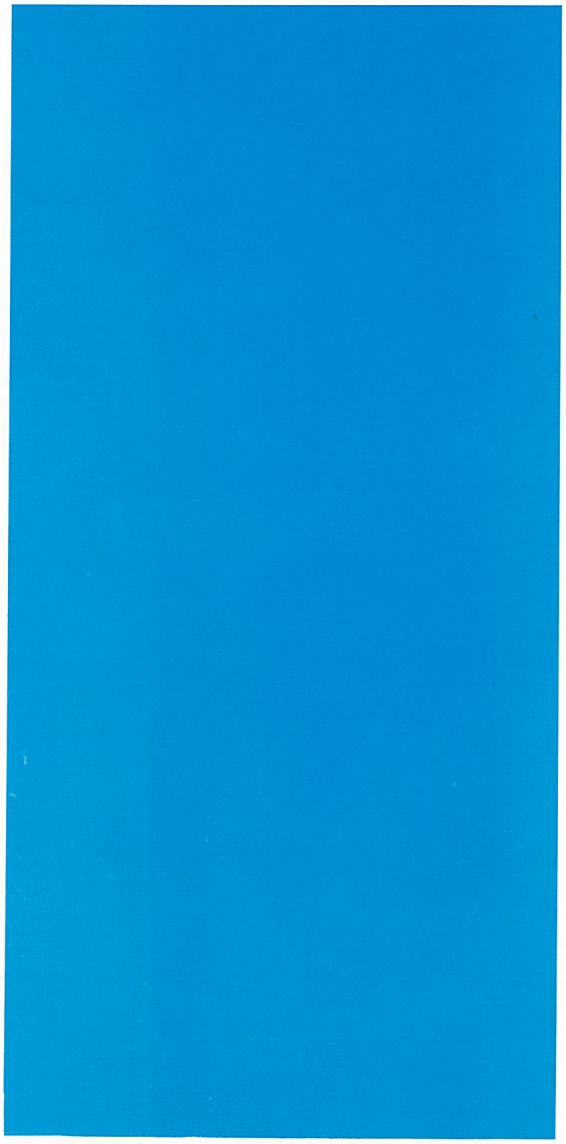
NOUVELLES ESSENCES COMMERCIALISABLES D'AMÉRIQUE LATINE



NEW MARKETABLE SPECIES IN SOUTH AMERICA

NUEVAS ESPECIES COMERCIABLES DE AMERICA DEL SUR

NEW MARKETABLE SPECIES IN SOUTH AMERICA

Açacu

DENOMINATIONS

BOTANICAL NAME

- *Hura crepitans* L. (Euphorbiaceae family)

COMMERCIAL NAMES

International name ..... AÇACU

- Bolivia..... : Ochoho, Jabillo
- Brazil ..... : Açacu, Assacu
- Central America.. : Jabillo
- Colombia ..... : Ceiba lechosa, Ceiba amarilla, Ceiba de leche
- Ecuador ..... : Habillo
- French Guiana .... : Sablier, Bois du Diable
- Guyana ..... : Sandbox
- Mexico ..... : Arbol del diablo, Haba
- Peru..... : Catahua amarilla
- Surinam ..... : Possentrie, Possum, Urawood
- U.S.A. ..... : Possum wood, Sandbox, Hura
- Venezuela..... : Ceiba blanca, Javillo

Açacu

ORIGIN AND SUPPLY

Geographical distribution
Açacu occurs in Central America, tropical South America, the Caribbeans and the West Indies.
It is particularly abundant in the coastal plain of Paramaribo (Surinam), in Trinidad, as well as in French Guiana, Guyana and Brazil.
It is mostly found in "varzea" (regions subject to flooding) and alongside rivers.

Frequency in the forest
According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 0.5 to 2 m^3/ha.

Supply
Nowadays, Açacu is commonly harvested throughout the Amazonian basin. Exports are still small, but they increase every year. Because of the frequency of the species in the forest, the exports could develop considerably in the future both as logs and sawnwood.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree
Açacu is a slender large tree which can be up to 40 m high. Its 12 to 25 m long trunk has rather small and relatively unmarked buttresses.
The bark is smooth and greyish, and, like the sapwood, it contains an irritant sap.
In Brazil, one can distinguish between yellow or white Açacu and black or red Açacu; the latter differs from the former by the reddish tint of the leaf undersides.

Conformation of the logs
Açacu logs are of fairly good shape. They are straight and cylindrical. Their pith can have a pink tint. Their diameter varies from 0.70 to more than 1.50 m.
White Açacu sapwood is 10 to 15 cm wide (for diameters from 0.70 to 1 m). It is barely defined from the heartwood. In red Açacu, the sapwood is well defined from the heartwood and is thicker (15 to 25 cm).

Preservation of the logs
If the logs stay in the forest several months after felling, they are rapidly attacked by insects and fungi. Thus, they have to be treated or removed quickly from logging sites or stored in water, which ensures good preservation.

Ability to float
As Açacu green logs' density is lower than 1, the logs can easily be floated out of logging sites.

DESCRIPTION OF THE WOOD

The sapwood is white to ashen-coloured. The heartwood is cream-white in white Açacu, and pinkish brown in black Açacu.
The grain is generally straight, sometimes wavy and irregular.
The texture is medium to coarse.
Internal stress is frequent.
With a magnifying glass (× 15), the following can be observed :
- rare (about 2 per mm^2), relatively large (180 to 230 µ) vessels, frequently blocked by thin-walled tyloses;
- large intervascular pitting (12 to 15 µ);
- short diffuse-in-aggregates parenchyma;
- uniseriate rays, 7 to 9 per mm, of homogeneous structure, formed of procumbent cells.

TECHNICAL PROPERTIES

Açacu is a very light to lightweight, very soft to soft wood with small tangential and radial shrinkage.
Volumetric shrinkage is small.
Its strength properties are poor.

Principal physical and mechanical properties
N.B.: the values given below and preceded by an asterisk correspond to a 12% wood moisture content (French Standard NF B 51-002).

Density
- **Air dry*:** 320 to 590 kg/m^3 (average 450 kg/m^3)
- **Green:** 600 to 750 kg/m^3
- **Basic density:** 0.38

Hardness (Chalais-Meudon scale)*: 1.6 (very soft to soft)

Saturation point: 27%

Total volumetric shrinkage: 8.8%

Total tangential shrinkage: 4.7%

Total radial shrinkage: 2.9%

Sensitivity to variations in air humidity: not very important

Movement in use: very stable

Volumetric shrinkage for 1% variation in moisture content: 0.37%

Splitting strength*: 8.9 x 10^3 N/m (9.1 kg/cm)

Compression strength*: 31 MPa (318 kg/cm^2)

Bending strength*: 60 MPa (616 kg/cm^2)

Modulus of elasticity in bending*: 7,500 MPa (77,000 kg/cm^2)

Shock resistance*: 0.24 kg/cm^2 (poor).

DURABILITY AND IMPREGNABILITY

Note: the properties given below are those of the heartwood. The sapwood must always be considered as having lower resistance to insects and fungi than the heartwood.

Natural resistance to fungi
Açacu resists poorly to white rot fungi *(Coriolus versicolor, Pycnoporus sanguineus, Lentinus squarrosulus)* and brown rot fungi *(Antrodia sp.).*

Natural resistance to Lyctus
On account of the size of the little defined or undefined sapwood, the wood is liable to Lyctus attacks.

Natural resistance to termites
Resistance to termites *(Reticulitermes santonensis)* is poor.

Impregnability
Açacu impregnates well.

CHEMICAL PROPERTIES

Chemical composition of the wood

Açacu is characterized by:

- a high content in extractives with benzene-alcohol (15%),
- a low content in extractive with water (1.3%),
- a low content in lignin (25%),
- a moderate content in cellulose (43%) and hemicelluloses (13%).

PROCESSING

Sawing

Açacu saws relatively easily, but sawn surfaces can sometimes be woolly because of internal stress. On sawing, wood splitting occurs rather frequently. To minimize these defects, it is advisable to saw in the round.

Some woods have a high silica content (c ≃ 0.14%). Stellited saw teeth should thus be used.

Sawing of green Açacu logs may cause important mucous membranes irritation, so an efficient dust extraction system should be used.

In spite of the defects mentioned above, sawing yields are generally good because of the logs' size and adequate shape.

Slicing and peeling

Açacu slices and peels rather easily. Thin veneers can be cold-peeled or peeled after steaming at about 65 °C.

Veneers dry relatively slowly and tend to distort, but risk of splitting is small. During drying, brown staining may occur, but could be eliminated by sanding.

Veneers can be glued satisfactorily with urea formaldehyde and phenol formaldehyde glues.

The recommended maximum pressure for gluing is from 0.8 to 1.3 MPa, according to wood density.

Drying

Air drying

Açacu air drying is naturally quick, which minimizes the risk of fungal damage. However, the rapidity of the procedure causes distortion and splitting, especially when the wood does not have a straight grain. During air drying tests performed in tropical climate (temperature ≃ 30 °C - Humidity of the air ≃ 85%), 25 mm thick pieces went from green to a 20% moisture content in twenty days with the occurrence of noteworthy distortion.

At the end of this drying process, some distortion and splitting was observed on the flat-sawn pieces whose grain was wavy. On the other hand, the wood with straight grain was not distorted at all.

All sawn pieces had an even distribution of moisture content (little or no difference in moisture content between the periphery and the core of the pieces).

Conclusion: if Açacu is dried too quickly, splitting and distortion may occur, especially on pieces with wavy grain.

So Açacu should be dried carefully and slowly. If it is air dried, a fungicidal treatment should be applied to the wood to avoid any risk of blue staining.

Low temperature and high humidity should be maintained during artificial drying.

The logs will thus have to be dried in sheds with limited natural ventilation and so, they will have to be treated beforehand to avoid any risk of blue staining.

Kiln drying

Açacu artificial drying should be carried out carefully, because of the possible risk of distortion and splitting mentioned above.

As an indication, for 41 mm thick wood, 11 days were needed to go from green to a 10-12% moisture content following the kiln schedule below:

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
52	42	41	94
33	42	40	87
25	46	42	78
18	49	44	75
11	52	46	71

Fastening

Açacu nails and screws easily. Nail and screw-holding power is satisfactory.

Gluing

Açacu glues well and without any problems with all types of glues in current industrial use.

This species can be used for glued-laminated purposes.

Machining

Açacu works with no trouble; however, the cutters will have to be kept sharp to avoid woolly surfaces. The use of carbide-edged tools is advisable.

Finishing

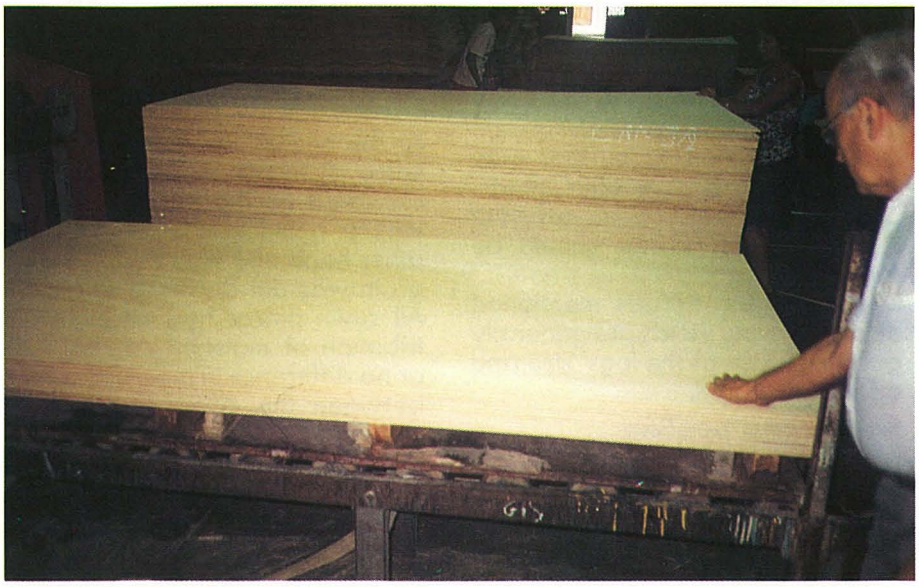
Açacu sands without problems. For purposes which require a perfectly smooth surface, one should:

- sand very carefully,
- fill in the grain prior to any finishing operation.

Varnish and paint give a satisfactory finish.

CONCLUSIONS AND USES

As Açacu is commonly found in the forest and easy to use, it is suited for many purposes except those that require high strength properties. Açacu could be more commercialized and exported in the future.
Provided the necessary precautionary measures are taken on drying (low temperature and high relative humidity), and on machining (sharp equipment to obtain smooth surfaces), Açacu can be used without any problems.
Açacu is a lightweight, soft white wood with rather low strength properties.
Its good amenability to preservative treatment makes up for its poor strength, so that, in some cases, it can be used outdoors successfully after treatment in a pressure impregnation plant.
It dries quickly, works easily, but the machines will have to be fitted with an efficient dust extraction system to avoid risks of irritation of mucous membranes.
On account of its properties and frequency in the forest, Açacu can be used for the production of plywood or blockboards.
It can also be used for packaging purposes, matches, furniture units, joinery or toys. Logs are used locally as floaters.
First grade wood is suitable for mouldings, second grade one for packaging and packing cases.



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NEW MARKETABLE SPECIES IN SOUTH AMERICA

Cedrorana

DENOMINATIONS

BOTANICAL NAME

- *Cedrelinga catenaeformis* Ducke (Mimosaceae family)

COMMERCIAL NAMES

Internationale name ..... TORNILLO

- Brazil ..... : Cedrorana
- Colombia..... : Achapo
- Ecuador ..... : Seique, Seiqui, Tsaik, Chuncho
- French Guiana.... : Don Cede
- Peru ..... : Tornillo, Huayra caspi

Cedrorana

ORIGIN AND SUPPLY

Geographical distribution
Cedrorana mainly occurs throughout the Amazonian region: Brazil -Bolivia - Peru. It grows best in regions subject to flooding (« varzea »), or in very wet soils (alongside rivers in « terra firma » areas).

Frequency in the forest
According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 1 to 12 m^3/ha.

Supply
Cedrorana is frequently commercialized on the local markets of Brazil and Peru. However, the exports are still small. The wood could be exported as logs or sawnwood from these main producing areas and could, in the future, give rise to a trade of great interest.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree
Cedrorana is a large tree (40 to 50 m). The bole, devoid of buttresses, is 18 to 25 m long. The 2 to 4 cm thick bark holds well and its rough surface is very similar to Cedro's. That is the reason why these trees are called Cedrorana.

Conformation of the logs
The logs are usually of good form. Their diameter generally varies from 70 to 150 cm.

Preservation ot the logs
The sapwood can be attacked by pinhole borers and the heartwood by fungi, so the logs should not have a prolonged stay in the forest. If the logs are stored for a long time, a preservative treatment is necessary.

Ability to float
Cedrorana logs can be floated out of logging sites, as their density when green is lower than 1.

DESCRIPTION OF THE WOOD

Cedrorana is pink, sometimes with greenish or orange tints. The sapwood is not well defined. The grain is generally straight; it may be oblique or more or less deeply interlocked in some logs. The texture is coarse. When freshly cut, the wood does not have any specific smell.
With a magnifying glass (× 15), the following can be observed:
- very large (220 to 350 µ), rare (1 to 2 per mm^2) vessels;
- not well defined, cylindric or lozenge parenchyma with solitary cells laid among fibres;
- very thin, uniseriate rays, 8 to 10 per mm, often echeloning on flat-cut surfaces.

TECHNICAL PROPERTIES

According to origins, Cedrorana physical and mechanical properties can vary more or less. Cedrorana is a very light to light weight and soft wood. Tangential and radial shrinkage is small to moderate. Its volumetric shrinkage is moderate. Its strength properties are poor.

Principal physical and mechanical properties
N.B. : the values given below and preceded by an asterisk correspond to a 12 % wood moisture content (French Standard NF B 51-002).

Density
- **Air dry*** : 360 to 640 kg/m^3 (average: 510 kg/m^3)
- **Green** : 750 kg/m^3
- **Basic density** : 0.33

Hardness (Chalais-Meudon scale)*: 2.2 (soft)

Saturation point: 29 %

Total volumetric shrinkage: 11.7 %

Total tangential shrinkage: 7.0 %

Total radial shrinkage: 3.8 %

Sensitivity to variations in air humidity: moderate to very important.

Movement in use: fairly stable

Volumetric shrinkage for 1 % variation in moisture content: 0.46 %

Splitting strength* : 14.0 × 10^3 N/m (14.3 kg/cm)

Compression strength* : 38 MPa 385 kg/cm^2)

Bending strength* : 79 MPa (803 kg/cm^2)

Modulus of elasticity in bending*: 8,800 MPa (90,000 kg/cm^2)

Shock resistance* : 0.32 kg/cm^2 (poor).

DURABILITY AND IMPREGNABILITY

Note : the properties given below are those of the heartwood. The sapwood must always be considered as having lower resistance to insects and fungi than the heartwood.

Natural resistance to fungi
The tests carried out on this wood show that the resistance of the wood can be considered:
- good against *Polyporus versicolor*
- average against *Lenzites trabea*
- average against *Poria monticola*
- very good against *Pycnoporus sanguineus*
- very good against *Lentinus squarrosulus*
- poor against *Antrodia sp.*

On account of these results and to avoid any risk of degradation with time, it is advisable to plan a fungicidal treatment for any outdoor use.

Natural resistance to Lyctus
Cedrorana can be attacked by Lyctus.

Natural resistance to termites
The wood offers poor resistance to termites *(Reticulitermes santonensis).*

Impregnability
The wood cannot be impregnated satisfactorily. To ensure adequate preservative treatment, double vacuum-treatment should be provided.

PROCESSING

Sawing
Cedrorana saws without any trouble and it calls for no great power in conversion. The wood silica content can be considered negligible ($c < 0.05$ %). Thus, the wood is not abrasive. Sawing yield may sometimes be poor because of the presence of internal defects (heart damage, cup shakes, borer damage).

Slicing and peeling
Cedrorana slices and peels easily. The logs should be steamed at a temperature between 65° and 70 °C.
Drying the sheets is easy and good quality veneers are obtained (small tangential shrinkage, moderate risk of splitting).

Veneer glues well with urea formaldehyde and phenol formadehyde glues. Recommended gluing pressure for the production of plywood is between 1.4 and 1.6 MPa.
Veneer is of good quality. However, the nature of the wood (appearance and resistance) will limit its use to the production of common use plywood.

Drying
Air drying
In tropical climate, Cedrorana dries very quickly.
Kiln drying
As an indication, 9 days were needed to lower the moisture content of 41 mm thick wood from 30 % to 10 % following the kiln schedule below:

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
30	46	42	78
15	46	42	78
12	52	46	71
10	52	46	71

Following this drying process, the following relatively minor defects were observed:
- end-splitting,
- light warping.

At the end of this drying process, moisture was evenly distributed among the periphery (9 %) and the pith (12 %).

Conclusion: Cedrorana dries quickly. However, to avoid any possible risk of distorsion or splitting, drying should be carried out carefully.

Fastening
Nails and screws penetrate with no trouble. Nail-holding power varies.

Gluing
Tests carried out with resorcinol type resin have showed that:
- resistance to shearing in glue joints is similar to that determined in solid wood,
- adherence is rather good,
- holding length time of glue joints is very good (delamination test).

Considering these results, Cedrorana glues well and it can be used for the production of glued-laminated units.

Machining
The wood works easily, but may sometimes give woolly surfaces. Machining requires the use of an efficient dust extraction system associated with the equipment because of the irritant effect of dust.

Finishing
Cedrorana sands without problems: for purposes which require a perfectly smooth surface, one should fill in the grain prior to any finishing operation; varnish and paint give a satisfactory finish.

Cedrorana

CONCLUSIONS AND USES

Cedrorana is a lightweight wood with various properties according to origins.
Although its tangential and radial shrinkage is slightly greater than that of woods with the same density, Cedrorana dries without problem and rapidly.
This wood is suitable mainly for purposes which do not require any important strength properties.
It can be used for the production of:

- furniture units
- mouldings or panelling
- interior joinery and exterior joinery (with treatment)
- toys
- turned objects

and generally speaking, whenever an easy to work wood is required.
Lesser quality wood can be used for packing cases and shuttering.
Finally, it is also suitable for the production of inside plies of blockboards or plywood.
Its use as glued-laminated beams or panels is possible for purposes which do not require very high resistance.

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NEW MARKETABLE SPECIES IN SOUTH AMERICA

Copaiba

DENOMINATIONS

BOTANICAL NAME

- *Copaifera multijuga* Hayne (Cesalpiniaceae family)

Note : several Copaifera with various properties are commercialized under the name of COPAIBA. The « multijuga » species only, which corresponds to soft wood Copaifera, will be dealt with here.

COMMERCIAL NAMES

International name ..... COPAIBA

- Brazil: Copaiba, Copahiba angelim, Copaiba marimari

Copaiba

ORIGIN AND SUPPLY

Geographical distribution

Copaiba in a broad sense occurs throughout tropical America, from Mexico in the north to Paraguay in the south, mainly on "terra firma" (areas not subject to flooding). *Copaifera multijuga* occurs only in Amazonia and in Pará.

Frequency in the forest

According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 0.3 to 0.4 m^3/ha.
In some regions, Copaiba frequency in the forest can however reach 1 to 2 m^3/ha.

Supply

Copaiba is a common wood on the local market. Its export remains low today and is mainly limited to plywood export; it could develop, in the form of logs as well as sawnwood, should demand increase in the future.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree

Copaiba can be very large. Its bole, with buttresses, is 13 to 22 m long. The bark, 0.5 to 2 cm thick, is reddish brown, smooth, holds tightly and may contain resin.

Conformation of the logs

The logs are usually of good form, straight and cylindrical, but lobed in some cases. The pith is sometimes off-centre. The log diameter ranges from 45 to 80 cm.
The sapwood is 2 to 3 cm thick and not well defined from the heartwood when freshly cut.

Preservation of the logs

Copaiba logs can be attacked by fungi.
Since sapwood and heartwood are susceptible to insect attacks, the logs should be removed from felling sites rapidly and should be treated if the logs are not sawn or peeled immediately.

Ability to float

Because Copaiba green logs' density is lower than 1, they can be floated out of logging sites.

DESCRIPTION OF THE WOOD

The wood is pink to brown-red, sometimes with coppery veins. The oblique slash often shows easily visible, yet little abundant, resin exudations.
Growth rings are easily visible.
The texture is medium to coarse.
The grain is generally straight, sometimes wavy or interlocked.
When freshly cut, the wood does not have any particular smell.
With a magnifying glass (x15), the following can be observed:

- less than 5 per mm^2 (2 to 4) vessels, of medium size (140 to 170µ);
- parenchyma of two kinds: either lozenge or terminal tangential bands, 6 to 14 cells wide, including a line of resin canals of 70 to 100µ in diameter;
- 2-up to 3- seriate rays, 5 to 6 per mm, of homogeneous structure.

TECHNICAL PROPERTIES

Copaiba is a very light to light weight, very soft to soft wood with small tangential and radial shrinkage. Its volumetric shrinkage is moderate.
Its strength properties are poor.

Principal physical and mechanical properties

N.B.: the values given below and preceded by an asterisk correspond to a 12 % wood moisture content (French Standard NF B 51-002).

Density

- **Air dry*** : 450 to 540 kg/m^3 (average 500 kg/m^3)
- **Green** : 900 to 1,000 kg/m^3
- **Basic density** : 0.42

Hardness (Chalais - Meudon scale)* : 1.6 (very soft to soft)

Saturation point : 27 %

Total volumetric shrinkage: 9.6 %

Total tangential shrinkage: 5.9 %

Total radial shrinkage: 3.1 %

Sensitivity to variations in air humidity: moderate to very important

Movement in use: fairly stable to stable

Volumetric shrinkage for 1 % variation in moisture content: 0.41 %

Splitting strength* : 12.1 × 10^3 N/m (12.4 kg/cm)

Compression strength* : 37 MPa (382 kg/cm^2)

Bending strength* : 74 MPa (754 kg/cm^2)

Modulus elasticity in bending* : 9,068 MPa (92,500 kg/cm^2)

Shock resistance* : 0.25 kg/cm^2 (poor).

DURABILITY AND IMPREGNABILITY

Note : the properties given below are those of the heartwood. The sapwood must always be considered as having lower resistance to insects and fungi than the heartwood.

Natural resistance to fungi
Copaiba *(Copaifera multijuga)* has a very poor resistance to white rot fungi *(Coriolus versicolor, Pycnoporus sanguineus, Lentinus squarrosulus)* and brown rot fungi *(Antrodia sp.)*. The wood has a low natural durability.

Natural resistance to Lyctus
This wood is liable to insect attacks.

Natural resistance to termites
Resistance to termites *Reticulitermes santonensis* is very poor.

Impregnability
Copaiba wood impregnates poorly.

CHEMICAL PROPERTIES

Chemical composition of the wood
Copaiba is characterized by :

- a high content in extractive substances (extractives with benzene-alcohol : 6.3 % - extractives with water : 8.5 %),
- a high content in hemicelluloses (19 %),
- a low content in lignin (23 %),
- a relatively low content in cellulose (40 %) compared to the average tropical wood content.

PROCESSING

Sawing
Copaiba saws without any particular problems and does not require any powerful equipment.
Sawn timber may present woolly surfaces. It is thus advisable to keep cutters sharp.
The wood has a blunting effect on tools (silica content < 0.05 %).
Yields are usually good.

Slicing and peeling
Copaiba slices and peels easily. It is commonly used locally for the production of plywood.

Drying

Air drying
Copaiba air dries rapidly and without any noteworthy distortion.

Kiln drying
As an indication, for 41 mm thick wood, 7 days were needed to lower the moisture content of wood from 40 % to 18 % following the kiln schedule below.

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
40	42	40	87
30	46	42	77
24	52	46	69
18	52	46	69

At the end of this drying process, no wood distortion was observed. On a few pieces, the splits prior to drying were shown to have opened.

Conclusion : Copaiba dries easily and quickly. The risks of the occurrence of defects are minor.

Fastening
Copaiba nails and screws with no problems. Tests however demonstrated that nails do not hold well.

Gluing
Copaiba glues without trouble with the glues in current industrial use. For this purpose, dry wood (about 16 % m.c.) with low content of resin should be used.

Machining
This wood works easily, but may sometimes give woolly surfaces. It is thus advisable to keep cutters sharp.

Finishing
Copaiba sands easily. Paint, varnish and wood finish can be applied with no trouble.

Copaiba

CONCLUSIONS AND USES

Copaiba has relatively poor strength properties, low natural durability; it does not impregnate easily, dries easily and quickly and works easily.
It is used extensively on local markets for the production of plywood. The best sawn pieces can be used for interior joinery.

Copaiba can be stained easily. Thus, it is appreciated for furniture. Because of its light weight, Copaiba suits many indoor purposes. It is suitable for instance for the production of:

- panelling
- moulding
- instalment units
- light constructional work.

The second and third grade pieces can be used for packaging and formwork purposes.

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NEW MARKETABLE SPECIES IN SOUTH AMERICA

Guariuba

DENOMINATIONS

BOTANICAL NAME

- *Clarisia racemosa* Ruiz and Pav. (Moraceae family)

COMMERCIAL NAMES

International name ..... GUARIUBA

- Bolivia ..... : Murure
- Brazil ..... : Guariuba (Amazonas)
  Oiticica (south of Bahia, north of Espirito Santo)
  Tatajuba amarela (Pará)
- Colombia .... : Moral, Aji, Guariuba
- Ecuador ..... : Pituca, Matapalo
- Peru ..... : Capinuri, Murere

Guariuba

ORIGIN AND SUPPLY

Geographical distribution

Guariuba occurs all over the north of South America (Venezuela -Colombia - Bolivia - Brazil - Peru - Ecuador). In Brazil, it is found in the forests of the coastal region (Mata atlantica) as well as in Pará and Amazonas states. However, in the Amazonas state, it is apparently more abundant than in the Pará region.

Guariuba grows on well-drained soils and mainly on plateaux. It is a « terra firma » (area not subject to flooding) tree.

Frequency in the forest

In the forest, Guariuba frequency is generally low.

According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 0.1 to 0.5 m^3/ha.

Supply

Guariuba is well rated locally, its trading is small though not negligible.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree

Guariuba is a large tree reaching 40 m. The length of its bole varies from 15 to 20 m. Its trunk is generally well cylindrical and devoid of buttresses. Poles vary from 50 to 80 cm in diameter. The bark, about 1 cm thick, is smooth, thin and of a greyish or reddish colour. When it is slashed, white latex exudes from it.

Conformation of the logs

Guariuba logs are usually well cylindrical, of good form and devoid of important defects. When green, the sapwood is well defined.

Preservation of the logs

If the logs have to stay in the forest for several months after felling, the sapwood may be damaged (blue staining - pinhole borers).

The logs should thus be removed from the forest within reasonable time limits, and should, if necessary, be given preservative treatment if the logs are to be exported.

Ability to float

Guariuba green logs density is greater than 1, so the logs cannot be floated out of logging sites, except if they are associated with floatable lumber on the rafts.

DESCRIPTION OF THE WOOD

The wood, whose sapwood is defined, 2 to 5 cm thick and light yellow, has a relatively bright yellow heartwood which changes to a more or less dark brown on exposure to light. Parenchyma bands design light leafy patterns on flat-cut surfaces, lines on quarter-cut surfaces. On quartered surfaces, light fleck may be seen.

The grain is generally straight, sometimes with areas of interlocked grain of various importance. The texture is medium. The wood surface has a lustrous appearance. Guariuba does not have any characteristic smell when dry.

With a magnifying glass (× 15), the following can be observed:

- Large (about 200 µ) vessels, less than 5 per mm^2, often blocked by white and/or orange deposits.
- Abundant parenchyma, usually tangential, sometimes rather paratracheal aliform and largely confluent. Thinner bands can be interpreted as terminal bands. The arrangement of the parenchyma permits to distinguish easily between this wood and Tatajuba *(Bagassa spp.)* whose parenchyma is paratracheal and vasicentric.
- 4-up to 6-seriate rays, 4 to 5 per mm.

TECHNICAL PROPERTIES

Guariuba is a moderately heavy and moderately hard wood, with small to moderate shrinkage. Its strength properties are medium.

Its main physical and mechanical properties are given below.

Principal physical and mechanical properties

N.B.: the values given below and preceded by an asterisk correspond to a 12% wood moisture content (French standard NF B 51-002).

Density

- **Air dry *:** 620 to 770 kg/m^3 (average: 690 kg/m^3)
- **Green:** greater than 1,000 kg/m^3
- **Basic density:** 0.59

Hardness (Chalais-Meudon scale)* : 4.6 (fairly hard)

Saturation point : 22%

Total volumetric shrinkage: 10.5%

Total tangential shrinkage: 6.5%

Total radial shrinkage: 3.1%

Sensitivity to variations in air humidity: not very important

Movement in use: fairly stable

Volumetric shrinkage for 1% variation in moisture content: 0.52%

Splitting strength *: 11 x 10^3 N/m (11.2 kg/cm)

Compression strength *: 68 MPa (692 kg/cm^2)

Bending strength *: 147 MPa (1,495 kg/cm^2)

Modulus of elasticity in bending *: 13,700 MPa (140,000 kg/cm^2)

Shock resistance *: 0.41 kg/cm^2 (poor).

DURABILITY AND IMPREGNABILITY

Note: the properties given below are those of the heartwood. The sapwood must always be considered as having lower resistance to insects and fungi than the heartwood.

Natural resistance to fungi

The mycological tests carried out in laboratory showed that the wood presented:

- very good resistance to *Coriolus versicolor, Pycnoporus sanguineus, Lenzites trabea* and *Antrodia sp.* ;
- relatively low resistance to *Lentinus squarrosulus.*

In view of these results, Guariuba can then be considered not very durable.

Natural resistance to Lyctus
Guariuba is not susceptible to insect attacks.

Natural resistance to termites
Tests carried on Guariuba samples proved that this wood showed good resistance to termites *(Reticulitermes santonensis).*

Impregnability
Guariuba impregnates poorly.

CHEMICAL PROPERTIES

Chemical composition of the wood
Guariuba is abundant in extractives (extractives with benzene-alcohol: 8% - extractives with water: 3 %).
However, some variability was noted from one tree to another.
This species contains relatively few mineral ashes (about 1.4%), but the silica content in the latter is high.
The contents of the other components (cellulose: 45% - hemicelluloses : 17% - lignin : 30 %) are the average tropical wood contents.

ENERGY PROPERTIES

Wood heat value
Guariuba heat value, determined on ovendry wood, is 20.5 MJ/kg (4,900 kcal/kg).

Carbonization
In laboratory, with a 36% yield, charcoal with 31.5 MJ/kg (7,500 kcal/kg) heat value was obtained.
This very lightweight charcoal (density: 0.34) has relatively many mineral ashes (7%), is poor in volatile substances (7%). It is moderately friable and does not take up moisture again easily.
Pyroligneous liquids produced represent 37% (in weight) of the initial wood and contain 34% tars.
The pyrolysis of one ton of ovendry wood also gives 170 m^3 of gas with heat value greater than 13.1 MJ/m^3 (about 3,300 $kcal/m^3$).

PROCESSING

Sawing
The measurements of the silica content, performed on 4 samples, gave values ranging from 0.2% to 1%. Guariuba should then be considered in all cases as a siliceous, thus blunting, wood.
As all siliceous woods, Guariuba will have to be sawn as soon as possible after felling and will require the use of stellited saws.

Slicing and peeling
This species peels and slices without any difficulty.
The logs must be steamed at a temperature of about 65 °C.
Drying veneers is moderately easy (small to moderate tangential shrinkage - relatively little risk of splitting).
Veneers can be glued with urea formaldehyde or phenol formaldehyde glues satisfactorily. Recommended gluing pressure for the production of plywood ranges from 1.2 to 1.6 MPa.

Drying

Air drying
Guariuba dries rapidly, without any problems or any important risk of distortion.

Kiln drying
As an indication, for 41 mm thick wood, 21 days were needed to lower the moisture content of wood from 90% to 17% following the kiln schedule below.

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
green	42	41	94
50	48	43	75
30	54	46	65
20	60	51	63
15	60	51	63

At the end of this drying process, the following observations could be made:
For back-sawn woods, very little distortion and a moisture gradient between the boards' peripheral areas and pith lower than 2%.
For quarter-sawn woods, sometimes important end-splitting and a moisture gradient between the boards' peripheral areas and pith of about 10%.
To avoid the defects noticed on the quarter-sawn pieces, drying should thus be carried out carefully, by increasing the humidity rates listed above by about 5% and by adjusting the drying conditions in relation to quarter-sawn samples.

Fastening
Guariuba can be nailed and screwed with no trouble.

Gluing
Tests carried out with resorcinol type resin show that:
- resistance to shearing in glue joints is comparable to that of solid wood;
- adherence is medium to good;
- holding length time of glue joints is good (delamination test).

In view of these results, one can consider that Guariuba glues well and can be used for glued-laminated purposes.

Machining
Because of the high silica content, carbide edged tools should be used for machining and the cutters should be kept sharp, if a smooth surface is to be obtained for woods with interlocked grain.

Finishing
The wood sands easily.
Varnish and paint are held well and a good quality finish is obtained.

CONCLUSIONS AND USES

Guariuba is a stable wood with attractive properties; it can be used for numerous purposes.
Because of the silica content in this wood, adequate equipment (with stellite or carbide tipping) will be required. Drying will also call for some precautions to avoid the development of splitting at the end of the cycle.
However these constraints do not limit the use of Guariuba which can suit many purposes.
First grade logs (with small amounts of interlocked grain) can be used for the production of:

- decorative veneer
- plywood
- furniture
- interior joinery
- flooring
- panelling.

Second grade logs can be used for:

- constructional work
- industrial flooring
- wagon bottoms
- wood construction.

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NEW MARKETABLE SPECIES IN SOUTH AMERICA

DENOMINATIONS

BOTANICAL NAME

- *Calophyllum brasiliense* Camb. (Clusiaceae family)

COMMERCIAL NAMES

International name ..... JACAREUBA

- Argentina ..... : Jacareuba
- Brazil ..... : Jacareuba, Cachicamo, Guanandi, Cedro do Pantano
- Central America ..... : Galba, Palo Maria, Barillo, Santa Maria
- Colombia ..... : Aceite Maria, Aceite
- Cuba..... : Ocuje
- Ecuador ..... : Maria, Bella Maria
- Guyana ..... : Kurahara
- Peru..... : Jacareuba, Lagarto caspi, Alfaro
- Surinam ..... : Kurahara, Koerli, Lorahara
- Venezuela..... : Palo Maria

Jacareuba

ORIGIN AND SUPPLY

Geographical distribution
Jacareuba occurs in Mexico and throughout tropical South America. It is also found in the West Indies and the Caribbeans. It grows on all types of soil, often in association with Mahogany and Cedro.

Frequency in the forest
According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 0.20 to 2.10 m^3/ha.

Supply
Jacareuba is very well known and famous in South America, but it has not been exported widely up to now. Considering its frequency in the principal producing areas, this species could be exported more in the future either as logs, sawnwood or as processed or semi-processed goods.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree
Jacareuba is a large tree (30 to 50 m). Its bole, generally devoid of buttresses, is 15 to 25 m long.
The colour of the bark changes; it becomes greenish yellow and fissured in old trees. When it is slashed, it exudes a yellow gum.

Conformation of the logs
The logs are generally of good form, straight and cylindrical. Their diameter can reach 1.8 m.
The sapwood is 4 to 6 cm thick and cannot always be distinguished from the heartwood because it is not clearly demarcated.

Preservation of the logs
If Jacareuba logs stay in the forest for several months, the sapwood can be attacked by fungi and insects. However, as a rule and provided logging conditions are normal, a preservative treatment of the logs is not required.

Ability to float
Because Jacareuba green logs' density is lower than 1, the logs can be floated out of logging sites.

DESCRIPTION OF THE WOOD

The sapwood is pinkish white; the heartwood is pink-brown, with thin dark red parenchyma lines.
The grain is generally wavy, with frequent and often well developed interlocking.
The texture is medium.
The wood does not have any specific smell.
With a magnifying glass (× 15), the following can be observed:
- Nearly all solitary vessels, less than 10 per mm^2 (5 to 8), of medium size (150 - 180 µ); some vessels are smaller (50 to 80 µ) and are scattered among the others.
- Tangential parenchyma, continuous at the boundaries of growth rings, and often incompletely vasicentric.
- Seriate rays, about 7 to 10 per mm, of subhomogeneous structure.

TECHNICAL PROPERTIES

Jacareuba is lightweight to moderately heavy, soft to moderately hard, with moderate tangential and radial shrinkage. Its volumetric shrinkage is moderate to high.
Its strength properties are medium.

Principal physical and mechanical properties
N.B. : the values given here in after and preceded by an asterisk correspond to a 12 % wood moisture content (French Standard NF B 51-002).

Density
- **Air dry* :** 630 kg/m^3
- **Green :** 800 to 900 kg/m^3
- **Basic density :** 0.52

Hardness (Chalais-Meudon scale)* : 3.1 (soft to fairly hard)

Saturation point : 29%

Total volumetric shrinkage : 13.3%

Total tangential shrinkage : 7.7%

Total radial shrinkage : 5.0%

Sensitivity to variations in air humidity : not very to fairly important

Movement in use : fairly stable (after drying)

Volumetric shrinkage for 1% variation in moisture content : 0.54%

Splitting strength * : 14.2 × 10^3 N/m (14.5 kg/cm)

Compression strength * : 58 MPa (590 kg/cm^2)

Bending strength * : 111 MPa (1,137 kg/cm^2)

Modulus of elasticity in bending * : 12,300 MPa (126,000 kg/cm^2)

Shock resistance * : 0.57 kg/cm^2 (moderate)

DURABILITY AND IMPREGNABILITY

Note : the properties given below are those of the heartwood. The sapwood must always be considered as having lower resistance to insects and fungi than the heartwood.

Natural resistance to fungi
Jacareuba has a good resistance against white and brown rot fungi.

Natural resistance to Lyctus
Jacareuba heartwood is not susceptible to Lyctus attacks.

Natural resistance to termites
The wood resistance to termites *(Reticulitermes santonensis)* is poor to medium.

Impregnability
Jacareuba impregnates poorly.

CHEMICAL PROPERTIES

Chemical composition of the wood
Jacareuba is characterized by:
- a high content in polymeric substances (cellulose: 46.8% - lignin: 33.5%) ;

• a low content in extractive substances (extractives with benzene-alcohol: 2.1%; extractives with water: 1.9%.
This species is barely siliceous (0.01 %).
The contents of the other chemical components are the average tropical wood contents (ashes: 0.9 %, hemicelluloses: 13.3 %).

PROCESSING

Sawing
Jacareuba saws rather easily and does not require the use of any powerful equipment. Sometimes, the presence of resin in the wood can cause problems.

Slicing and peeling
Jacareuba is particularly attractive for peeling and slicing. The logs should be steamed carefully (recommended length of time: 72 hours) to avoid any risk of splitting on veneers.
During peeling and slicing, the resin contained in the wood may sometimes cause a build up on the saws.

Drying
Air drying
Air drying should be performed in protected conditions and all the usual necessary precautions for wood liable to distortion should be taken:
• loading the wood to minimize the risk of distortion of the pieces located on top of the stacks;
• applying products to fill end splits of sawn pieces.

Kiln drying
As Jacareuba controlled drying is a delicate operation which requires many precautions, it can only be used for wood with hardly any interlocking grain.
Under these conditions for sawnwood with thicknesses ranging from 27 to 54 mm, the following kiln schedule is suggested:

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
green	42	39	82
50	48	43	74
40	48	43	74
30	48	43	74
25	54	46	65
15	54	46	65

Conclusion : because of irregular grain or interlocking, Jacareuba sawn pieces tend to distort on drying. The move of moisture from the pith towards the outside is very slow, which favours case-hardening.
To limit the occurrence of defects, it is advisable to produce quarter-sawn stock and give it an initial period of air drying.

Fastening
Nails and screws penetrate rather easily and hold well. In some instances, however, pre-boring could be needed.

Gluing
Jacareuba glues well with all types of glue in current industrial use.

Machining
Jacareuba machines with difficulty because of its marked interlocked grain. As for all similar types of wood, the cutters should be kept sharp and at a 15° cutting angle.

Finishing
Jacareuba sands easily, but the possible presence of resin can cause a build-up on the pads. Paint, varnish and wood finish can be applied without any problems. For very delicate uses, the grain should be filled first.

CONCLUSIONS AND USES

Jacareuba is an attractive wood for its appearance, good strength properties, good natural durability and frequency in the forest and despite its defects on drying.

On account of its sometimes important interlocked grain and the possible occurrence of distortion on drying, this species should essentially be used for peeling and slicing. Jacareuba peeled veneers make plywood valued in South America for their appearance and strength properties.

In the same way, veneers sliced on quartered surfaces are well rated and valued for their ribboned appearance.

Jacareuba sawnwood is suitable for a wide range of local purposes which do not require first grade wood (e.g. structural use, wood construction, exterior joinery, decking, coach work, packing cases, etc.).

If exported, Jacareuba sawn logs will have to be given particular care; they will have to be dried to a moisture content of about 20% and be graded, so that only first grade wood is exported.

First grade sawnwood with small interlocked grain is suitable for the production of:

- shingles
- interior joinery
- decking
- structural work
- barrels.

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NEW MARKETABLE SPECIES IN SOUTH AMERICA

DENOMINATIONS

BOTANICAL NAMES

- *Hymenaea courbaril* L. (Cesalpiniaceae family)
- *Hymenaea intermedia* Ducke
- *Hymenaea parvifolia* Huber
- *Hymenaea oblongifolia* Huber

Note: in the trade, different species of the genus Hymenaea are often mixed up and sold under the single name of "JATOBA". However, in some regions, the name of JUTAI is usually reserved for Hymenaea intermedia and Hymenaea parvifolia.

COMMERCIAL NAMES

International name ..... JATOBA

- Brazil..... : Jutai, Jatoba, Jutai mirim
- Central America : Courbaril, Algarrobo, Guapinol
- Colombia ..... : Algarrobo
- French Guiana .. : Courbaril
- Peru..... : Azucar - Huayo
- Surinam ..... : Rode Locust
- Venezuela..... : Algarrobo
- West Indies ..... : Copalier

Jatoba

ORIGIN AND SUPPLY

Geographical distribution
Jatoba occurs widely, from Mexico to southern Brazil and northern Argentina. *Hymenaea intermedia, Hymenaea oblongifolia* and *Hymenaea parvifolia* are mainly found in the Amazonian basin. They are trees of "terra firma" (non flooded areas) and grow best on clay soils.
Hymenaea courbaril is more frequently found at the edges of forest areas and alongside rivers. It grows best on well-drained sandy soils.

Frequency in the forest
According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 0.15 to 0.30 m^3/ha.

Supply
This wood is used locally for various purposes, and its exports are getting more important. It was already valued and exported from the West Indies and the Caribbean in the XVIII century.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree
Jatoba is a large tree which can reach 30 to 40 m.
Its trunk is cylindrical, without buttresses.
In the forest, it is easy to distinguish between *Hymenaea intermedia* and *Hymenaea parvifolia* on the one hand and *Hymenaea courbaril* on the other, on account of the following characteristics:
- *Hymenaea courbaril:* smooth light brown bark containing translucent orange gum;
- *Hymenaea intermedia* and *Hymenaea parvifolia*: rough bark, thicker than that of Courbaril.

Conformation of the logs
Jatoba logs are generally very well shaped. Their diameter varies from 50 to 80 cm. The bole length is 18 to 25 m.
The sapwood is well defined from the heartwood and its width is:
- 3 to 6 cm for *Hymenaea intermedia* and *Hymenaea parvifolia*;
- 6 to 12 cm for *Hymenaea courbaril.*

Preservation of the logs
Jatoba sapwood can be attacked by insects and fungi. The heartwood generally has a very good durability.
After felling and if the logs have to stay in the forest for some time, a fungicidal and insecticidal treatment is not compulsory. On the other hand, the logs should be stored away from the rays of the sun to avoid any risk of end-splitting.

Ability to float
Jatoba green logs' density is greater than 1, so the logs cannot be floated out of logging sites, unless they are supported with floater logs in the rafts.

DESCRIPTION OF THE WOOD

The sapwood is white to cream-white. The heartwood can vary from light brown to purplish brown or orange-brown or also brown-red according to origins and species.
Growth rings are often clearly visible and give a decorative appearance on flat-sawn surfaces. The texture is fine to medium. The grain is generally straight. Interlocking is hardly present.
When green, *Hymenaea courbaril* has an unpleasant smell which vanishes on drying.
With a magnifying glass (× 15), the following can be observed:
- large (150 to 230 µ), not numerous (2 or 3 per mm^2) vessels, sometimes blocked by whitish deposits;
- parenchyma of two kinds:
  - lozenge and not frequently confluent parenchyma,
  - frequently thin terminal lines at the boundaries of growth rings;
- 3-up to 5- seriate relatively wide rays, 4 to 7 per mm, of subhomogeneous structure.

Tangential lines of traumatic canals, included in parenchyma bands, can be found sporadically.

TECHNICAL PROPERTIES

Jatoba woods are heavy *(Hymenaea courbaril)* to very heavy *(Hymenaea intermedia, Hymenaea parvifolia),* hard to very hard with small *(Hymenaea courbaril)* to moderate *(Hymenaea intermedia, Hymenaea parvifolia)* tangential and radial shrinkage. Their volumetric shrinkage is moderate *(Hymenaea courbaril)* to high *(Hymenaea intermedia, Hymenaea parvifolia).* Their strength properties are high.

Principal physical and mechanical properties
N.B.: the opposite values preceded by an asterisk correspond to a 12 % wood moisture content (French Standard NF B 51-002).

DURABILITY AND IMPREGNABILITY

Note: the properties given below are those of the heartwood. The sapwood must always be considered as having lower resistance to insects and fungi than the heartwood.

Natural resistance to fungi
The tests carried out on these various species show that the *parvifolia* species has a very good natural resistance to wood-boring fungi. The *intermedia* species is, on the other hand, somewhat more prone to fungal attacks.
Hymenaea courbaril is moderately resistant.
The wood can be used without preservative treatment for purposes in unfavourable weather conditions or for exterior joinery.
On the other hand, the use of the wood in direct contact with the

	Hymenaea courbaril		*Hymenaea intermedia Hymenaea parvifolia*
Density:			
• **Dry air***	780 to 1,090 kg/m³ (average: 880 kg/m³)		1,010 to 1,100 kg/m³ (average: 1,070 kg/m³)
• **Green**	1,100 kg/m³		1,200 kg/m³
• **Basic density**	0.69		0.91
Hardness (Chalais-Meudon scale)*	8.4 (hard to very hard)		15.2 (very hard)
Saturation point	21 %		21 %
Total volumetric shrinkage	10.5 %	to	12.6 %
Total tangential shrinkage	7.0 %	to	7.5 %
Total radial shrinkage	3.4 %	to	4.6 %
Sensitivity to variations in air humidity	not very important		moderately important
Movement in use	fairly stable		
Volumetric shrinkage for 1 % variation in moisture content	0.53 %	to	0.69 %
Average splitting strength*	19.3 x 10³ N/m (19.7 kg/cm)	to	23.0 x 10³ N/m (23.5 kg/cm)
Average compression strength*	84 MPa (859 kg/cm²)	to	107 MPa (1,088 kg/cm²)
Average bending strength*	170 MPa (1,733 kg/cm²)	to	221 MPa (2,252 kg/cm²)
Modulus of elasticity in bending*	17,900 MPa (183,000 kg/cm²)	to	22,370 MPa (228,000 kg/cm²)
Shock resistance*	0.70 kg/cm²	to	0.77 kg/cm² (moderate)

ground or in permanent wet conditions is not advisable.

Natural resistance to Lyctus
Jatoba is not attacked by Lyctus (dry wood insects).

Natural resistance to termites
The wood's resistance to termites *(Reticulitermes santonensis)* is good to very good according to species.

Impregnability
Jatoba impregnates very poorly.

Carbonization
Carbonization performed at 500 °C in laboratory retort, with a 32.2 % yield, produced charcoal having the following properties:
- Ash ratio: 2.5 %
- Volatile substance index: 6.3 %
- Friability: 18.0 %
- Moisture uptake: 5.7 %
- Heat value: 33.3 MJ/kg.

One kg of carbonized ovendry wood also gave:
- 0.4 l pyroligneous liquid containing 22 % tar.

ENERGY PROPERTIES

Wood heat value
The heat value of *Hymenaea courbaril* ovendry wood is about 20 MJ/kg.

PROCESSING

Sawing
Jatoba saws without trouble provided powerful equipment is used, on account of the wood hardness and the log diameter. Stellited saws are not needed; however if Jatoba logs are to be sawn in great quantities, they are advisable. The wood silica content is negligible ($c < 0.05$ %).

Slicing and peeling
Jatoba is excellent for slicing and can give very beautiful decorative veneers. Because it is very hard, it is not suitable for peeling.

Drying

Air drying
The wood air dries fairly quickly. As an indication, 27 mm thick Courbaril sawnwood went from a 61 % initial moisture content to a 18 % final moisture content in 51 days. However, because of the nature of the wood, it should be dried away from the rays of the sun and in barely ventilated sheds to avoid any risk of radial splitting.

Kiln drying
As an indication, in a conventional kiln, for 41 mm thick planks, the moisture content went from 36 % to 15 % in a month following the schedule below.
This drying experiment as well as other experiments carried out with similar schedules show that, on drying, high density Jatoba can sometimes develop an important radial split in the hearts of the planks. The other defects that may occur (checking, distortion, etc.) are quite limited.

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
40	40	40	100
30	40	38	80
20	46	40	70
15	54	46	60

Jatoba

Hymenaea courbaril, of lower density, dries more quickly than the other species.
As an indication, in trials in a conventional kiln, the moisture content of *Hymenaea courbaril* (41 mm thick) sawnwood went from 40 % to 16 % with the following schedule:

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
green	40	38	87
50	44	40	78
40	48	42	70
30	52	43	60
20	56	44	50
15	60	44	40

Conclusion: Jatoba, which is particularly dense and hard, seems to dry relatively easily compared to the other woods from the same category. However, more precautions should be taken with Jatoba woods having a high density and whenever possible, the woods should be dried after an initial period of air drying to avoid any risk of end splitting.

Fastening
Nails and screws hold well; preboring is needed because of the wood hardness.

Gluing
Gluing tests carried out with resorcinol glue show that:
- resistance to shearing in glue joints compared to that in solid wood is about 25 % lower,
- adherence is low,
- resistance to weathering of glue joints is limited (delamination test).

On account of these results, the use of Jatoba for exterior purposes (eg. glued-laminated structural work) is not advisable. On the other hand, it is suitable for any glued interior purposes provided variations in humidity are small and the wood is not subjected to considerable loads.

Finishing
Jatoba sands and varnishes without any problems; it has a decorative appearance which is highly valued for its colour.

CONCLUSIONS AND USES

Jatoba is a very heavy wood (density close to or greater than 1) with high strength properties.
Its natural durability is also important.
Compared with woods with similar properties, it dries well and is stable in use.
Jatoba has an attractive appearance and its numerous qualities make it suitable for top quality as for construction wood.
It is suited for:
- cabinet work
- exterior and top quality joinery
- flooring
- solid structural work, heavy construction
- decking
- slicing.

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NEW MARKETABLE SPECIES IN SOUTH AMERICA

Marupa

DENOMINATIONS

BOTANICAL NAME

- *Simarouba amara* Aubl. (Simaroubaceae family)

COMMERCIAL NAMES

International name ..... MARUPA

- Bolivia..... : Chiriuana
- Brazil..... : Marupa, Parahyba, Tamanqueira
- Central America.... : Aceituno, Olivo Megrito, Xpasak
- Colombia ..... : Marupa, Simaruba
- Ecuador ..... : Cedro amargo
- French Guiana ..... : Simarouba, Acajou blanc
- Guyana ..... : Simarupa
- Peru..... : Marupa
- Surinam ..... : Soemaroeba
- Venezuela : Cedro blanco, Simarouba

Marupa

ORIGIN AND SUPPLY

Geographical distribution
Marupa occurs in Central America (Mexico) and throughout tropical South America.
In the West Indies, it is found on well-drained heights. Marupa grows best on sandy soils.

Frequency in the forest
According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 0.3 to 1.6 m^3/ha.

Supply
This species is used locally and is nowadays regularly harvested in the Amazonian basin. Its exports are still limited however, but could develop in the future. Indeed, French Guiana, Guyana and Surinam possess enough potential supply to meet future increasing demand.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree
Marupa is a large tree reaching 45 m. Its bole, with no buttresses, is 15 to 30 m long.
The bark is 1 to 2 cm thick, and smooth; it is beige to greyish brown on young trees and cracked on old trees. The slash of the bark gives off a bitter smell.

Conformation of the logs
The logs are of good form, straight and cylindrical, but may taper off markedly. The diameter of logs varies from 0.60 to 0.90 m.
The sapwood is not defined from the heartwood.

Preservation of the logs
Marupa logs could resist to insect attacks well because of the bitter substances contained in the bark, but they can be attacked by fungi. They will have to be removed from felling sites quickly. If the logs are not processed rapidly after felling, they will require the application of fungicidal treatment in the forest and possibly on the log yard too.

Ability to float
Because Marupa green logs' density is lower than 1, they can be floated out of logging sites.

DESCRIPTION OF THE WOOD

Marupa is cream-coloured with occasional yellow or greyish traces. It has a uniform colour after drying.
The grain is generally straight and regular.
The texture is moderately coarse to coarse.
With a magnifying glass (× 15), the following can be observed:
- rare (1 to 3 per mm^2), large (200 to 280 µ), solitary or radial multiple (in 2-3) vessels;
- two forms of parenchyma:
  - paratracheal, long aliform and confluent parenchyma forming more or less continuous wavy bands;
  - sporadically in terminal lines sometimes including a band of vertical resin canals;
- storeyed, sometimes only echeloning, 3-up to 5-seriate rays, 4 to 6 per mm, of homogeneous or subhomogeneous structure.

TECHNICAL PROPERTIES

Marupa is very lightweight, very soft, with small to moderate tangential and radial shrinkage. Its volumetric shrinkage is moderate. Its strength properties are poor.

Principal physical and mechanical properties
N.B.: the values given below and preceded by an asterisk correspond to a 12 % wood moisture content (French Standard NF B 51-002).

Density
- **Air dry*:** 350 to 480 kg/m^3 (average 420 kg/m^3)
- **Green:** 600 to 700 kg/m^3
- **Basic density:** 0.35

Hardness (Chalais-Meudon scale)*: 1.1 (very soft)
Saturation point: 34 %
Total volumetric shrinkage: 9.9 %
Total tangential shrinkage: 6.5 %
Total radial shrinkage: 2.9 %
Sensitivity to variations in air humidity: moderately important
Movement in use: stable
Volumetric shrinkage for 1 % variation in moisture content: 0.36 %
Splitting strength*: 8.7 x 10^3 N/m (8.8 kg/cm)
Compression strength*: 36 MPa (367 kg/cm^2)
Bending strength*: 68 MPa (698 kg/cm^2)
Modulus of elasticity in bending*: 8,400 MPa (86,000 kg/cm^2)
Shock resistance*: 0.16 kg/cm^2 (poor).

DURABILITY AND IMPREGNABILITY

Note: the properties given below are those of the heartwood. The sapwood must always be considered as having lower resistance to insects and fungi than the heartwood. It is always susceptible to insect attacks.

Natural resistance to fungi
Marupa has a very poor durability against white rot fungi *(Coriolus versicolor, Pycnoporus sanguineus, Lentinus squarrosulus)* and brown rot fungi *(Antrodia sp.)*.

Natural resistance to Lyctus
Marupa heartwood can be attacked by Lyctus.

Natural resistance to termites
The wood durability against termites *(Reticulitermes santonensis)* is poor.

Impregnability
Marupa impregnates well.

CHEMICAL PROPERTIES

Chemical composition of the wood

This species is relatively poor in hemicelluloses (12.5 %) and abundant in cellulose (51.4 %).
It gives relatively few mineral ashes (0.4 %) and its silica content is negligible (0.01 %).
The contents of the other chemical components average the tropical wood contents:
- extractives with benzene-alcohol: 3.4 %
- extractive with water: 2.0 %
- lignin: 31.2 %.

ENERGY PROPERTIES

Wood heat value

The heat value of Marupa ovendry wood is 20 MJ/kg.

Carbonization

Carbonization performed at 500 °C in laboratory retort (with a 32.1 % yield) produced coal having the following properties:
- volatile substance index: 6.3 %
- ash ratio: 2.2 %
- heat value: 34 MJ/kg
- friability: 8.0 %
- moisture uptake: 7.8 %.

One kilo of carbonized ovendry wood gave 0.35 l of pyroligneous liquid containing 18 % tars.

PROCESSING

Sawing

Marupa saws easily. The wood causes no blunting. Its silica content is considered negligible ($c < 0.05$ %). Yields obtained are generally good.

Slicing and peeling

Marupa slices and peels easily because it is not hard and the logs are well formed, but veneers are sometimes fragile. Peeling can be cold-performed or carried out after moderate steaming (about 65 °C).
Veneer drying is relatively quick, bringing no important defects (small risk of splitting).
Veneers glue well with urea formaldehyde or phenol formaldehyde glues.
Recommended gluing pressure for the production of plywood ranges from 0.9 to 1.2 MPa, according to wood density.

Drying

Air drying

Marupa air dries easily and quickly. Before this operation and for very thick sawnwood, the application of fungicidal and insecticidal treatment is recommended.
In some cases, splitting may develop on the stock. It is thus advisable to dry in protected conditions systematically to prevent the development of defects.
In tropical climate, 2 to 3 cm thick Marupa sawn pieces can dry in the open in two or three months.

Kiln drying

Marupa dries relatively rapidly. Drying does not pose any specific problems (little or no distorsion after drying).
The kiln schedule below can be used for drying sawnwood with thicknesses ranging from 27 to 54 mm.

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
green	55	51	80
35	57	51	70
30	60	52	65
20	69	55	50
15	74	56	40

Conclusion: considering its small shrinkage and its straight, regular grain, Marupa timber dries well as a rule. The only precautionary measure to be taken, before drying in the open in protected conditions, should be the application of fungicidal and insecticidal treatment on the wood.

Fastening

Marupa can be nailed and screwed without any trouble. Nail-holding power is fair.

Gluing

Marupa glues well with all types of glue in current industrial use.
It can be used as glued-laminated wood.

Machining

Marupa machines very easily and a smooth finish can be obtained without any problems.
It is well suited for turnery; during the operation, it is advisable to:
- choose a very high rotation speed for the tools;
- keep cutters sharp.

Finishing

The wood sands easily. Paint, varnish and wood finish can be applied without any problems. For very delicate uses, after sanding, the grain should be filled prior to final finishing operations.

CONCLUSIONS AND USES

Considering its frequency in the forest, its easy use, its numerous possible purposes (except those requiring high strength properties), Marupa is nowadays highly rated locally and its commercialization and exports could develop in the future.

Because of its strength properties and good amenability to preservative treatment, Marupa can be used for a wide range of purposes, e.g.:

- mouldings
- light furniture
- panelling
- interior joinery
- musical instruments (piano keys, organ parts)
- toys
- cores of blockboards.

On account of its easy machining Marupa is valued for turnery.

Second choice timber can be used for packing cases and packaging purposes.

Peeled veneers are suitable for the production of plywood (inside and possibly face plies), lightweight packaging and matches.

Marupa can compete with some lightweight species, e.g. Ayous, Poplar or possibly Ramin. As for these species, an insecticidal treatment should be provided for indoor uses, and a fungicidal and insecticidal treatment for outdoor uses.

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NEW MARKETABLE SPECIES IN SOUTH AMERICA

Pará-pará

DENOMINATIONS

BOTANICAL NAME

- *Jacaranda copaia* D. Don (Bignoniaceae family)

COMMERCIAL NAMES

International name ..... PARA-PARA

- Argentina ..... : Caroba, Jacaranda, Tarco
- Bolivia..... : Tinto blanco
- Brazil ..... : Caroba (Amazonas region), Caroba do mato
  Pará-pará (Pará region), Marupa falso
- Central America ..... : Jacaranda, Palo de Buba, Samarapa
- Colombia ..... : Chingale, Pavito
- Ecuador ..... : Arabisco, Kuiship
- French Guiana ..... : Copaya, Bois Pian, Faux Simarouba
- Panama ..... : Gualandai
- Peru..... : Chicharra caspi, Ishtapi
- Surinam ..... : Goebaja, Futi, Foetei
- Venezuela : Gobaja, Gualanday

Pará-pará

ORIGIN AND SUPPLY

Geographical distribution
Pará-pará occurs widely, from Central America to the south of the Amazonian basin (Brazil - Peru - Bolivia). Pará-pará mainly grows on "terra firma" (non-flooded areas). It can grow on poor, even half-lateritic soils.

Frequency in the forest
According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 0.3 to 2 m^3/ha.

Supply
Today, Pará-pará is mainly used locally.
Although this species has attractive properties, its exports are limited. They could increase in the future.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree
In the forest, Pará-pará is a tree of medium height. The length of its bole varies from 12 to 16 m. Its trunk is generally cylindrical. The diameter varies from 50 to 80 cm. The 10 to 15 mm thick bark is yellowish beige.

Conformation of the logs
The logs are in general of good form. Some logs can contain brittleheart. Sapwood is not well defined.

Preservation of the logs
As the logs are highly liable to pin borers and fungal damage, they have to be treated immediately after felling and rapidly removed out of the forest on lorries (floating should be avoided).
The application of the treatment should be repeated when the logs get to the sawmill and at each handling.

Ability to float
Pará-pará logs float as their density when green is lower than 1, but this mode of transportation is not advisable (low durability of the wood). Besides, after a prolonged stay in the water, the logs tend to sink.

DESCRIPTION OF THE WOOD

Pará-pará is a yellowish white or pinkish white wood.
The grain is straight. The texture is medium to coarse. The wood surface, after planing, has a lustrous appearance and a light fleck on quarter-cut surfaces.
The wood has no particular taste, but on the other hand, it has an unpleasant smell when freshly cut.
With a magnifying glass ($\times$ 15), the following can be distinguished:
- large to very large (150 to 250 μ) vessels, less than 5 per mm^2;
- paratracheal parenchyma, with 2 short to long, straight or wavy, sometimes confluent lateral extensions;
- relatively thin rays (2- up to 3-seriate), 5 per mm on average, of homogeneous structure, with no specific arrangement, which permits to distinguish between Pará-pará and Marupa whose rays are storeyed.

TECHNICAL PROPERTIES

Pará-pará is a very light to lightweight wood, with poor strength properties. Tangential and radial shrinkage is moderate. Volumetric shrinkage is high.
Its main physical and mechanical properties are given below.

Principal physical and mechanical properties
N.B.: the values given below and preceded by an asterisk correspond to a 12 % wood moisture content (French Standard NF B 51-002).

Density
- **Air dry*:** 370 to 540 kg/m^3 (average: 430 kg/m^3)
- **Green:** 800 to 900 kg/m^3
- **Basic density:** 0.33

Hardness (Chalais-Meudon scale)*: 1.1 (very soft to soft)

Saturation point: 31 %

Total volumetric shrinkage: 14.6 %

Total tangential shrinkage: 8.5 %

Total radial shrinkage: 5.7 %

Sensitivity to variations in air humidity: very important

Movement in use: moderately stable to unstable

Volumetric shrinkage for 1 % variation in moisture content: 0.56 %

Splitting strength*: 8 x 10^3 N/m (8.2 kg/cm)

Compression strength*: 31 MPa (318 kg/cm^2)

Bending strength*: 60 MPa (612 kg/cm^2)

Modulus of elasticity in bending*: 9,000 MPa (92,000 kg/cm^2)

Shock resistance*: 0.22 kg/cm^2 (poor).

DURABILITY AND IMPREGNABILITY

Note: the properties given below are those of the heartwood. The sapwood must always be considered as having lower resistance to insects and fungi than the heartwood.

Natural resistance to fungi
The mycological tests carried out in laboratory show that the wood presents a very low resistance to all species of fungi *(Pycnoporus sanguineus, Coriolus versicolor, Lenzites trabea,* etc.).
In view of these results, Pará-pará is then to be considered not resistant.

Natural resistance to Lyctus
This wood is particularly susceptible to dry wood insects attacks (Lyctus).

Natural resistance to termites
Pará-pará's natural resistance to termites is poor *(Reticulitermes santonensis).*

Impregnability
This wood treats easily. Preservative products penetrate very well.

CHEMICAL PROPERTIES

Chemical composition of the wood

- Pará-pará contains few extractives (extractives with benzene-alcohol: 1.1 % - extractives with water: 1.4 %);
- the ash ratio (0.7 %) is also low, and so is the silica content;
- hemicelluloses are not abundant (12 % on average);
- lignin content is also lower than the average tropical wood content (27 %).

As a consequence, cellulose content is very high, reaching about 58 %.

ENERGY PROPERTIES

Wood heat value

Pará-pará's heat value, determined on ovendry wood, is 19.7 MJ/kg (4,700 kcal/kg).

Carbonization

Pará-pará charcoal obtained after pyrolysis performed at 500 °C in laboratory retort has the following properties:

- Density: 0.22
- Ash ratio: 2.4 %
- Volatile substances: 7 %
- Relatively non friable coal
- Moderate moisture uptake
- Heat value: 33.5 MJ/kg (8,000 kcal/kg).

Mass yields from the pyrolysis are 30 % for coal, 39 % for the pyroligneous liquid which contains (in weight) 33 % of light tars (density lower than that of the aqueous phase).

One ton of ovendry wood also gives 135 m^3 of gas with heat value greater than 14 MJ/m^3 (3,350 kcal/m^3).

PROCESSING

Sawing

The presence of more or less important internal stress in the wood can be noted on sawing provoking the shattering of planks (through-and-through sawing). The surface of the boards or boules is often woolly.
It is advisable to keep the saws well sharpened and saw around the logs to minimize the risk of splitting caused by internal stress.
The silica content in the wood is negligible.

Slicing and peeling

Pará-pará can be sliced and peeled without any prior steaming.
Veneers are of good quality.
Drying is moderately easy (moderate to high tangential shrinkage-relatively high risk of splitting).
Veneers can be glued satisfactorily with urea formaldehyde or phenol formoldehyde glues.
Gluing pressure for the production of plywood ranges from 0.9 to 1.2 MPa, according to density.

Drying

Air drying

Pará-pará dries rapidly, without any high risk of distorsion. Pieces of wood thicker than 50 mm should be treated before drying, to avoid any risk of blue staining.

Kiln drying

As an indication, for 41 mm thick wood, 10 days were needed to lower the moisture content of wood from 30 % to 9 % following the kiln schedule mentioned below.

At the end of this drying process, no drying defects were observed. Moisture in the pieces of wood was evenly distributed (moisture gradient between the core and the periphery lower than 1 %).

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
30	42	41	94
20	42	39	82
15	48	43	74
10	54	46	65

Conclusion : Pará-pará dries quickly and easily. In practice, higher temperatures than those mentioned above could be used.

Fastening

Pará-pará can be nailed and screwed with no trouble; on the other hand, nail and screw-holding power is poor.

Gluing

Tests carried out with resorcinol type resin show that:

- resistance to shearing in glue joints is good, even slightly greater than that of solid wood;
- adherence is medium;
- holding length time of glue joints is good (delamination test).

In view of these results, one can consider that Pará-pará glues well and can be used for glued-laminated purposes.

Machining

Pará-pará works without any problems. However, the cutters have to be kept sharp to avoid woolly surfaces.

Finishing

The wood sands easily.
Varnish and paint give a good finish.

CONCLUSIONS AND USES

Pará-pará is a very lightweight white wood with poor strength properties.
Despite its high volumetric shrinkage, the wood dries without trouble. On the other hand, it has a very low resistance to fungi, and must be given a preservative treatment as soon as the smallest risk of rewetting arises. For outdoor purposes, the wood should be given insecticidal treatment.

Pará-pará can be used for many purposes which do not require high strength properties, especially for the production of:

- mouldings
- broomsticks
- packing cases
- matches
- toys

and some furniture or interior joinery units.
It is also suitable for the production of plywood or blockboard.
On account of its properties and purposes, its use and commercialization could develop in the future.

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NEW MARKETABLE SPECIES IN SOUTH AMERICA

Sande

DENOMINATIONS

BOTANICAL NAMES

- *Brosimum utile* Pittier (Moraceae family)
- *Brosimum potabile* Ducke
- White wood *Brosimum*

COMMERCIAL NAMES

International name ..... SANDE

- Brazil ..... : Amapa, Amapa doce (not Amapa amargoso)
- Colombia .... : Sande, Lechero, Arbol vaca, Guáimaro
- Costa-Rica .. : Palo de vaca
- Ecuador..... : Sande
- French Guiana ..... : Dokali, Takina
- Panama ..... : Sandy, Cow tree, Palo de vaca
- Peru..... : Panguana
- Venezuela.... : Sande, Marina, Palo de vaca

Sande

ORIGIN AND SUPPLY

Geographical distribution
Sande is found mainly on "terra firma" (non flooded areas) from Mexico to the Amazonian basin (Ecuador, Colombia, Northern Brazil) as well as in French Guiana, Guyana and Surinam.

Frequency in the forest
According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 0.30 to 3 m^3/ha.

Supply
Nowadays, as it is very common in the forest, Sande is used locally (Ecuador - Colombia - Brazil).
Moreover, it is exported from Brazil in rather large quantities either as sawnwood or plywood.
These exports could increase in the future.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree
Sande is a medium-sized tree (20 to 25 m high). Its trunk, 10 to 15 m long, is generally well cylindrical, straight, of good form, without marked buttresses. When the bark is slashed, it exudes a white gum.

Conformation of the logs
Sande logs are generally regular, cylindrical and of good form. Their diameter is from 0.70 to 0.90 m. The sapwood is not well defined from the heartwood when freshly cut. Sometimes, large diameter logs have a small red heart.

Preservation of the logs
Sande logs are prone to attacks by insects and fungi. They should not be stored in the forest for too long and they should be applied a fungicidal and insecticidal treatment.

Ability to float
Sande green logs' density is lower than 1, so the logs can be floated out of logging sites.

DESCRIPTION OF THE WOOD

When dry, the sapwood is barely or not defined. The heartwood is a greyish white to golden beige-white colour.
The grain is often irregularly interlocked.
The texture is medium.
With a magnifying glass (× 15), the following can be observed:
- medium-sized vessels (130 to 230 µ), 2 to 5 per mm^2;
- thinly aliform vasicentric parenchyma;
- 3-up to 7-seriate rays, 4 to 8 per mm, of homogeneous or sometimes heterogeneous structure (2 to 5 lines of square cells at the boundaries);
- laticifers.

TECHNICAL PROPERTIES

Sande is a lightweight to moderately heavy, moderately hard wood with moderate tangential and radial shrinkage. Its volumetric shrinkage is high.
Its strength properties are medium.

Principal physical and mechanical properties
N.B.: the values given below and preceded by an asterisk correspond to a 12% wood moisture content (French Standard NF B 51-002).

Density
- **Air dry *:** 680 to 700 kg/m^3 (average 690 kg/m^3)
- **Green:** 800 to 900 kg/m^3
- **Basic density:** 0.57

Hardness (Chalais-Meudon scale) *: 3.9 (fairly hard)

Saturation point : 28%

Total volumetric shrinkage: 13.9%

Total tangential shrinkage: 8.2%

Total radial shrinkage: 5.8%

Sensitivity to variations in air humidity: fairly to very important

Movement in use: fairly stable to stable

Volumetric shrinkage for 1% variation in moisture content: 0.59%

Splitting strength*: 10.6 x 10^3 N/m (10.8 kg/cm)

Compression strength *: 64 MPa (652 kg/cm^2)

Bending strength *: 118 MPa (1,204 kg/cm

Modulus of elasticity in bending *: 15,090 MPa (154,000 kg/cm^2)

Shock resistance *: 0.38 kg/cm^2 (poor to moderate).

DURABILITY AND IMPREGNABILITY

Note: the properties given belov are those of the heartwood. Th sapwood must always be consi dered as having lower resistanc to insect and fungi than the heart wood.

Natural resistance to fungi
Sande has a very poor resistanc to white rot fungi *(Coriolus versico lor, Pycnoporus sanguineus, Lenti nus squarrosulus)* and to brown ro fungi *(Antrodia sp.).*

Natural resistance to Lyctus
Sande heartwood is attacked b Lyctus.

Natural resistance to termite
The wood's natural resistance t termites *Reticulitermes santonens* is extremely poor.

Impregnability
This wood treats easily and im pregnates well.

CHEMICAL PROPERTIES

Chemical composition of th wood
Sande is characterized by:
- low contents in extractive sub stances (extractives with ben zene-alcohol: 2.4%, extractiv with water: 2.7%),
- a low ash ratio (0.4%),
- a negligible silica content.

Sande's other chemical compo nents average those of tropic woods:

- hemicelluloses : 12.8%
- cellulose : 48.2%
- lignin : 30.5%

ENERGY PROPERTIES

Wood heat value

The heat value of Sande ovendry wood is about 20 MJ/kg.

Carbonization

Carbonization performed at 500 °C in laboratory retort, with a 30.7% yield, produced charcoal having the following properties:

- density: 0.45%
- volatile substance index: 6.0%
- ash ratio: 1.3%
- heat value: 34 MJ/kg.
- friability: 11.5%
- moisture uptake: 6.4%

PROCESSING

Sawing

Sande is a moderately hard wood which does not call for powerful sawing equipment.
Its silica content is very low. When released, internal stresses may accelerate teeth overheating.

Slicing and peeling

Sande peels and slices rather easily. Logs are steamed at about 30 °C.
Veneer drying may present some problems (risk of splitting - moderate to high shrinkage). Veneer glues satisfactorily with urea formaldehyde or phenol formaldehyde glues.
Recommended gluing pressure for the production of plywood ranges from 1.3 to 1.4 MPa.
The presence of gum sap in the wood usually causes a build up on the cutters.

Drying

Air drying

Sande air dries quickly, without any problems or risk of important distortion when the grain is straight. On the other hand, pieces with marked interlocking tend to twist. Sande should thus be air dried carefully, by limiting air circulation inside wood stacks.
Before air drying and for very thick sawn wood, the application of fungicidal and insecticidal treatment is recommended.

Kiln drying

As for air drying, Sande dries relatively rapidly artificially, but it may pose some problems in case of interlocked grain.
Drying should thus be performed carefully, because of the possible risks of distortion of some pieces. For 41 mm thick wood, the kiln schedule below can be used.

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
green	45	43	90
60	45	42	85
40	45	41	80
30	50	44	70
25	55	46	60
20	60	50	55
15	65	52	50

Conclusion : Sande controlled drying does not pose any particular problems if it is performed carefully and if the sawn pieces have small interlocked grain. For wood with large interlocked grain, distortion may occur. In this case, the wood should be dried in the open (under loading) or it should be kept for purposes where the pieces do not necessarily have to be perfectly straight or stable in time.

Fastening

Nails and screws penetrate easily and hold well in Sande.

Gluing

Sande glues well with all types of glue in current industrial use. Sande is now little used as glued-laminated wood, but this use could develop successfully.

Machining

Sande machines easily except when internal stresses develop. For pieces with interlocked grain, cutters should be kept sharp and at about 15 ° cutting angles.

Finishing

The wood sands rather easily.
Paint, varnish and wood finish can be applied without any problems.

CONCLUSIONS AND USES

Sande is a wood:

- with medium strength properties,
- with somewhat low durability, but good amenability for preservative treatment,
- sometimes with interlocked grain which can cause distortion on sawn pieces after drying,
- easy to use.

On account of its important availability in producing areas and provided some precautions are taken on drying wood with interlocked grain, and on machining (sharp edged equipment), this species can be used for a wide range of purposes.

Sande's principal use is for peeling and slicing. Veneers are used for the production of plywood and for lightweight packaging.

Important quantities of Sande are regularly imported to the United States and Canada for the production of door frames.

This species can also be suitable for:

- mouldings
- furniture units
- interior joinery
- light construction work
- packaging.

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NEW MARKETABLE SPECIES IN SOUTH AMERICA

Tauari

DENOMINATIONS

BOTANICAL NAMES

- *Couratari oblongifolia* Ducke and Knuth (Lecythidaceae family)
- *Couratari guianensis* Aubl. = *C. pulchra* Sandw., = *C. panamensis* Standl.
- *Couratari multiflora* Eyma = *C. fagifolia* Eyma
- *Couratari stellata* A.C. Smith
- *Couratari macrosperma* A.C. Smith.

COMMERCIAL NAMES

International name..... COURATARI

- Brazil ..... : Tauari, Imbirema
- French Guiana ..... : Couatari, Mahot cigar, Inguipipa
- Guyana ..... : Wadara, Wandara
- Surinam ..... : Ingipipa
- Venezuela..... : Tauari

Tauari

ORIGIN AND SUPPLY

Geographical distribution
Tauari occurs throughout Central America and tropical South America (French Guiana, Guyana, Amazonian basin).

Frequency in the forest
According to the regions and available results of inventories, the gross volume of trees of more than 0.4 m in diameter ranges from 0.15 to 3.5 m^3/ha.

Supply
Nowadays Tauari is widely harvested and used locally; exports started to develop some time ago and they could increase in the future, should demand grow.

CHARACTERISTICS OF THE BOLE AND LOG

Description of the standing tree
Tauari is a large tree reaching 30 m. The length of the bole varies from 10 to 16 m. The trunk is generally straight and cylindrical with marked buttresses which can rise up to 5 m above ground level.
The bark is 1 to 2 cm thick, smooth and lightly cracked.

Conformation of the logs
Tauari logs are generally cylindrical and of good form. Their diameter varies from 50 cm to 80 cm. The sapwood is not defined from the heartwood.

Preservation of the logs
Tauari logs are prone to attacks by insects and fungi. Not to incur any risks, their storing in the forest should be limited to a few weeks. If they are stored for longer than several months, a preservative treatment should be applied.

Ability to float
Tauari green logs density is lower than 1, so the logs can be floated out of logging sites.

DESCRIPTION OF THE WOOD

The colour of Tauari wood varies according to species, from cream-white to light beige.
The grain is generally straight.
The sapwood is not defined from the heartwood.
The texture is medium.
The fleck is faint and barely visible.
When freshly cut, the wood has a particular unpleasant smell which vanishes on drying.
With a magnifying glass (× 15), the following can be observed:
- medium-sized (130 to 220 µ) vessels, 2 to 5 per mm^2 ;
- parenchyma in tangential mono-seriate or locally biseriate bands, 5 to 9 per mm, reticulated with the rays ;
- 2-up to 4-seriate rays, 5 to 8 per mm, of fairly homogeneous structure.

TECHNICAL PROPERTIES

Tauari is a lightweight to moderately heavy, soft to moderately hard wood with small to moderate tangential and radial shrinkage. Its volumetric shrinkage is moderate. Its strength properties are medium.

Principal physical and mechanical properties
N.B. : the values given below and preceded by an asterisk correspond to a 12% wood moisture content (French Standard NF B 51-002).

Density
- **Air dry *:** 520 to 670 kg/m^3 (average: 620 kg/m^3)
- **Green:** 850 to 950 kg/m^3
- **Basic density:** 0.46

Hardness (Chalais-Meudon scale) *: 2.7 (soft to fairly hard)

Saturation point: 28%

Total volumetric shrinkage: 14.0%

Total tangential shrinkage: 7.0%

Total radial shrinkage: 4.5%

Sensitivity to variations in air humidity: moderate to very important

Movement in use: fairly stable

Volumetric shrinkage for 1% variation in moisture content: 0.50%

Splitting strength *: 12.4 x 10^3 N/m (12.6 kg/cm)

Compression strength *: 48 MPa (490 kg/cm^2)

Bending strength *: 96 MPa (976 kg/cm^2)

Modulus of elasticity in bending *: 11,688 MPa (119,222 kg/cm^2)

Shock resistance *: 0.34 kg/cm^2 (poor)

DURABILITY AND IMPREGNABILITY

Note: the properties given below are those of the heartwood. The sapwood must always be considered as having lower resistance to insect and fungi than the heartwood.

Natural resistance to fungi
Tauari has a very poor resistance to white rot fungi *(Coriolus versicolor, Pycnoporus sanguineus, Lentinus squarrosulus)* and to brown rot fungi *(Antrodia sp.)*.

Natural resistance to Lyctus
On account of the undefined sapwood, the wood is liable to Lyctus attacks.

Natural resistance to termites
The wood's natural resistance to termites *(Reticulitermes santonensis)* is very poor.

Impregnability
Tauari impregnates well.

CHEMICAL PROPERTIES

Chemical composition of the wood
The following chemical composition is that of the *Couratari multiflora* species.
This species is characterized by:

- very low contents in extractive substances (extractives with benzene-alcohol: 1.6%, extractive with water: 1.8%),
- a high content in lignin (33.6%),
- a high silica content (0.23%).

The percentages of the other chemical components are the average tropical wood percentages:

- ashes: 1.2%
- hemicelluloses: 11.8%
- cellulose: 46.2%

The values given below are those of *Couratari multiflora* species.

Wood heat value

The heat value of the ovendry wood is 20 MJ/kg.

Carbonization

Carbonization performed at 500 °C in laboratory retort, with a 33.9% yield, produced charcoal having the following properties:

- density: 0.4
- volatile substance index: 6.8%
- ash ratio: 4.4%
- moisture uptake: 6.3%
- friability: 12.5%
- heat value: 33 MJ/kg.

Besides, 356 l of pyroligneous liquid per ton of ovendry wood containing 19.4% tar were obtained.

PROCESSING

Sawing

Tauari is a soft to moderately hard wood which saws easily and does not require powerful equipment.
On the other hand, on account of its high silica content (about 0.23%), Tauari is abrasive. Thus, the use of stellited saws is advisable and Tauari should be sawn as soon as possible after felling.

Slicing and peeling

Tauari peels and slices rather easily.
Logs are steamed at a temperature between 70° and 85 °C.
Veneer drying is delicate (risk of distortion, checking and possibly splitting) and it should be carried out with great care.
Veneer glues satisfactorily with urea formaldehyde or phenol formaldehyde glues.
Recommended gluing pressure for the production of plywood ranges from 1.3 to 1.7 MPa, according to wood density.

Drying

Air drying

Tauari air dries quickly, without any problems or risks of important distortion. To avoid any risk of fungal attacks on air drying, a fungicidal treatment should be applied, especially for thick sawnwood.

Kiln drying

Drying Tauari in controlled conditions is, like air drying, relatively easy. The risks of splitting and distortion are minor. As an indication, for 25 mm thick wood, the wood moisture content went from green to 10% in 35 days without the occurrence of defects.
The following kiln schedule can be used for drying Tauari up to 54 mm thick.

Conclusion : Tauari dries easily in the open and in controlled conditions; drying does not pose any particular problems and the risks of defects are minor.

Moisture content of wood (%)	**Temperature dry bulb** (°C)	**Temperature wet bulb** (°C)	**Relative humidity of air** (%)
green	57	51	70
50	57	48	60
40	60	47	50
30	66	49	40
20	77	53	30

Fastening

Tauari nails and screws easily, but nail-holding power is fair only.

Gluing

Tauari glues well with all types of glue in current industrial use.

Machining

Tauari works without any problems, but because of its high silica content, stellited cutters should be used on machining.

Finishing

Tauari sands easily. Some flat-sawn pieces have a highly valued decorative appearance.
Paint, varnish and wood finish can be applied easily and give a good surface finish.

CONCLUSIONS AND USES

Tauari is an attractive wood with satisfactory strength properties and which dries easily. It has a low durability, but impregnates well and can be used without trouble. Its properties make it suitable for a wide range of uses.

In producing countries, Tauari plywood from peeled veneers is used for the production of packaging and shuttering.

Tauari sawnwood can be used for:

- interior joinery
- mouldings
- light construction work
- basic furniture units to be stained
- exterior joinery (after treatment)
- packaging, packing cases
- high quality gymnasium flooring.

Because of its frequency in producing countries, Tauari is today frequently exploited and used locally. On the other hand, it is not widely commercialized on international markets, whereas it could be exported on a large scale and compete with traditional so called white woods, should demand develop.

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