

Product Possibilities in Cola Palm Leaves and Bark Found in IIT

Special Project

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Guide
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Approval sheet

The project entitled **“Product Possibilities in Cola Palm Leaves and Bark Found in IIT”** by **Krishna Kumar R.** is approved in partial fulfillment for the Masters Degree in Industrial Design course at Industrial Design Centre, Indian Institute of Technology, Bombay.

Guide

Chairperson

External Examiner

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1.0 Introduction

From time immemorial man has been fascinated by the things that surround him. In all his efforts he has been trying to conquer the limits of his ignorance. As part of this ongoing process a lot of materials both manmade and natural have been explored and put to use in various fields.

Leaves of cola palm tree with its characteristic and distinct texture attracts anybody's fascination. The project aims at exploring the possibilities of a craft product that could emerge from the studies in the properties of the material.



2.0 Scope of the project

There are about 210 full grown and 10 newly planted palms in campus. The leaf fall from these trees is about one to one and a half tractor loads per week which is either burnt away or dumped to decay in the dumping yard.

The project is a quest on whether these unused materials could be used to make products that could fit into a craft production base.

2.1 Similar products

For generations men have used the leaves and bark of palm trees for their manuscripts long before paper was invented. There were other traditional products like caps used in various parts of south India made from palm leaves. Some of the contemporary products include books bound in palm leaves and barks which are sold out as exclusive products in various craft and lifestyle stores and exhibitions.



3.0 Palm cola

The palm tree grows up to 25 feet in length, it has a very characteristic a green crown shaft, bottle shaped trunk with grey visible ring scars and is about two feet in diameter.



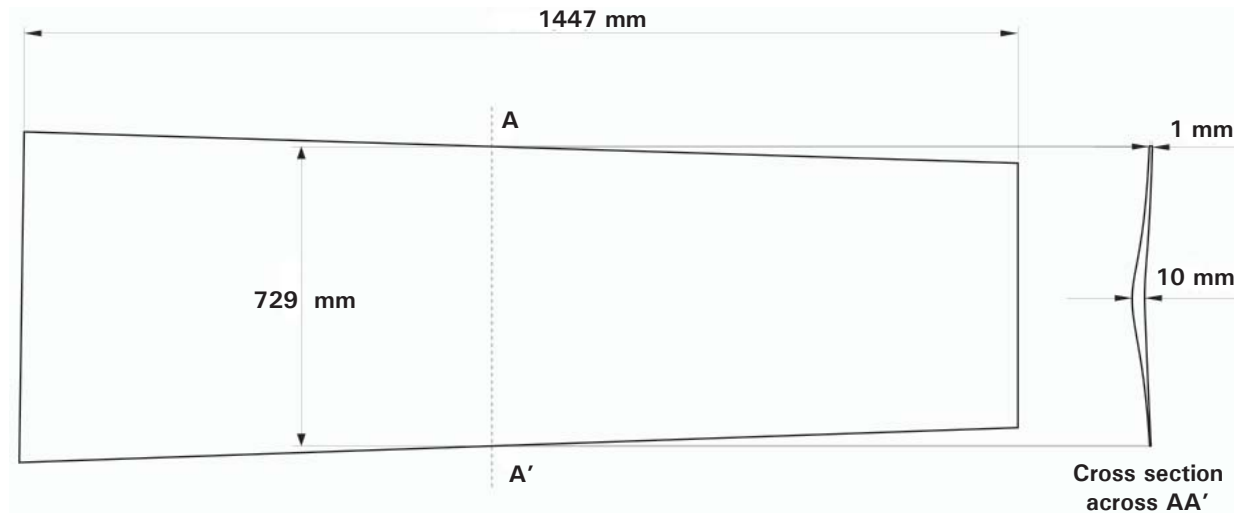
Leaf with the bark.

3.1 Physical features

Average dimensions of the bark after removing from the leaf is 3 feet by 5 feet. The bark has an uneven cross section varying from 1mm in the periphery to 9 mm in the centre. The bark has a hard and fibrous outer surface and a soft, smooth inner surface which has a cuticle layer over it.



The bark has an uneven thickness across its cross section.



Average leaf dimension.

Leaf dimensions. (in mm)			
No.	Length	Breadth	Thickness across cross sections
1	1530	830	9
2	1340	740	8
3	1610	960	11
4	1480	620	10
5	1510	680	10
6	1100	590	9
7	1550	660	12
8	1490	710	9
9	1720	930	13
10	910	640	6
11	1380	750	10
12	1530	660	11
13	1560	670	12
14	1520	750	8
15	1370	590	10
16	1430	730	9
17	1570	810	10
18	1190	680	9
19	1410	780	10
20	1550	840	12
21	1490	610	11
22	1610	820	14
avg.	1447.72	729.55	10.14

4.0 Methods and processes

A series of experiments were conducted to test the properties of the material and how they could be used in the development of a product.

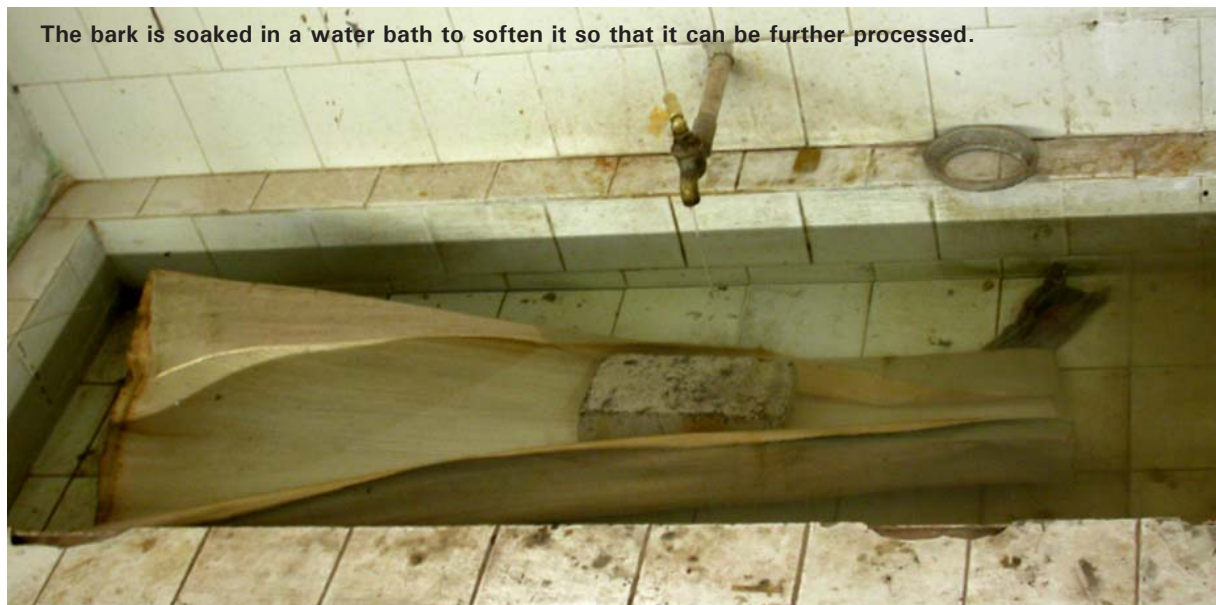
4.1 Preparing the Leaf

First the leaf has to go through some initial preparation so that it becomes flexible enough for any products to be manufactured out of it.

4.1.1 Soaking and Cleaning

The leaves once they fall can be separated from the bark with the help of a paperknife or a hacksaw. The leaf is quite flexible when it is in its wet condition that is when it is newly fallen. The leaf becomes brittle as it dries up so if dry leaves are to be worked upon then they need to be soaked in water for some time until it becomes flexible enough to work on.

The thin section at the periphery of a dry leaf takes about half an hour to get completely soaked and an hour and a half for the thicker sections at the middle of the bark.



Any fungal growth and dirt on the surface of the leaves that has to be cleaned in the wet condition before it is taken for further processing. This can be done with the help of a cloth.



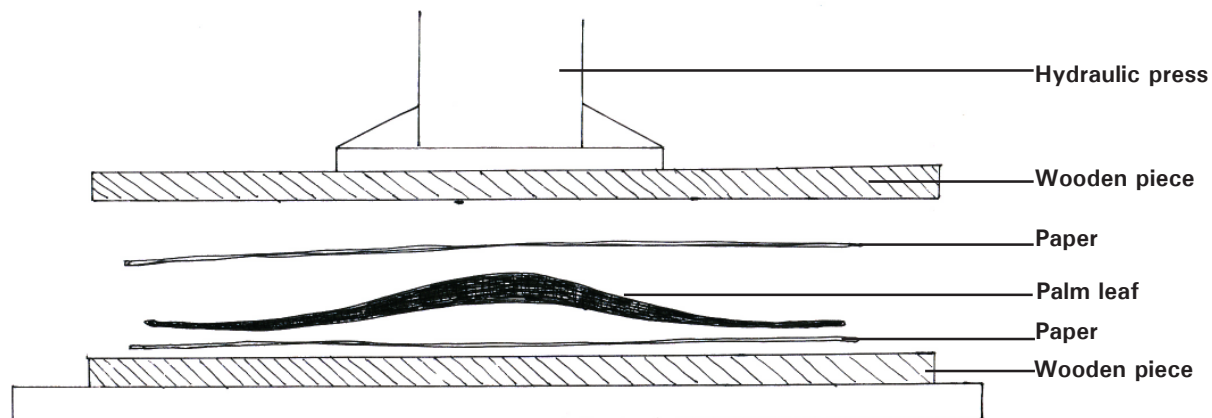
4.1.2 Drying and flattening of leaves

Wet leaves can be air-dried but due to the uneven thickness of the leaf, drying in the sun causes warping of leaves. The leaf dries to take its natural shape with the soft side inside and the harder surface outside.

A wet leaf is sandwiched in between two paper sheets and plywood pieces to be pressed either in a hydraulic press or a flywheel press. This is done to retain the bark texture and avoid the texture of the plywood getting transferred to the bark. A wet bark of 9mm thickness can be pressed to 4mm thickness in a hydraulic press by pressing it at 20tons. A flywheel press can help compress the sheet reduce the thickness from 9 mm to 7 mm.

Precaution:

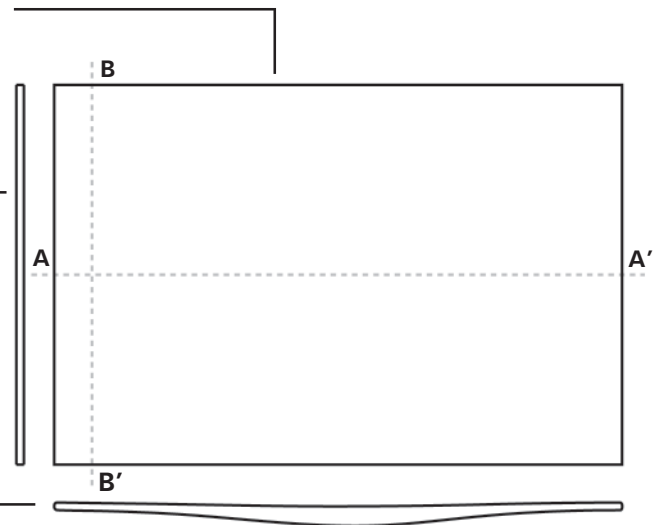
The leaves can be air dried in shade under pressure. A fly press or a hydraulic press can be used for pressing the leaves to flatten it.



Flat leaf without any curls

Cross section across BB'

Cross section across AA'

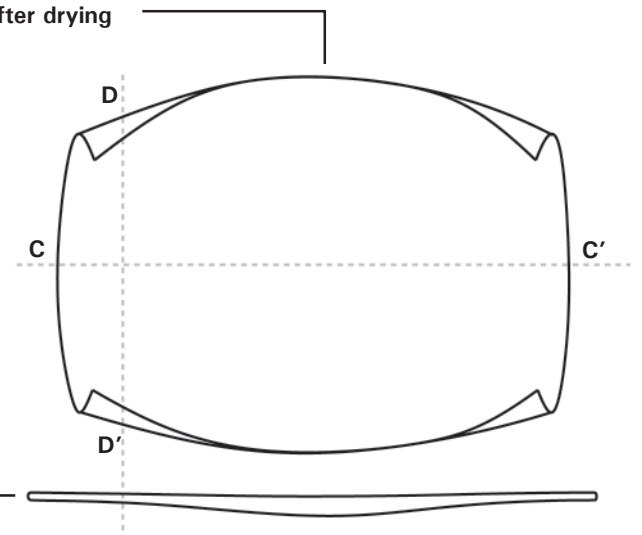


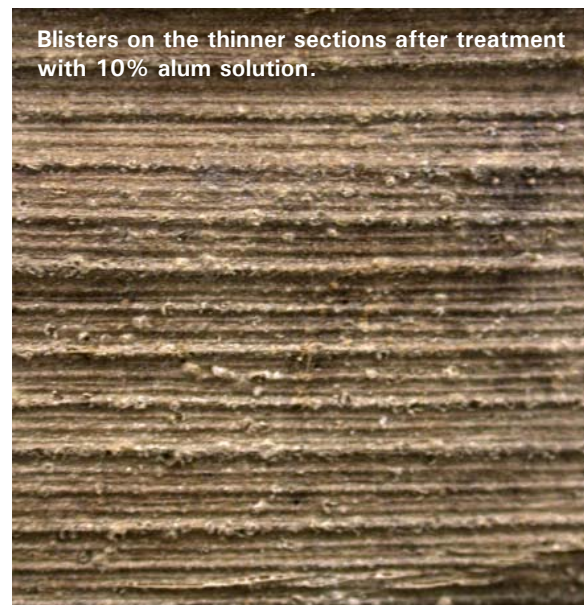
The thinner edges of the sheet crawls up with the softer side inside.

Leaf with edges curled up after drying

Cross section across DD'

Cross section across CC'





4.2 Treatments

The leaves are prone to fungal attack if not dried properly, so they need to be treated against it. Either chemical treatment can be done on the leaves or a surface coat can be given to protect it from any fungal attack.

4.2.1 Chemical Treatment -Alum

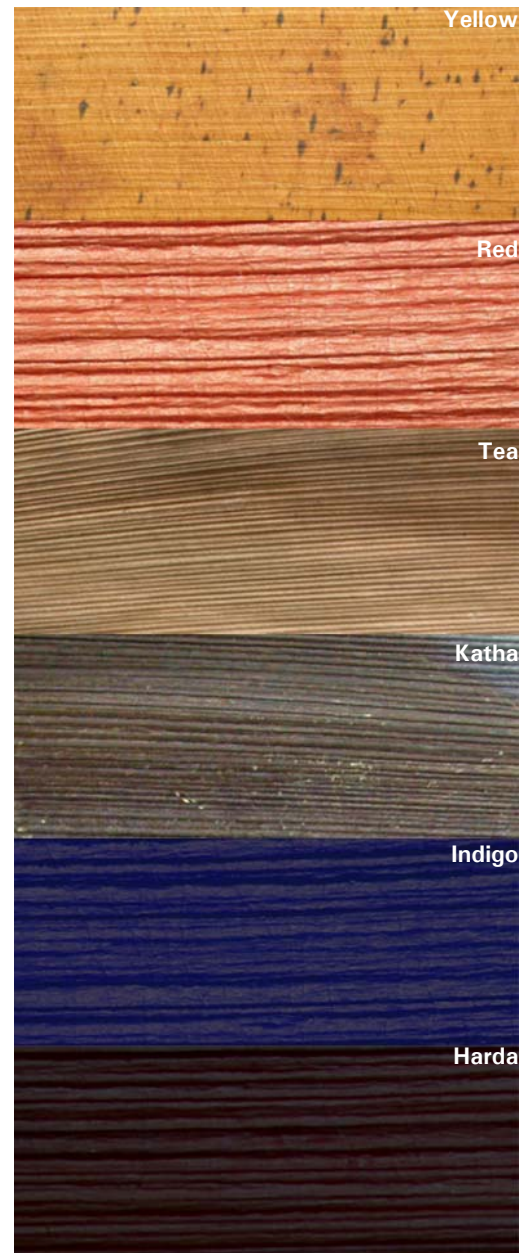
Standard alum treatment prescribed for bamboo was tried out in the Bark. The bark was boiled in 10% alum solution for half an hour; this causes blisters on the thinner sections. To avoid blisters a 5% solution was tried on the thinner sections for half an hour.

Alum treatment makes the bark more rigid and brittle and also causes colouration of the thinner sections. Though the treated leaves were not tested in a humidity chamber for fungal attack these leaves did not get any fungal growth for the next 4 months from December, whereas other untreated leaves were found to have severe fungus problems.



4.2.2 Surface coat

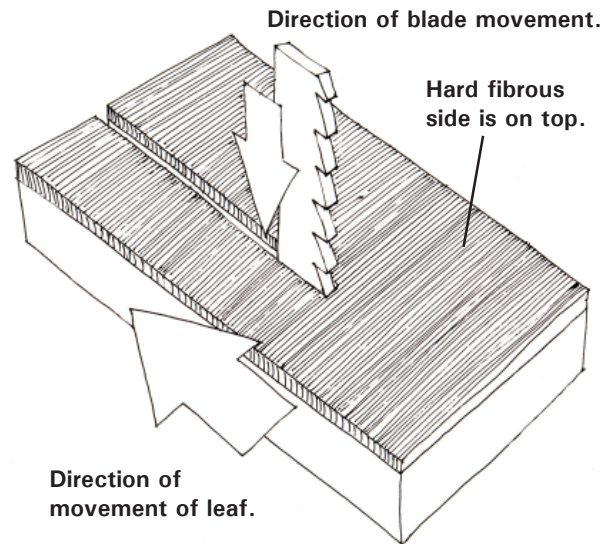
A thin layer of clear lacquer/ melamine is given to save against fungal attacks. This also brings out the colour of the bark.



4.2.3 Dyeing

Harda, indigo, katha, tea, red, orange and yellow dyes were tried on the bark.

#Reference bamboo dyeing book



4.3 Machining

A series of machining possibilities were tried on the material to know the optimum processes to be used at certain stage of a production to come up with an efficient system.

4.3.1 Cutting

The bark can be cut by hacksaw, band saw, circular saw, fret saw, paper cutter, scissors etc.

Caution:

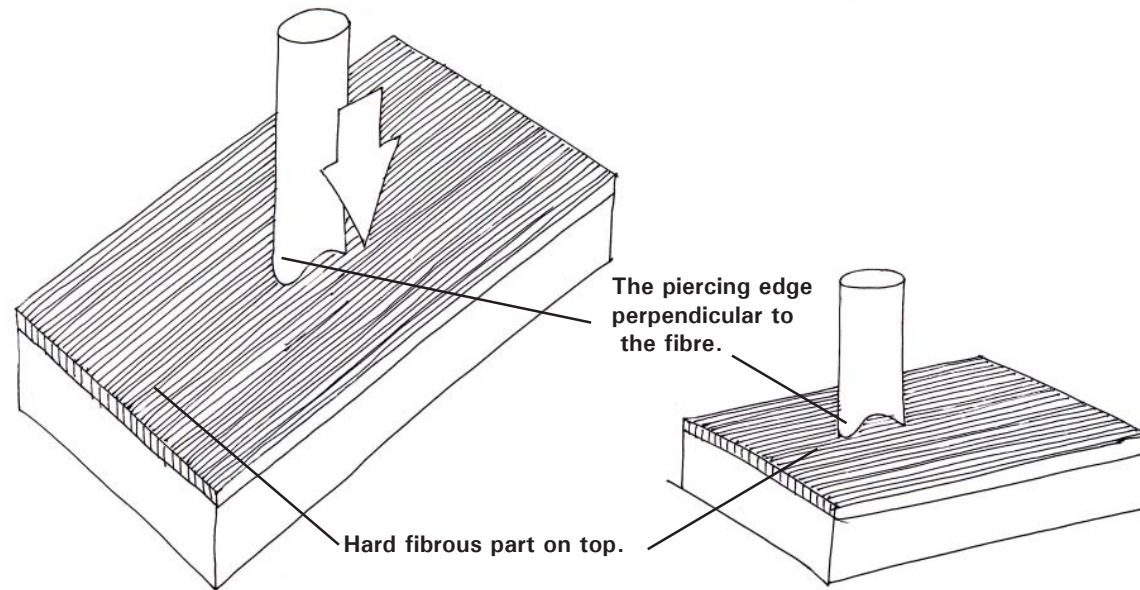
While using a band saw or a circular saw care should be taken that the outer hard surface should come first in the direction of cut otherwise the fibres start coming out.

A scissor can cut up to 3mm thick leaf without spoiling either sides of the leaf. A paper cutter gives a fine and smooth edge over a wide range of thickness.

Use of photo/paper cutting plate causes the peeling off of the softer side of the bark from the fibrous outer surface.

A dry edge can be sanded to give a smooth finish.





4.3.2 Punching

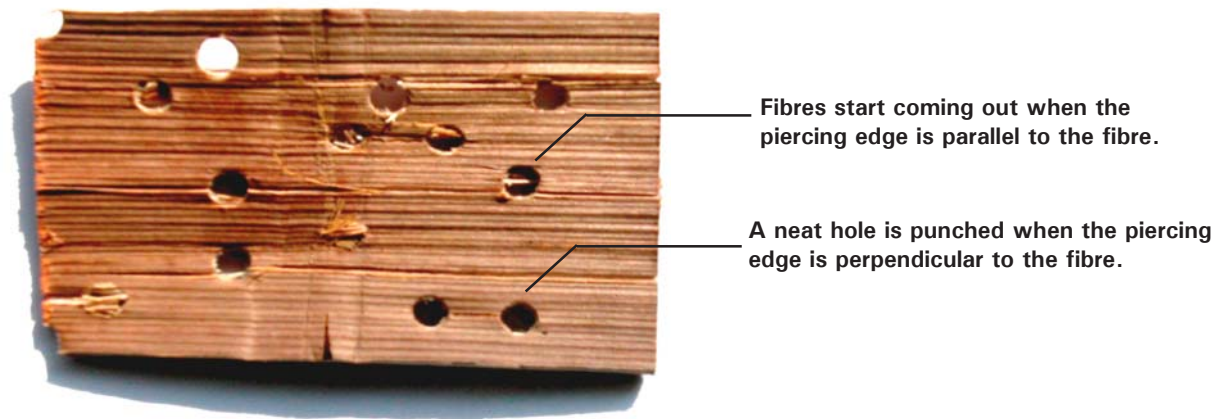
The bark can be punched with a paper punch (for up to 3 mm thick sections).

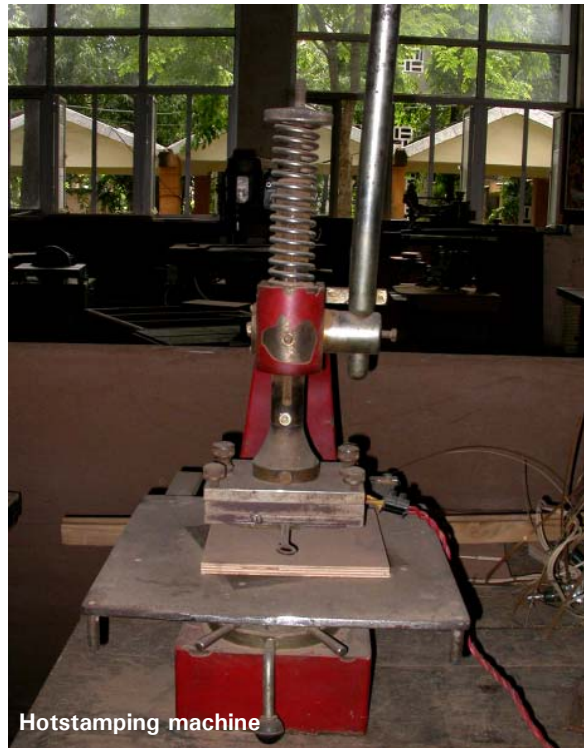
Caution:

The direction of punch should be parallel to the fibre structure (the piercing edge perpendicular to the fibre).

4.3.3 Drilling

Drilling is not possible on wet leaves as the fibres start coming out. It is possible on dry leaves of thickness more than 2mm.





Hotstamping machine

4.4 Surface Finishes

A set of surface finishing processes were tried out which could improve and enhance the quality and value of the material.

4.4.1 Hot pressing

Hot pressing on wet leaves give a better effect and gradation of colour. Films can also be used on the barks but the colour spreads out because of the fibrous nature of the material.



Hot pressing on wet leaf gives a lasting impression.

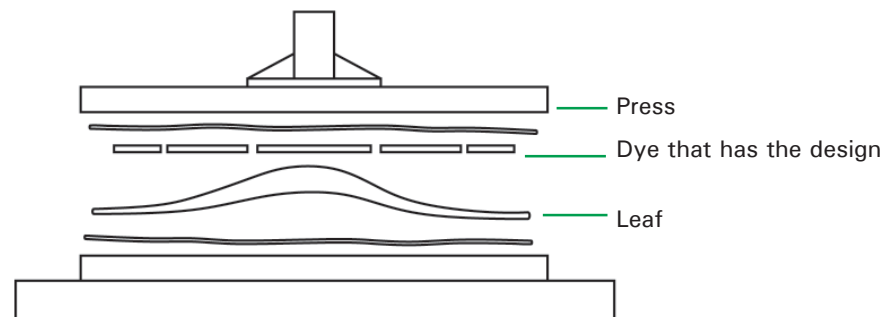


4.4.2 Embossing

A wet leaf is sandwiched in between two paper sheets and plywood pieces to be pressed either in a hydraulic press or a flywheel press for about 2 hours. This is done to retain the bark texture and avoid the texture of the plywood getting transferred to the bark. A wet bark of 9mm thickness can be pressed to 4mm thickness in a hydraulic press by pressing it at 20tons. A flywheel press can help reduce the thickness from 9 mm to 7 mm. The design to be embossed is either placed between two barks and then pressed or just on one bark and then pressed.



Embossing done on wet leaf and allowed to dry.





Letter punching blocks

4.4.3 Letter punching

Letters punched on wet leaves fade away once the leaf gets dry. Punching on dry leaves gives a permanent impression.



Letter Punching done on dry leaf.



Pyrographic tool

4.4.4 Pyrographic tool

The pyrography tool is used to burn the surface of the material and make lasting impressions on it.



Use of pyrographic tool on the leaf.



5.0 Joinery

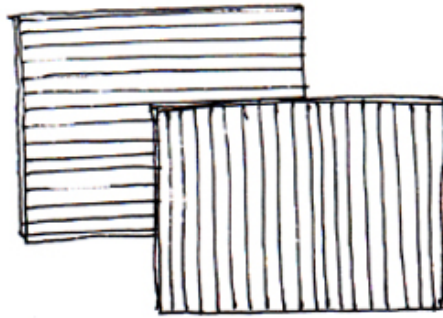
Various joineries like riveting, stitching and glueing were tried which would help in using it in combination with different materials as well as with itself.

5.1 Riveting

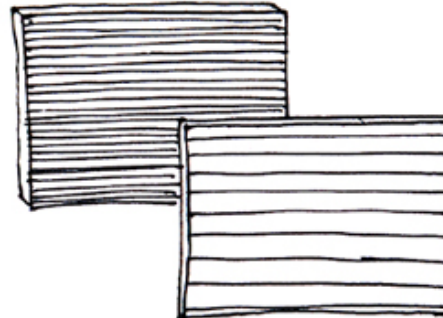
Riveting gives a sturdy grip on the material and works well if the thickness is adequate to support itself from the pressures that arise from the base material. Riveting can also be used as an aesthetic element

5.2 Stitching

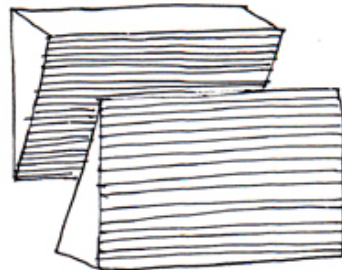
Stitching the material is also possible with hand; machine stitching is not very feasible as the bark starts to break from the stitch especially if it is dry.



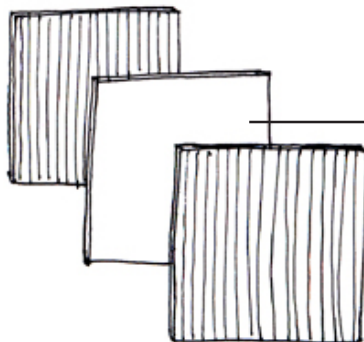
Two layers of bark with the fibres in different directions.



Two layers of bark with the fibres in the same direction.

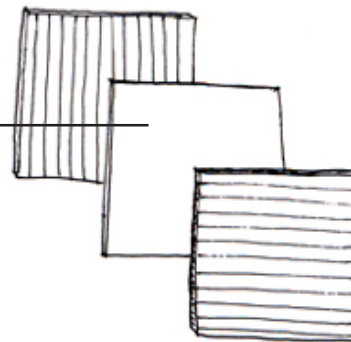


Two layers of bark with different thicknesses and the fibre in the same direction.



Paper sandwiched in between two layers of bark with the fibres in the same direction.

Paper



Paper sandwiched inbetween two layers of bark with the fibres in the same direction.

5.3 Glueing

The leaves can be pasted to itself or to a different material using adhesives like fevicol, araldite or rubber solution. Sandwiching of thin layers of bark improves the strength of the bark. Cross-hatching of different layers help prevent breaking of the bark along the fibre. Sandwiching of layers of bark with paper or cloth inside also help in improving the strength of the material.

6.0 Reference

Colouring Bamboo Strips with Natural Dyes
Instruction Manual
Industrial Design Centre, IIT Bombay.