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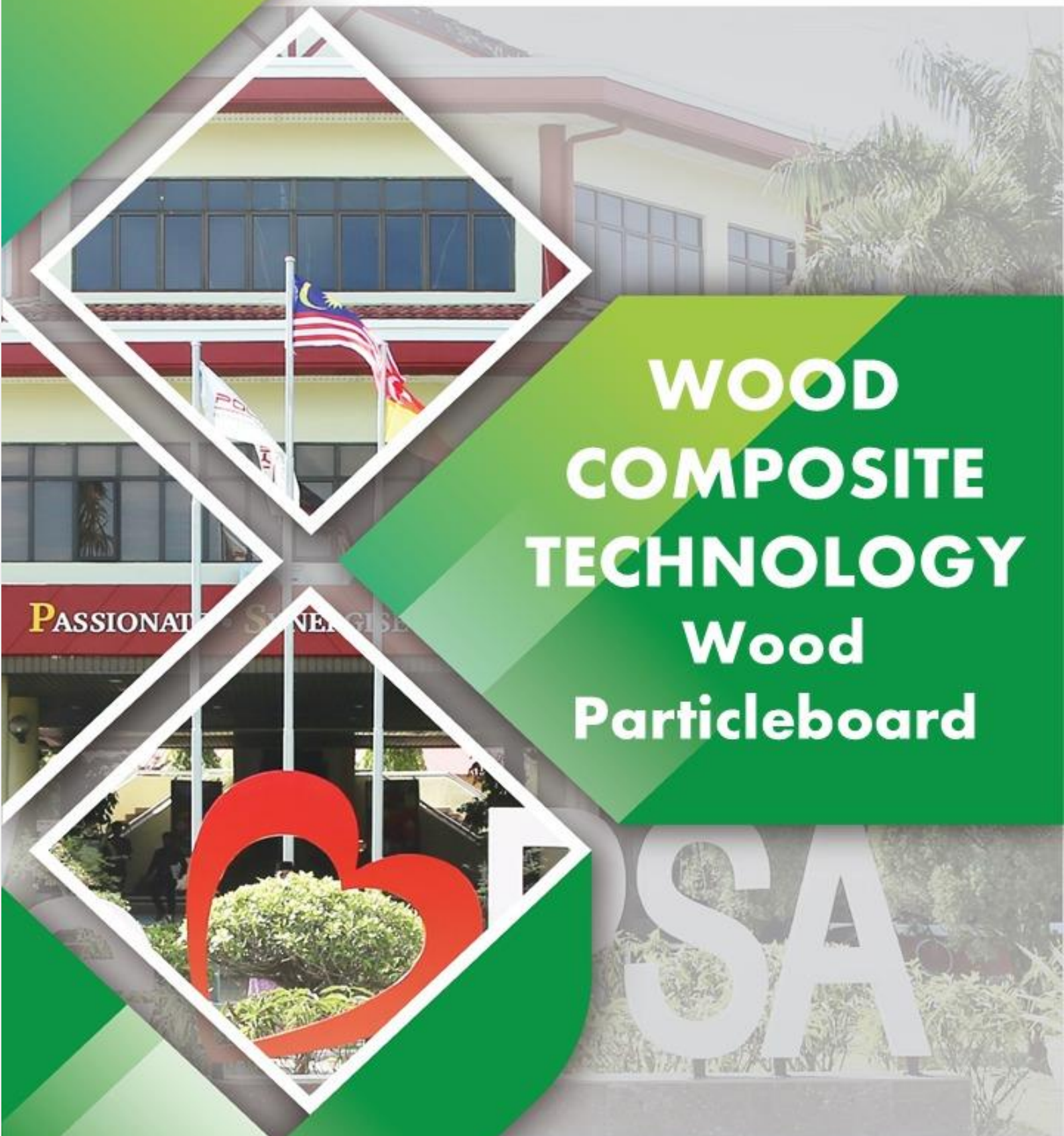

WOOD COMPOSITE TECHNOLOGY

Wood Particleboard

MUHAMMAD KAMAL ARIFFIN HAJI BADRUN
ZARIL FAIZAL GHAFFAR
HAZLAN ABDULLAH

CIVIL ENGINEERING DEPARTMENT

WOOD COMPOSITE TECHNOLOGY

Wood Particleboard

A SERIES OF WOOD TECHNOLOGY E-BOOK

by Wood Technologies

WOOD COMPOSITE TECHNOLOGY- Wood Particleboard

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ZARIL FAIZAL ZARAL GHAFFAR
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Telephone No. : 03 5163 4000
Fax No. : 03 5569 1903

PREFACE

Modern world uses more wooden material for its purposes. Nowadays, forest had been harvested untill it decreases. Wood as a raw material for particleboard fabrication is harvested from the forest. Due to the deforestration makes it hard to produced. Therefore to overcome the issues, Wood Technologies had agreed to use fast grown and lesser known species as raw material in Malaysia.

Armed with more than 15 years of experience in teaching the Wood Composite Technology Course, the Author had been inspired to produce the E-book throughout several compilation of R n D, Technical Presentation, Confference Presentation and Technology Competition.

Furthermore the Author had been exposed to the industrial using advanced material in fabricating particleboards.

BIBLIOGRAPHY

Muhammad Kamal Ariffin B. Hj. Badrun
Lecturer, Wood Based Technology Programme, Department of Civil Engineering,
Polytechnic of Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia.
Tel: +603-5163 4152
Hp: +6013-1282 9269
Fax: +603-5569 1903
Email: apexi71@yahoo.com
mkariffin@psa.edu.my
URL: http://www.psa.edu.my

Since joining the Polytechnic of Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Kamal has been involved with studies related to wood composite and lignocellulosic material. Before joining Polytechnic, Kamal worked at multi wood product company as a senior production executive. Since 2003, Kamal worked as a lecturer of Wood Composite Technology.

Hazlan Bin Abdullah
Lecturer,
Wood Based Technology Programme, Department of Civil Engineering,
Polytechnic of Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia.
Tel: +603-5163 4152
Hp: +6013-750 6257
Fax: +603-5569 1903
Email: hazlanpsa@gmail.com
URL: http://www.psa.edu.my

Since joining the Polytechnic of Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Hazlan has been involved with studies related to wood composite and lignocellulosic material. Before joining Polytechnic, Hazlan worked at multi wood product company as a line leader and Supervisor. Since 2002, Hazlan worked as a lecturer of Wood Composite Technology.

Zaril Faizal Bin Zaral Ghafar
Lecturer, Cirtificate of Design and Furniture Manufacturing Programme,
Temerloh Community College,Taman Bukit Mentakab,
Bypass Batu 2 Jalan Temerloh, Jln Temerloh - Mentakab, Mentakab,
28400 Mentakab, Pahang
Tel: +609-2701550/1552/1553/(HEP)1557
Hp: +6013-349 7165
Email: zarilfaizalpsa@gmail.com
URL: https://kktemerloh.mypolycc.edu.my/

Since joining the Polytechnic and Community College, Zaril has been involved with studies related to wood composite and lignocellulosic material. Before joining Polytechnic, Zaril worked at multi wood product company as a line leader and Supervisor. Since 2003, Zaril worked as a lecturer of Wood Composite Technology.

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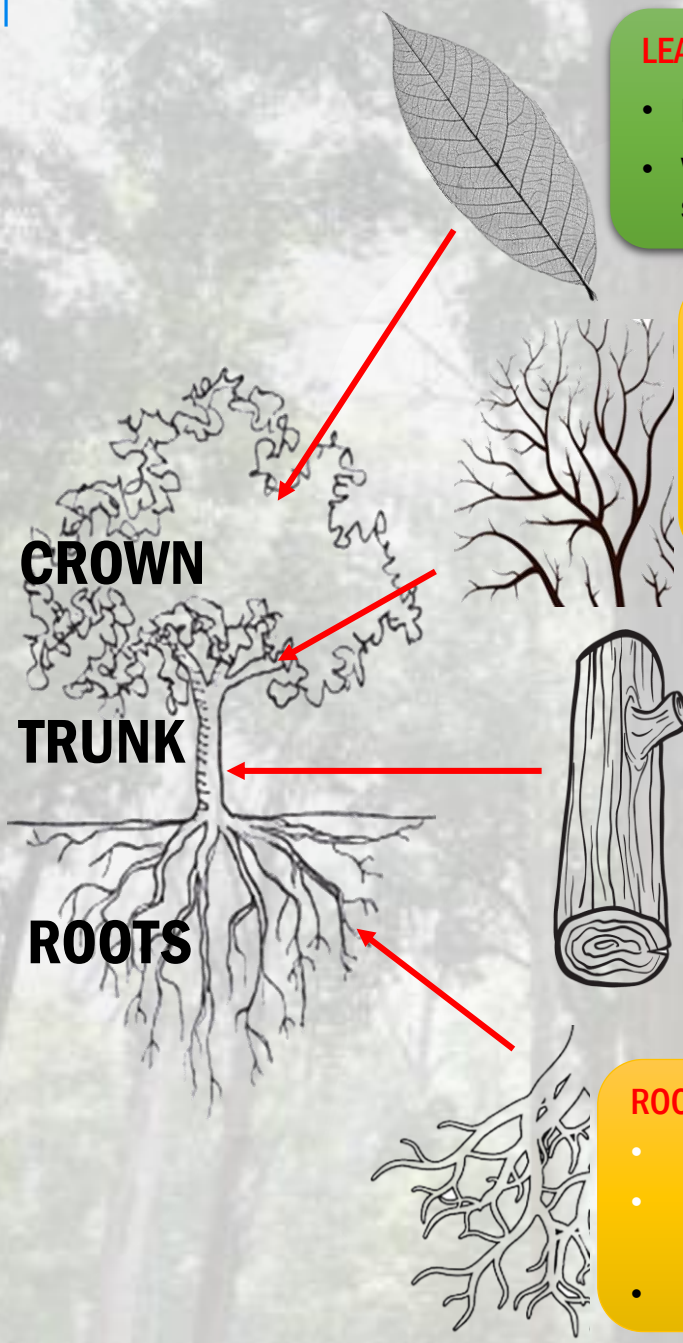
TREE ANATOMY



LEAVES

- Blade – for photosynthesis
- Veins – transport water and nutrients to leaves, move sugars and "food" to branches, stem, and roots.

BRANCHES

- Support leaves.
- Transport water/nutrients to leaves.
- Transport sugar and "food" to other branches, stem and roots.
- Storage area for energy reserves.

TRUNK

- Support branches/leaves.
- Transport water/nutrients to branches and leaves.
- Transport sugars and "food" to branches and roots.
- Storage area for energy reserves.
- Outer bark protects inner lining bark and sapwood from damage, diseases, decay and insects.

ROOT

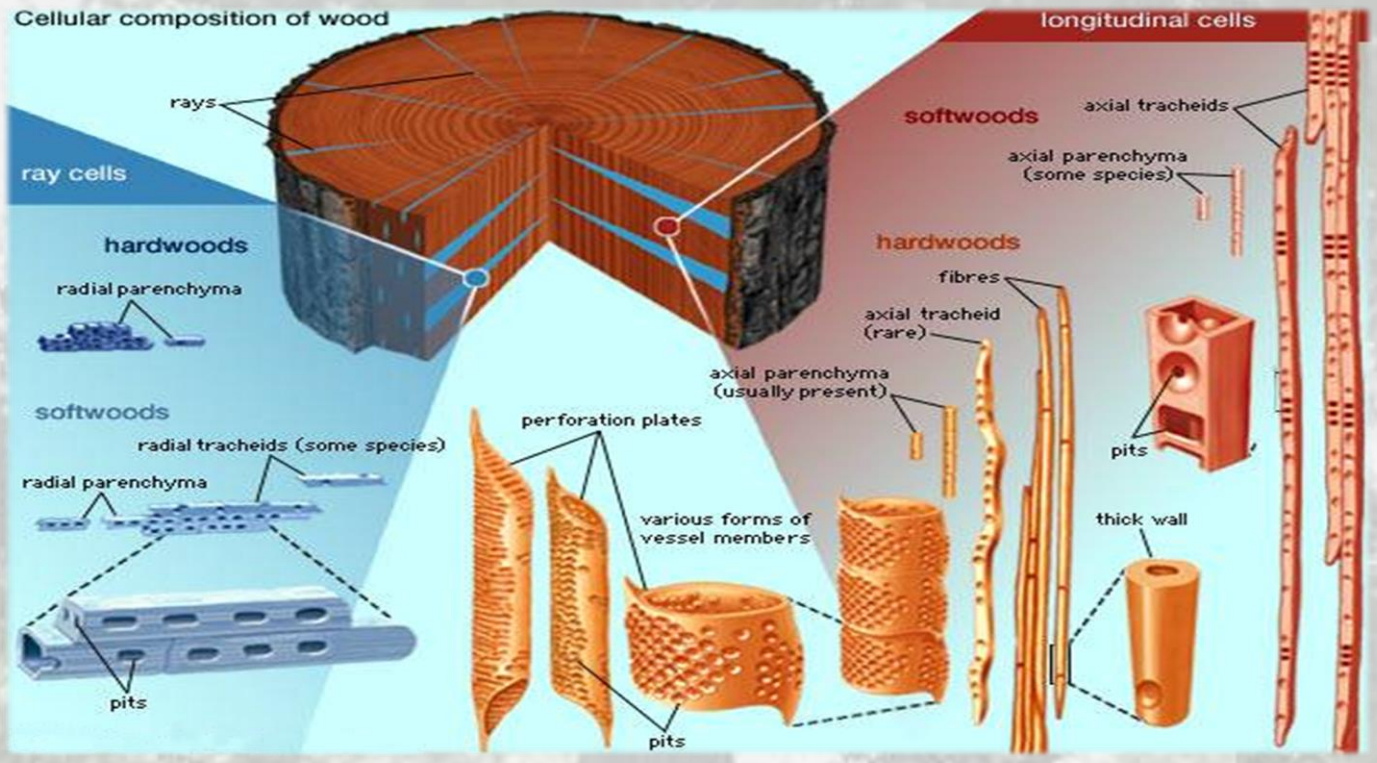
- Anchor tree.
- Transport water/nutrients from soil to trunk, branches, and leaves.
- Storage area.

Figure : The anatomy a living tree

What is a tree?

In technical terms, a TREE is an organic material of natural composites of cellulosic fibers which embedded in a matrix of lignin that resists compression that lives more than two years (perennial).

WOOD COMPOSITE TECHNOLOGY



Wood or lumber is made from natural composite

Wood its self is made from the bounding of so many fibers parallel arrange prior to a standing tree. A single fiber is bound by lignin throughout thousand and millions of micro fibril. Thus the bonding agent is made from natural compositions of

For specific properties, careful selection of residues and species are important.

The particleboard industry started in Europe during and shortly after World War II.

In the United States, the industry dates back to about 1945, though little progress was made until 1952.

Particleboard is used for furniture, tabletops, doors, underpayment, wall paneling, and many other purposes.

Core stock for furniture represents the largest single use. At present, particleboard goes mainly into interior applications.

Particleboard may develop in the construction field.

WOOD COMPOSITE TECHNOLOGY

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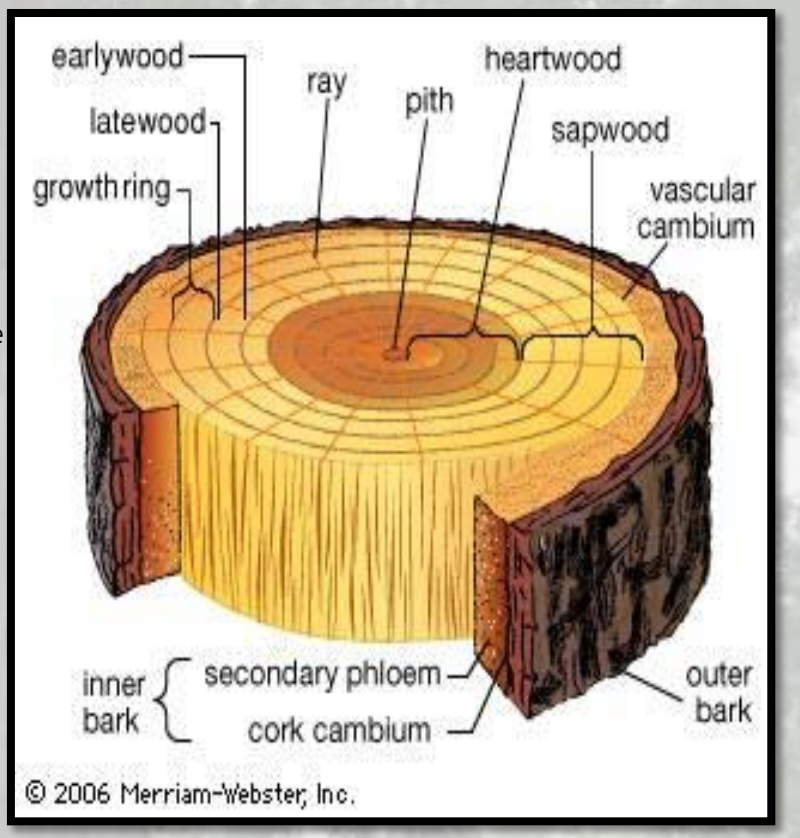

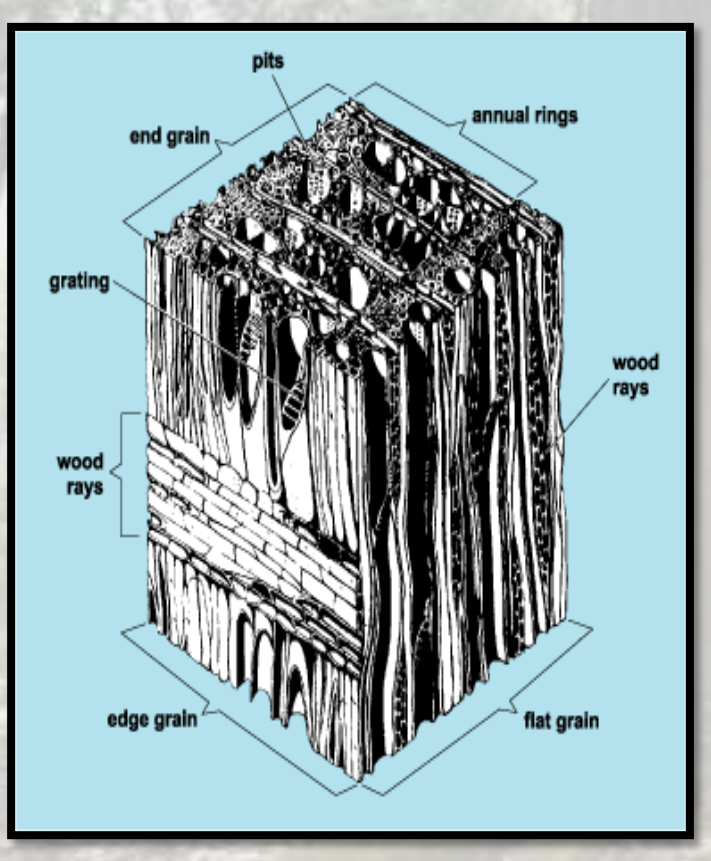

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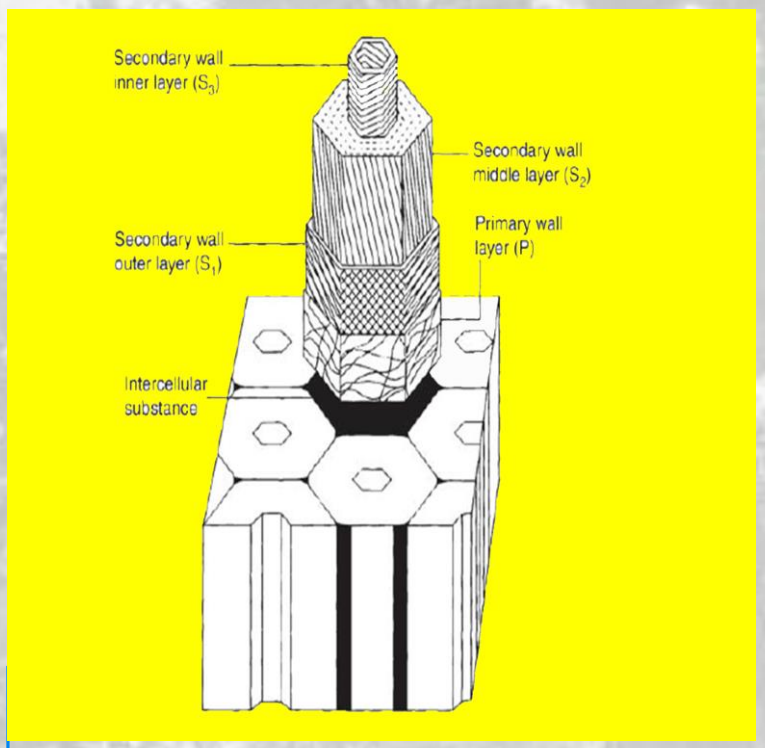

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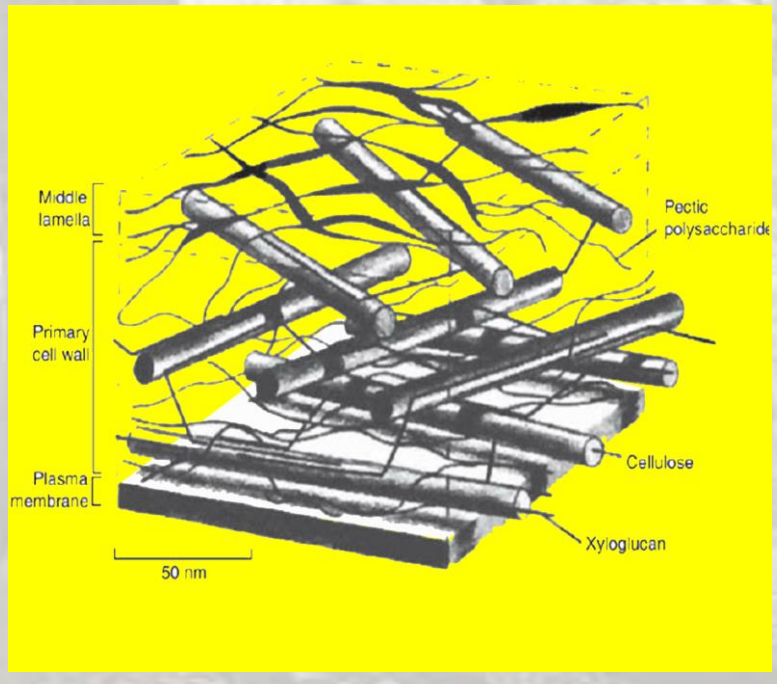


WOOD COMPOSITE TECHNOLOGY

CHRACTERISTIC 1

Often reaches 15 feet or more in height at maturity.

CHRACTERISTIC 2

Has a single trunk or dominant multiple trunks.

WOOD COMPOSITE TECHNOLOGY

CHRACTERISTIC 3

Has no normal branches on the lower trunk.

CHRACTERISTIC 4

Has at least a partially defined crown.

WOOD COMPOSITE TECHNOLOGY

CHRACTERISTIC 3

Has no normal branches on the lower trunk.

CHRACTERISTIC 4

Has a single trunk or dominant multiple trunks.

WOOD COMPOSITE TECHNOLOGY

CHRACTERISTIC 5

Usually larger than other plants and tend to be long-lived.

CHRACTERISTIC 6

Has a single trunk or dominant multiple trunks.

WOOD COMPOSITE TECHNOLOGY

CHAPTER 2

LIGNOCELLULOSIC MATERIAL

TREE AS A MATERIAL

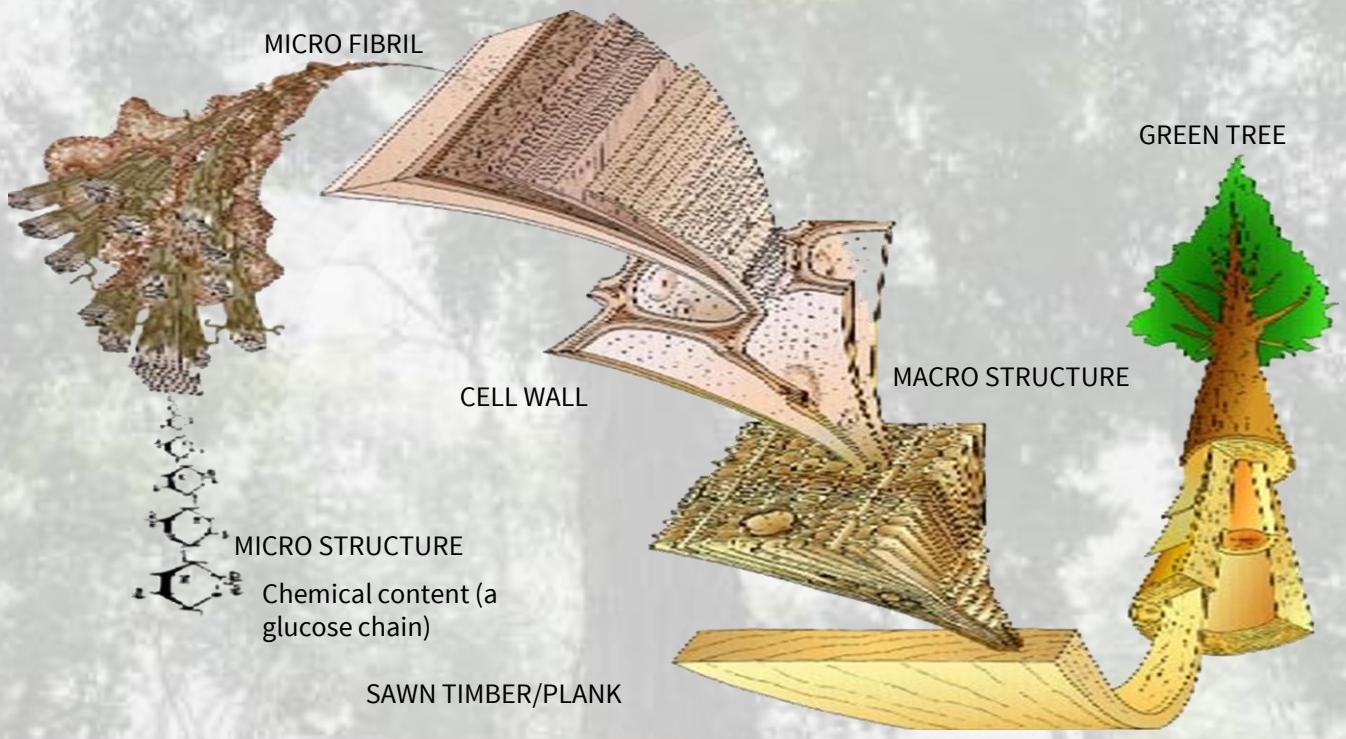


Figure : The Macro and Micro structure of a living tree

What is a tree?

In technical terms, a TREE is an organic material of natural composites of cellulosic fibers which embedded in a matrix of lignin that resists compression that lives more than two years (perennial).

COULD A TREE BE JUST PLANK

Most of the time, even back to the B.C. man always thinking of making tree into fire woods. Little by little by little by more, men evolution is parallel with the usage of a tree. Rather then being fire woods, men thinks to reconsidered staying in a decent house rather then caves. Wooden trees are turns to pallet of planks as for supporting a wooden house. Not more liking living in an empty house, men tries to use their capability to produce some household. Therefore, furniture's are born. Nowadays wooden material is a lot more then meets the eye.

WOOD COMPOSITE TECHNOLOGY

Non-Periodic Table of Wood Elements

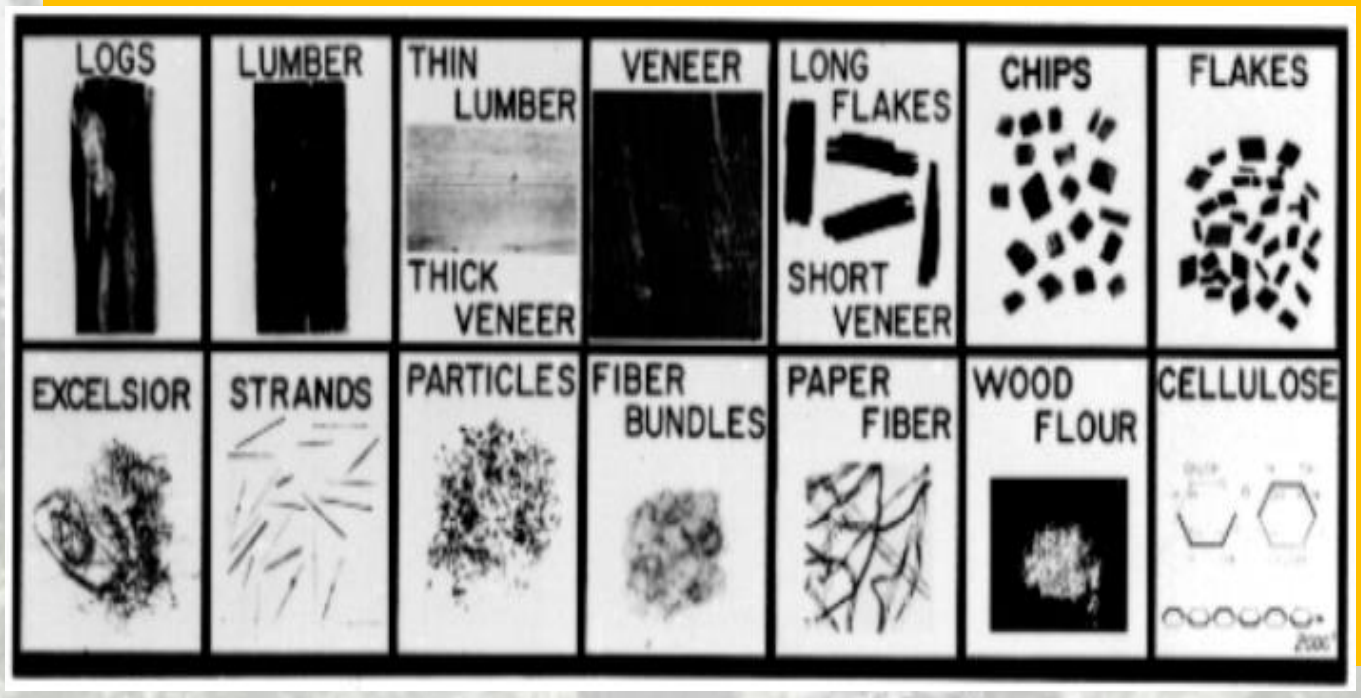


Figure XXX : The basic wood element, from largest to smallest (Marra 1969)

Wood elements in making wood composite

The basic element for composite wood material is according to the Non-pariodic Table of wood elements by Dr. George G. Marra, 1969. The elements may be the fiber, as it is in paper, but it can also be larger wood particles composed of many fibers and varying in size and geometry

These characteristics, along with control of their variations, provide the chief means by which materials can be fabricated with predetermined properties.

WOOD COMPOSITE TECHNOLOGY

Classification of wood composites

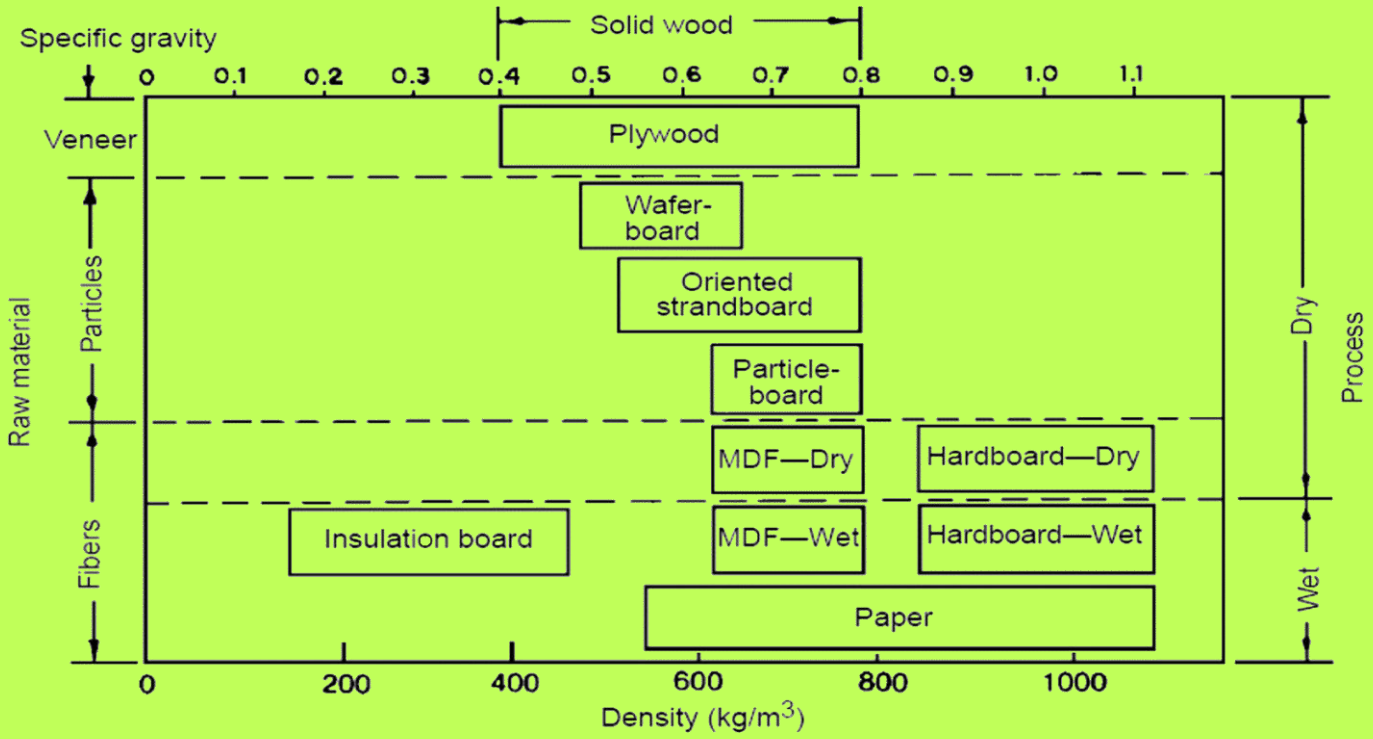


Figure XXX : Classification of Wood Composite Boards By Particle Size, Density and Process Type (Suchsland and Woodson 1986)

What is a Wood Composite?

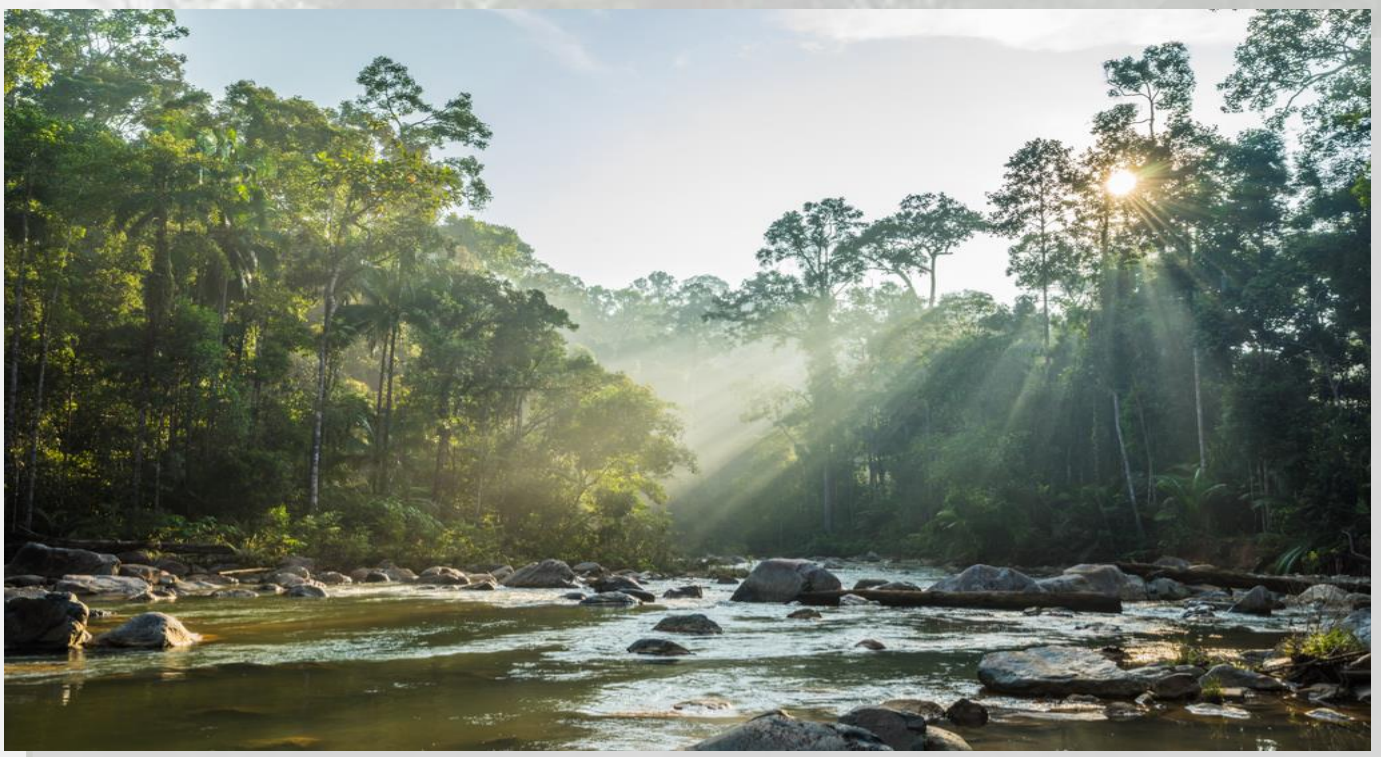
Series of panels made from basically partial of solid wood pieces (deliberately shredded into small pieces). Contain the same wood generally what we call lumber, but reconstructed and combined with the same or other species, to make it more stronger and durable then the lumber itself.
It is a mixture of several components that may include wood particles, wood fibres, wood veneers, wood strands, wood wools, wood dusts, wood flakes, wood chips (other sort of smashed lumber) and many parts of the trees (except the bark).
Sometimes the particles and fibres from different woods are combined, and adhesives is used to bound them together.

There are many types of wood composites. Some are made on the basis of fibers, particles and veneers. Typically it depends on the raw materials as shown in Figure XXX.
Eventually wood composites had been developed ever since the age of King Tut of Egypt, but only then in 1986, Suchsland and Woodson had primarily classified the types and panel of wood composites.
Even more, those two researchers had found that the more Specific Gravity (SG) of the lumber, it will affect the Density of the panel produced.

WOOD COMPOSITE TECHNOLOGY

CHAPTER 3

PART OF WOOD COMPOSITE



Wood Particleboard

The definition, particleboard usually made of medium density wood, made in panel form from of dry wood particles mixed with a binder(synthetic resin), formed and bonded to shape(with the help of mould) by pressure and heat (parallel with time period for binder to cure/hardened)

Known by several names, including chipboard, chip core, core board, synthetic lumber, and composition board.

Made from almost any types of wood, hardwood or softwood, whole nor residue, and of any species, but generally the lower density woods are much more suitable.

Other forms of lignocellulosic raw materials also are used to a lesser extent or for alternative purposes.

For specific properties, careful selection of residues and species are important.

The particleboard industry started in Europe during and shortly after World War II.

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WOOD COMPOSITE TECHNOLOGY

The transformation of a wooden material to a wood based product determine a research according to the application of the material it self. Thus fabrication, required a proximately accurate formalations, testings and permission from the authorities.

Figure : The many types of and usage of the wooden particleboard.

FABRICATION BECOMES MASS PRODUCTION.

From lab scale Research and Develepment (RnD), it becomes more and more demand as furniture raw material. Thus knowing the world will ended if the greedy desire in mass production of furnitures, men thinks of how they will secure the supply of wooden trees. Men made forest they call as it is what we know now as forest plantation. Well chosen species were planted all over the world as to curb with the harsh demand of wooden material product. Fast and lesser known tree species are being studied to fulfill the demand.

WELL MAINTAIN INDUSTRY

Modern days industry players thinking far a head of time. Maximising, manupulating and recycling over and over intime are those effort for being the best product supplier in the whole world. As for the decreasing forest, they bought a lot of harvested land to replant their raw material for the future need. Nevertheless, they need a lot of shraded wood material and willing to use the recyle material survived their demand.

Figure : The supply and demand of modern world needs.

WOOD COMPOSITE TECHNOLOGY

1

Wood as a basic material

Raw material had been best is the wood material itsef. Although the wood material offering the best fibre bound; eventually it is decreased manually by harvesting, deforestation and natural desaster.

2

Lignocellulosic based material

Not only woody plant as the best lignocellulosic material, but often been replaced by other lignocellulosic materials. Those were the non-woody plants. Catering the low supply of wood for future usage.

3

Recycled wood material

Due to shortage of material supply, recycled wood are often used as alternative. Furniture made from wood were collected to be recycled. Deform wooden houses, or thorn wooden houses were used to be recycled.

4

Saw mill wastage

Saw mills are known as its wastage. Off cuts, barks and deforms plank are used as a firewood to empowered the stim. Nevertheless it is also sold as firewood or burnt down as wood charcoal.

5

Industrial wastage

Wood furniture industries had raised like mushroom after the rain. Normally, plank and moulded joinery are used in making frames and apart of housing structure.

6

Agriculture waste

Agriculture and farming is one of the resons of forest depletened. More and more plantation are spread arround the world. Agriculture waste are ofthen used as altenative material for making particleboard arround the world.

WOOD COMPOSITE TECHNOLOGY

Particleboard in modern usage

Used as panels of modern flight or boating. Its resistance towards electricity made it a best choice in making electrical panels and the best thing is it funiture made easy to install. Due to its convinient in overall design, it’s the best material to convert, to install or to replace.

Particleboard in the daily life

Houses and buildings needs furniture's. Frames too are made from the partileboard. Doors, windows, floor railings are made from partilceboard.

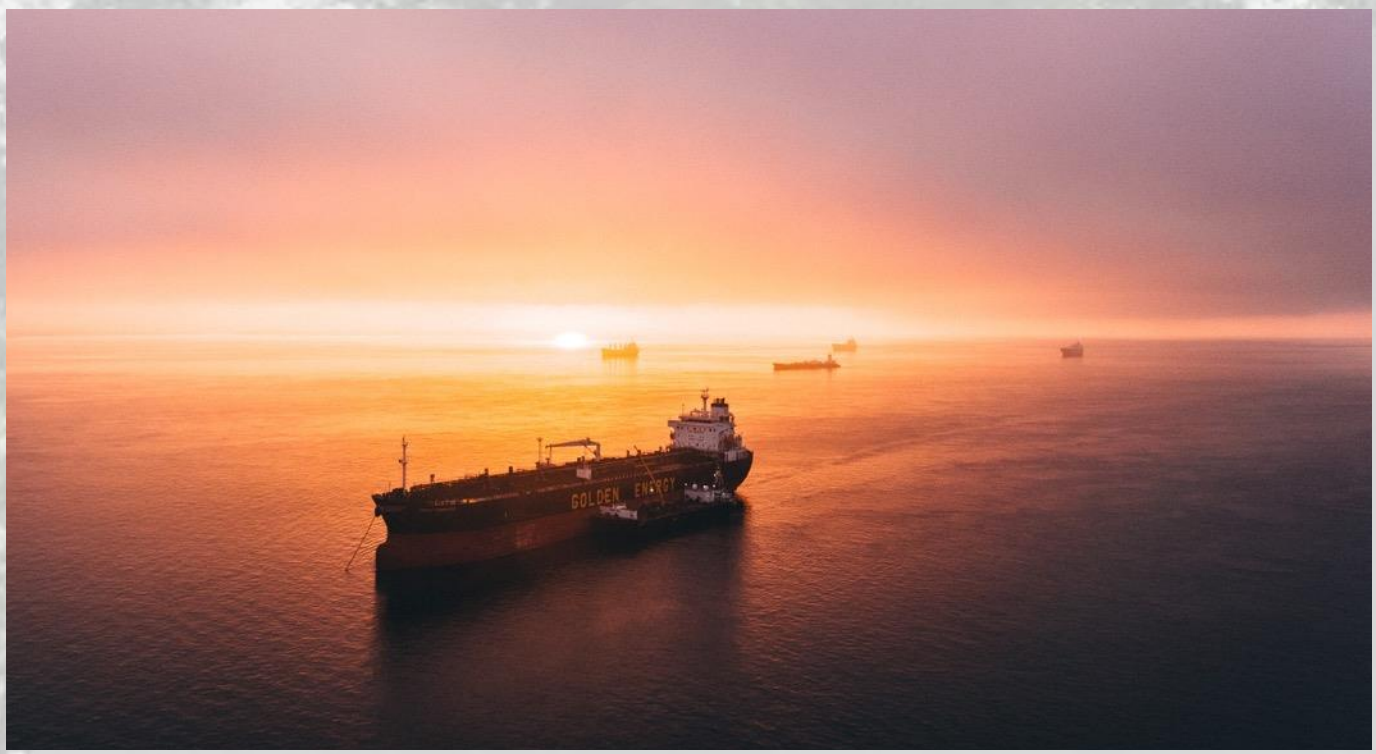
Particleboard in the industries

Film making needs a lot of props. A lot of models of houses and buildings. Ofthen used to be burnt down or exploded as action gets to the climax. Film industries needs a lot of particleboard. Not to forget the models made by the architectures, the furniture designers, the contractors, all using the same material. Nevertheless it’s a need for those who knows these material.

WOOD COMPOSITE TECHNOLOGY

PART OF WOOD COMPOSITE

Valuable particleboard are exported throughout the whole world. Signifise the important role of being a material for furnitures or structure usage.



Global demand for particleboard

Wide range of dimension, colors and shapes were being transported to all over the corners of the globe. Playing an important role of developed, well developed and third countries as a promising material for replacing the solid wood products. Solid wood products are still used but the pricing will affect the market domain while the particleboard product for such panels are used versitily among the wood panel players.

The facts

Wood based panels are composed of wood or other lignocellulosic material broken down into small elements and then reconstituted to form new products using different binders under pressure and heat. Production of wood composites such as particleboard and fiberboard has been constantly increasing in the past years. Both panel products are extensively used as a raw material in the furniture and cabinet industries. This fact sheet summarizes basic manufacturing steps, properties of the two types of panels, and their importance in furniture and cabinet manufacture as substrate for thin overlays.

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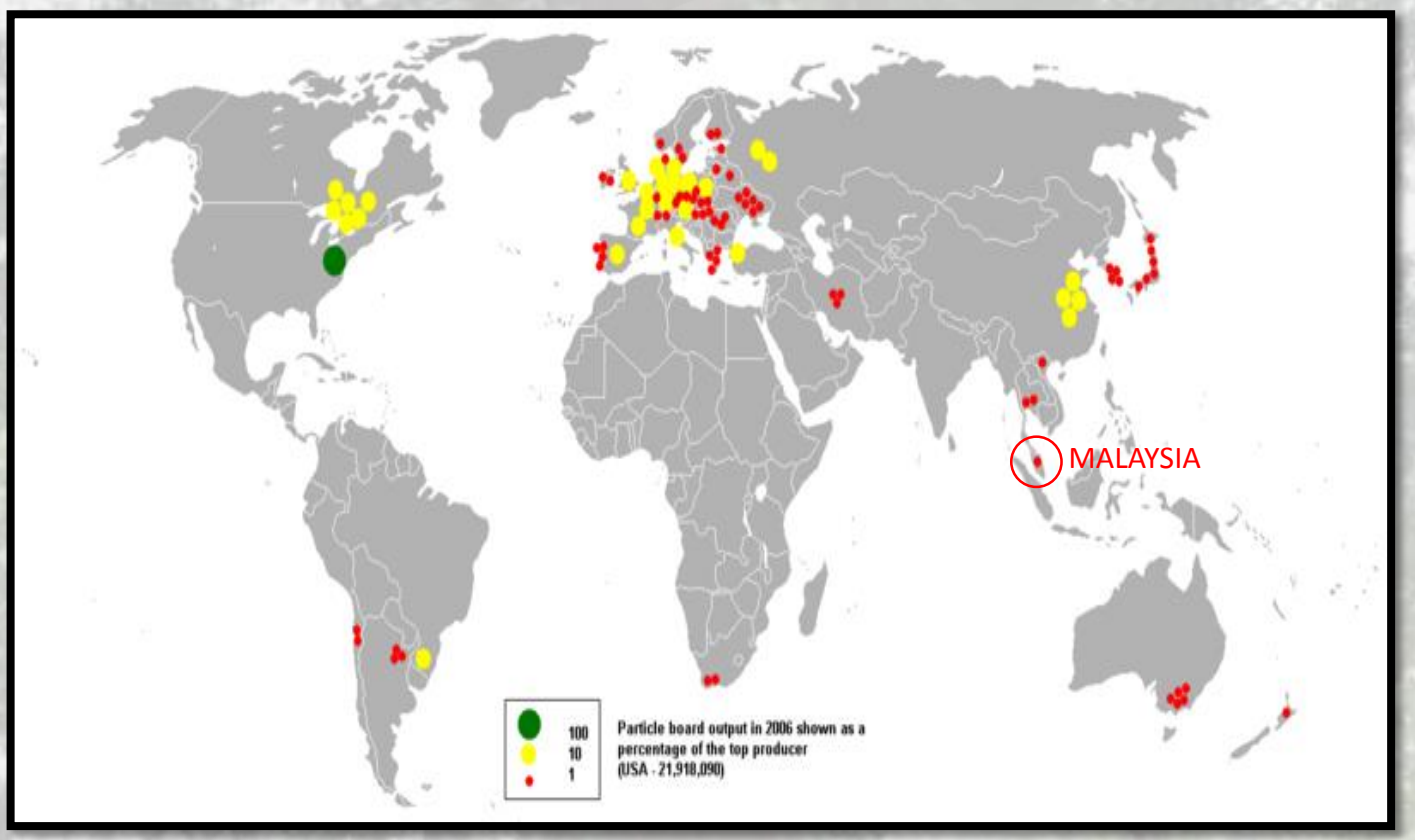

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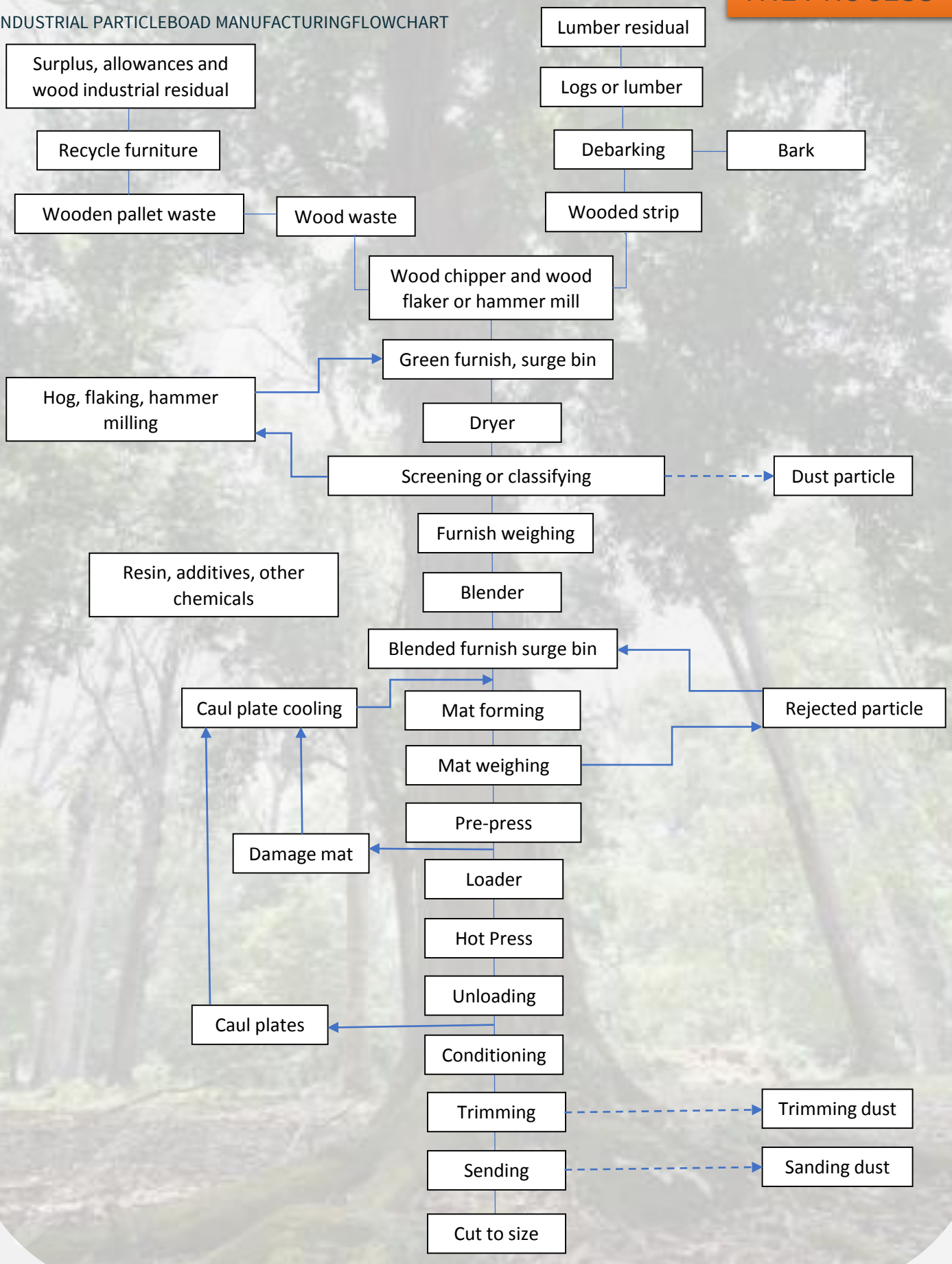
WOOD COMPOSITE TECHNOLOGY

THE PROCESS

INDUSTRIAL PARTICLEBOAD MANUFACTURINGFLOWCHART



WOOD COMPOSITE TECHNOLOGY

THE MANUFACTURING OF PARTICLEBOARD

Lumber harvesting (logging)

Logging or timber harvesting is the process in which certain trees are cut down by a lumberjack (or machine) for lumber, timber or wood particle material.

Nevertheless, the tree is not specified for lager trees, medium tree is quite sufficient.

For raw wood particle material, all parts of the tree should or can be used. Bole, trunks, branches and twigs are prereferable.

Lumber debarking

Debarking is the process of removing bark from a wood log or stake.

- Debarking generally involves the use of industrial machinery into which the log or stake is placed.
- These machines can be either stationary or portable.
- Generally they are powered by hydraulic motors.
- The log or stake is then pressed against blades or knives which remove the bark while the log is turned to ensure the removal bark from all around the log.
- Debarking can also take place by hand although this can be very time consuming and may not be suitable for large volumes.

Material flaking

Wood or lumber then were split or stripped. Then only the split or stripped lumber going through the process of hammer milling. Modern day practice are using the wood chipper and drum flaker machineries. Besides, more wood chips and more wood particle could be produced.

WOOD COMPOSITE TECHNOLOGY

SMALL LOG OR BRANCH STRIPPING

LOG/LUMBER SPLITTING

MODERN LOG TO DIMENSIONAL PLANK STRIPPING

MANUAL SPLITTING FOR FIRE WOOD

LOGYARD LUMBER SPLITTING

MANUAL LUMBER SPLITTING

WOOD COMPOSITE TECHNOLOGY

PARTICLEBOARD PREPARATION

a) Particleboard furnish is derived from a multiple of sources and as the competition for solid wood and solid wood residues increases, manufacturers are having to resort to the use of low grade residues, such as hogged mill waste, sawdust, planer shavings, etc., as well as wood species not previously considered.

b) In view of the wide assortment of furnish delivered to the mill-yard, segregation as to size, and if possible, species, must be carried out prior to the reduction process. Bark is removed from logs, if not already done in the forests, so as to avoid blunting chipper knives, and the provision of stone-traps and magnetic separators safeguard other reduction equipment from damage which would otherwise be caused if contraries were introduced with the fibre furnish.

c) The particle size and geometry, as required for the core and surface layers of the particleboard, are produced by a diverse range of reduction equipment which is matched to the variety and size of wood and wood residues used. Chippers, knife-ring-flakers, hammer mills, disc refiners, etc., each operating on a different principle, using either knives, hammer bars, grooved disc plates, etc., are but some in common use in the industry.

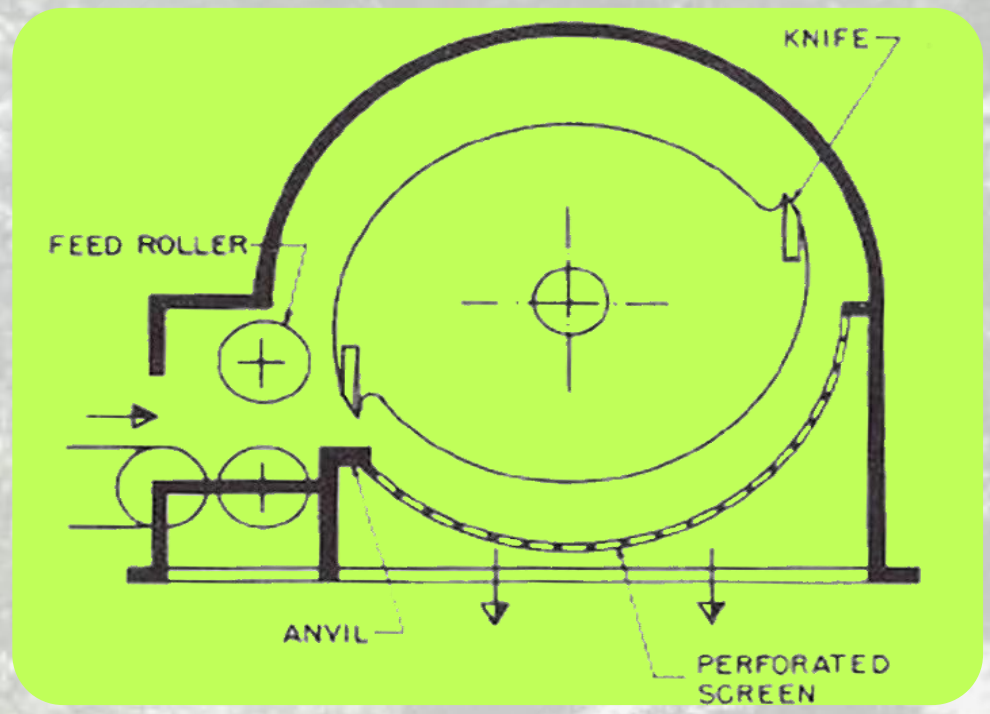

Recycle furniture


Lumber slabs


Lumber

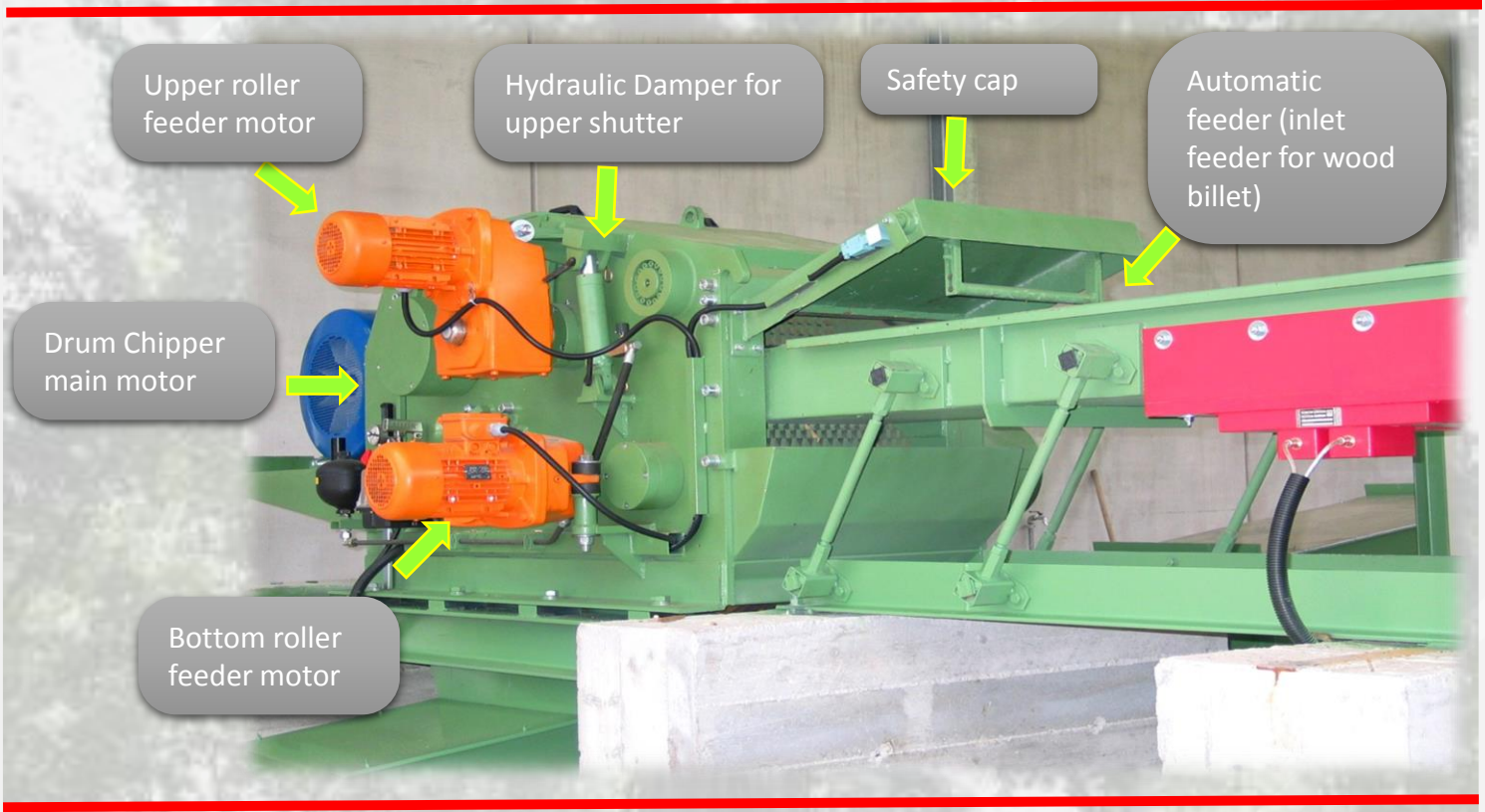

Wood chips

WOOD COMPOSITE TECHNOLOGY



a. Drum-type chippers are used for chipping veneer, slabs, edging and small-diameter wood.
b. Screens can be built into drum chippers to reduce oversize particles as illustrated in the left side figure.
c. In the composition board industry, chippers are used to reduce roundwood or other large material into a predetermined chip size for further refining.
d. In operation, the knives cut across the fibers at an angle.
e. The wood splits in the fiber direction because of a shearing action caused by the cutting and the hard impact of the knife striking the wood.

WOOD COMPOSITE TECHNOLOGY



The wood Chipper Machine

Normally, wood chipper machine is used to break down strips of wood into smaller chips. Not only providing wood chips for particle usage but supplying it to pulp and papper at the same time.

Wood Chipper is more prefarable due to its effeciency compared to the hammer mill. Hammer mills produces a lot of wood dust whilst wood chipper reduces the wood dust.

Hammer mill is one of the oldest types of technolgy since it uses the concept of hammering and was used to break the rocks into smaller particles.

Particle Screening

a) Directly after drying, the particles are screened for size in vibrating or gyrating screens, or by way of air classification. Screening normally takes place after the dryers as moist particles tend to stick together, plugging screen plates and lowering the overall efficiency of the screening process.

b) Particles are separated according to size, for the purpose of grading the furnish for the board face and core layers. It is essential that the oversized particles be recycled for further reduction and that the fines are screened out, so as to avoid consuming a disproportionate amount of resin binder, and to provide a valued source of fuel.

WOOD COMPOSITE TECHNOLOGY

1

Energy

Some manufacturers sort their particles before drying, so those outside the desired range are not dried, which saves energy.

2

Goal

Another goal of wet screening in the particleboard lines is to adjust the ratio between face and core particle before drying.

3

Distribution

The drying of particles process can be controlled more accurately when particle size distribution is known before.

4

Sorting

But wet particles are difficult to sort efficiently as they tend to stick together.

5

Classifying

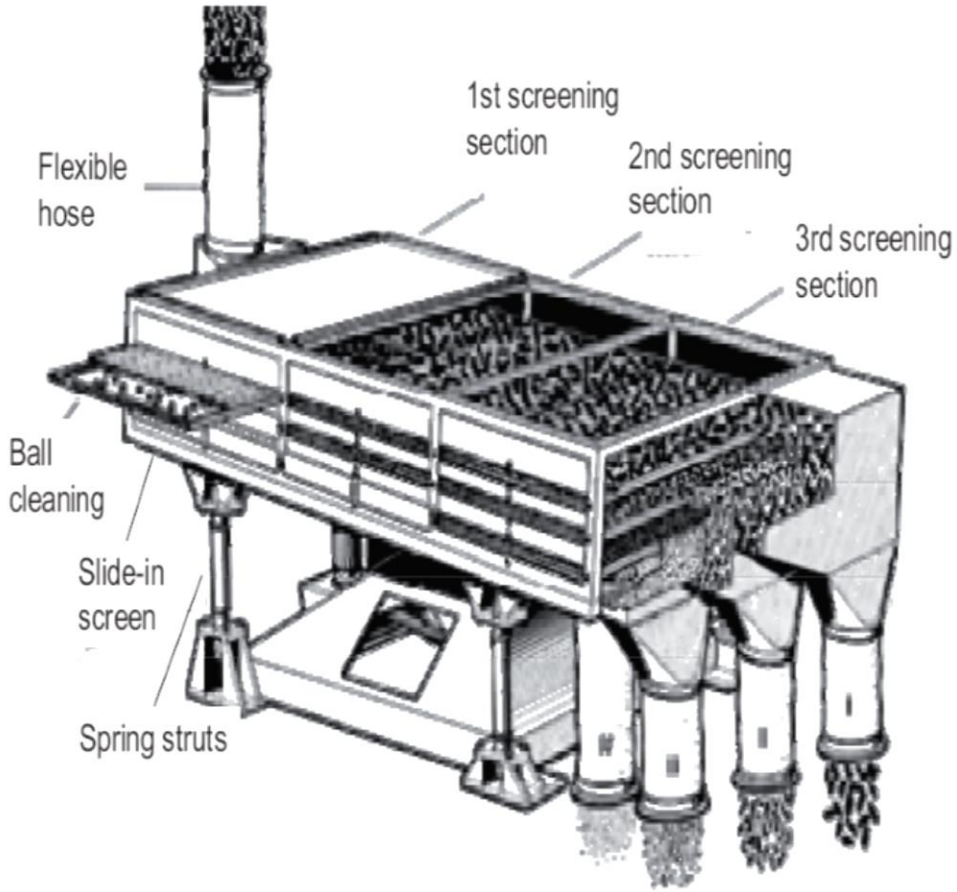
Consequently, in most particleboard factories the particles are classified after drying.

6

Drying

Another method of screening is the particle are pre-heated during the screening process making it dries quickly bor better sorting or classified.

Particle Screening



There are two methods of sorting particles: **mechanical sieves and air classifiers.**

Particle Sorting/Screening

There are three types of the mechanical sieves found in industry: **vibrating inclined screen, vibrating horizontal screen, and gyratory screen, which are readily recognizable from their housings.**

- **All** of these work on the same principle in that the particles are fed over a series of wire meshes, the particles either fall through or are passed to a collecting bin, see Figure above.

Particle Sorting

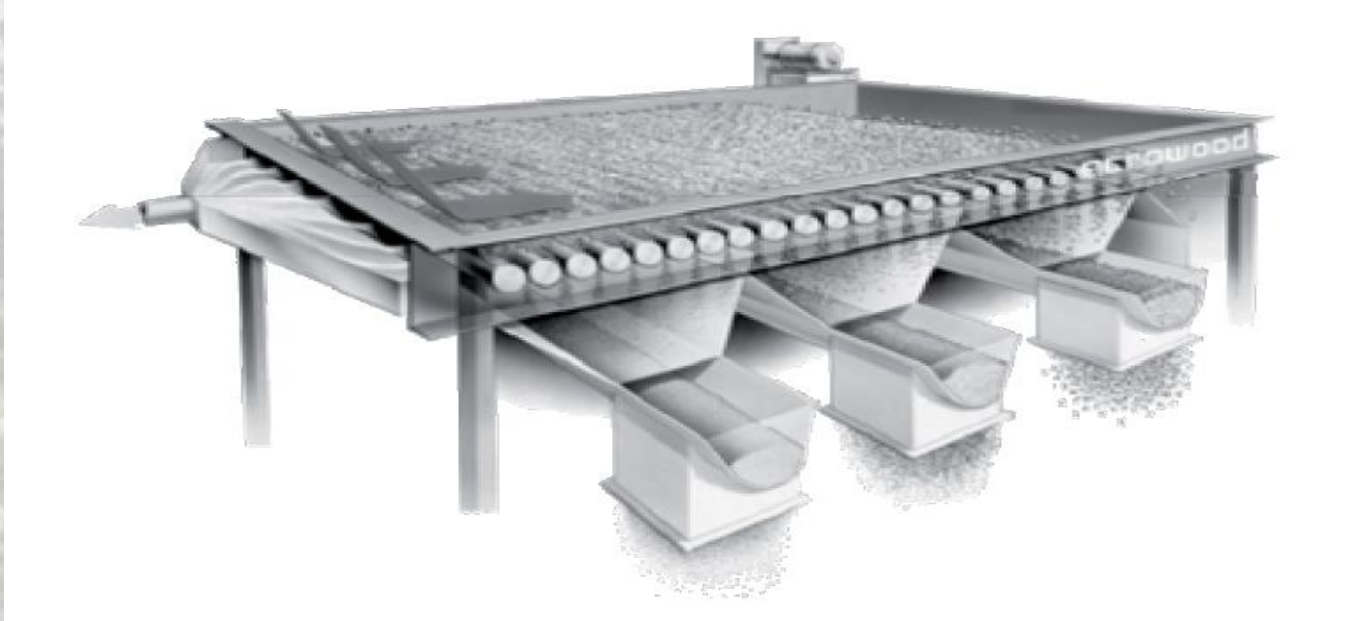


Figure showing a roller system for sorting particles generated from recovered raw material (Acrowood).

Particle size classification can also be achieved using dynamic screens of rotating rollers as shown above.

- The advantage of using this method is that the screens are largely self-cleaning.
- The texture of the roller surface and the distance in-between them permits highly accurate separation of particles into face and core fractions and also the elimination of sand, soil and foreign particles.

Particle Sorting

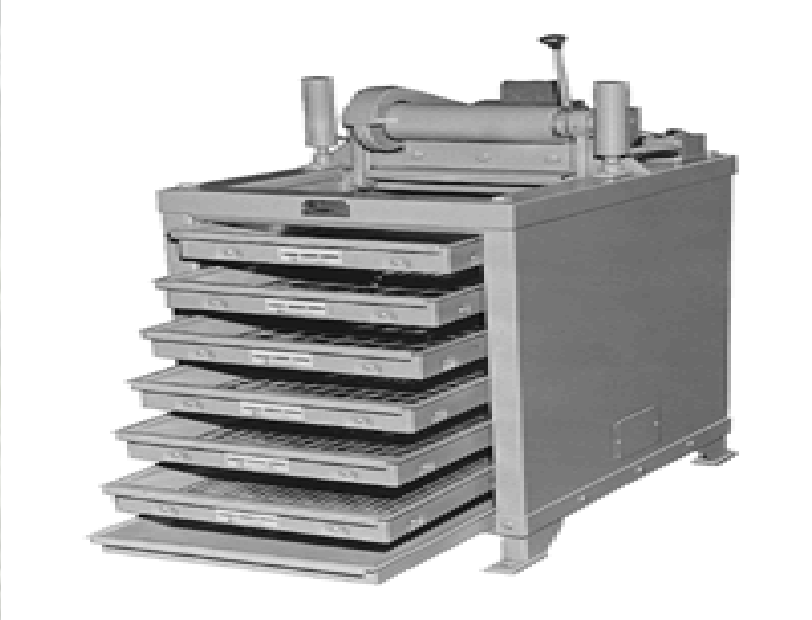


Figure Showing Glisson Multiple Tier Wood Particle Vibrating Screener

Figure Showing Industrial Gyrotory Screener

Particle Sorting

Figure Showing Horizontal Wood Chip and Particle Vibrating Screener

Figure Showing Horizontal Wood Chip Vibrating Screener With Conveyor Belting Inlet

Resin application and Blending

a) Liquid raw adhesives are often purchased as water-based solutions, containing approximately 50% (PF) to 65% (UF) solids.

b) These are thermosetting adhesives in which the curing process (condensation reaction) has been interrupted before delivery of the solution, thus storage duration is limited to several weeks depending on season, transportation and storage temperature.

c) Adhesives can be purchased in powder form for longer storage, but, this rarely used in Europe.

d) Before application on the dried furnish the adhesive solution must be blended, according to proven recipes, with water and additional additives,e.g. hardeners, colours, fire retardants, preservatives, etc..

e) Different adhesive formulations may be used for the surface and core layers.

f) The amount of adhesive mix to be added is calculated on a solid adhesive substance to oven dry wood basis.

g) The hardener solution, which is added to catalyse the resin curing reaction is introduced as a percentage of solid hardener substance to solid resin basis, is added as late as possible to avoid premature curing due to production line stoppages.

h) The surface and core layers experience different curing conditions during hot pressing and so different adhesive mixes are used for surface and core layer furnishes.

Resin application and Blending

i) Resination of the furnish is a continuous process, which requires constant and continuous mass and/or volume flow control (furnish weight, resin weight/volume) to guarantee accurate blending and uniform panel properties.

j) The mixing of the adhesive recipe on the other hand before application to the furnish fractions, is done either continuously or batch wise.

k) The type and amount of adhesive depends on panel type (interior or exterior application), particle size, hot pressing conditions etc.

l) The data in Table in the next page are just for general information and may vary.

Blending and Mat forming

a) Adhesives in the form of urea, phenol and melamine formaldehyde are generally used to bind together the particle mix, with the former being the most favored resin in use. Between three and ten percent by weight of resin, together with other additives used to impart such properties as fire resistance, etc., are blended under controlled conditions in batches or as a continuous operation. Blending may either take place in large vats at slow speed, or in small blenders with rapid mixing and shorter blending times.

b) In the more modern particleboard plants mat forming is a wholly mechanical process, whereas the older formers require manual equalizing. In spite of the wide variety of formers currently available, the underlying principles of mat formation are generally similar, in that a uniform flow of particles are fed to the former from a surge bin, which in turn meters an evenly distributed layer of particles into a frame on a moving belt or caul.

c) The formers may be fitted with single or multiple forming heads, which are either stationary or moving, and are so designed that the finest particles are delivered to form the surface layers of the mat and the coarser materials to form the core. In all cases it is paramount that an evenly distributed mat of the desired weight be formed. Mats that do not conform to standard are rejected and recycled.

d) Transportation of the mats to the pre-press and hot press is undertaken by either forming the mat on metal plates, called cauls, which are then either manually or mechanically wheeled to the presses, or in the case of caulless systems, by using flexible metal webs, plastic belts and trays that transport the mats through to the hot-press.

Types of Resin

Particle board	UF	4 % - 10 %	→ surface layer	8 % - 14 %
			→ core layer	4 % - 8 %
	PF	6 % - 8 %	→ surface layer	8 % - 12 %
			→ core layer	6 % - 9 %
	MDI	2 % - 6 %	→ surface layer	6 % - 8 %
			→ core layer	2 % - 4 %
OSB	PF	6 % - 8 %		
	MDI	2 % - 6 %		
MDF	UF	8 % - 14 %	→ in blow-line resin application	
	UF	6 % - 10 %	→ resin application to dry fibres	
	MUF	8 % - 12 %	→ for HDF as flooring quality	
	MDI	≈ 4 % - 10 %		
all panel types	wax	0,3 % - 2 %	applied as micro-crystalline wax emulsion or liquid paraffin	

Table showing Typical resin addition levels for different panel types (Ressel, 2008).

UF bonded particleboard for interior application			
UF resin (66 % solid content)	100 kg	Hardener solution	
Hardener (15 %)	10 kg	SL	5 % $(NH_4)_2SO_4$
Paraffin emulsion (50%)	10 kg		10 % NH_3
Water	12 kg		85 % H_2O
		CL	10 % $(NH_4)_2SO_4$
Adhesive solution	**132 kg**		5 % NH_3
			85 % H_2O

Table showing Urea Formaldehyde (UF) resin addition levels for different panel types (Ressel, 2008).

PF bonded particleboard for exterior application			
PF resin (45 % solid content)	100 kg	Hardener solution	
Hardener (50 %)	5 kg	SL	none
Paraffin emulsion (50%)	15 kg	CL	50 % K_2CO_3
Water	0 kg		50 % H_2O
Adhesive solution	**120 kg**		

Table showing Phenol Formaldehyde (PF) resin addition levels for different panel types (Ressel, 2008).

Particle Blending

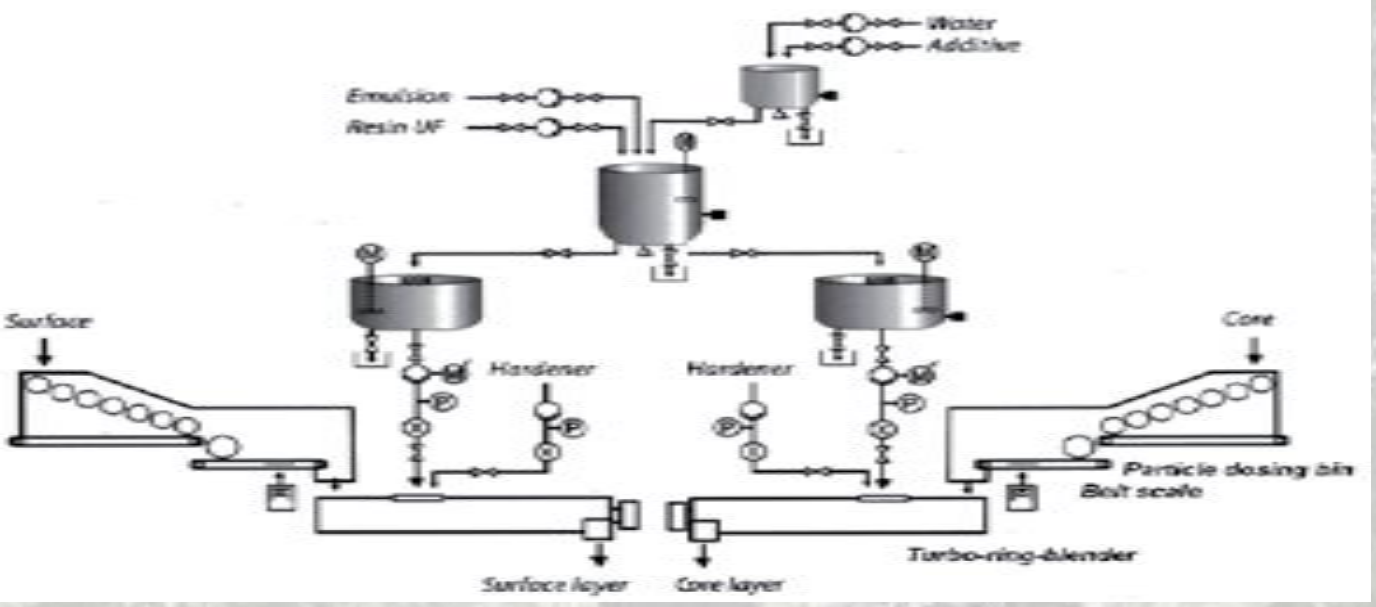


Figure showing Batch wise adhesive blending of particle (courtesy of Metso Panelboard).

a) Batch-wise adhesive blending is used for small and medium-capacity particleboard plants, operating with long production series without changing the adhesive formulation.

b) During batch-wise adhesive blending all of the adhesive formulation components, with exception of the hardener, are mixed in a tank.

c) Hardener solution is first added to the furnish in the particle blender.

Particle Sorting

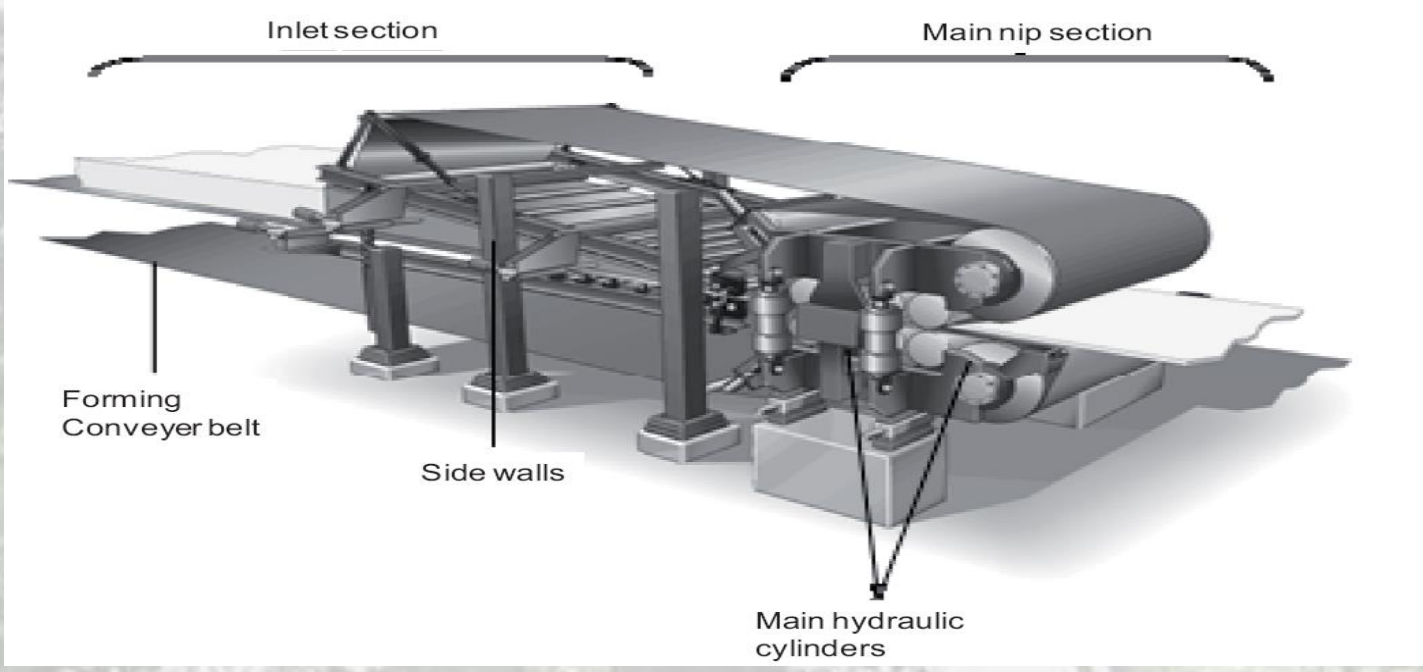


Figure above showing A pre-press process (Metso Panelboard).

Mat Pre-press.

- Since a **pre-pressed mattress is thinner the press does not have to open** so much in order to accommodate it.
- It therefore follows that the press inlet section main nip section does not have to close so much to compress the mattress to the desired thickness, which also helps to reduce the chance of precure.
- A press can compress a pre-pressed mattress far quicker than one that has not been pre-pressed because the prepress squeezes out much of the air in the mattress.
- This air can sometimes cause particles to be blown out of the side of the mattress if it is pressed too quickly.
- Consequently, the overall press cycle is reduced.

Hot Pressing

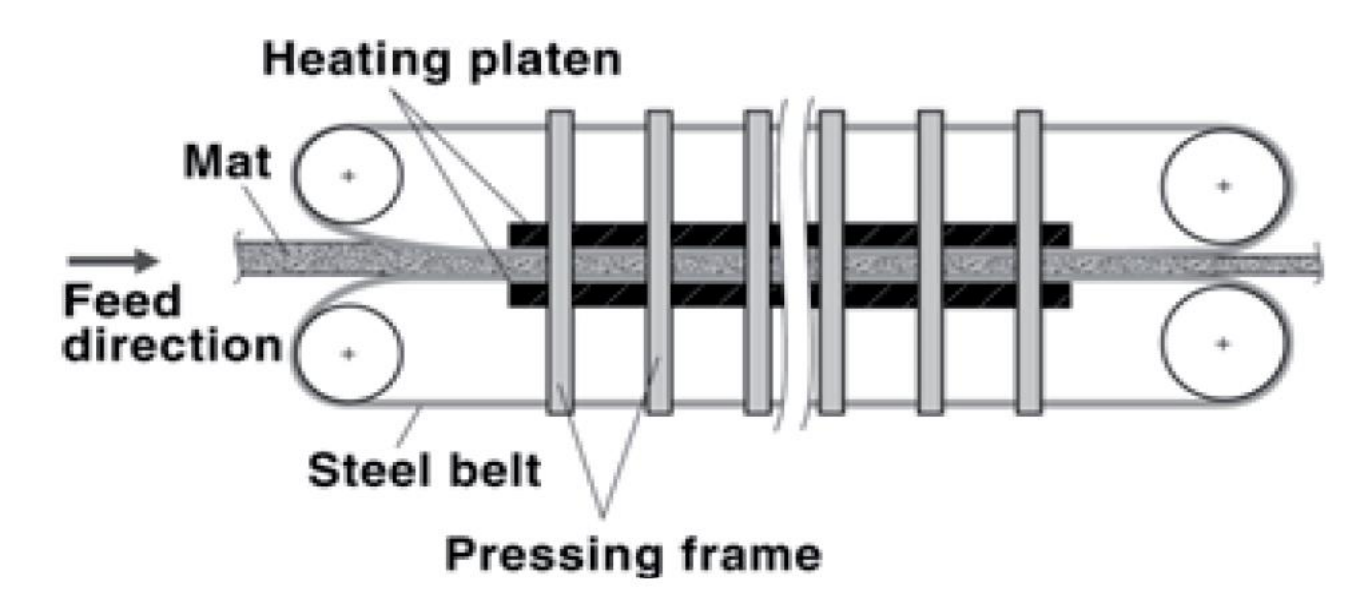


Figure above showing a diagram of the principles of a continuous press (Thoemen and Humphrey, 1999).

- Another advantage caused by the fact that a continuous press remains “closed” the whole time, is that the panels produced have very close thickness tolerances.
- This in turn, reduces the amount of sanding required.
- Tremendous amounts of money can be saved by minimising sanding losses.

Hot Pressing

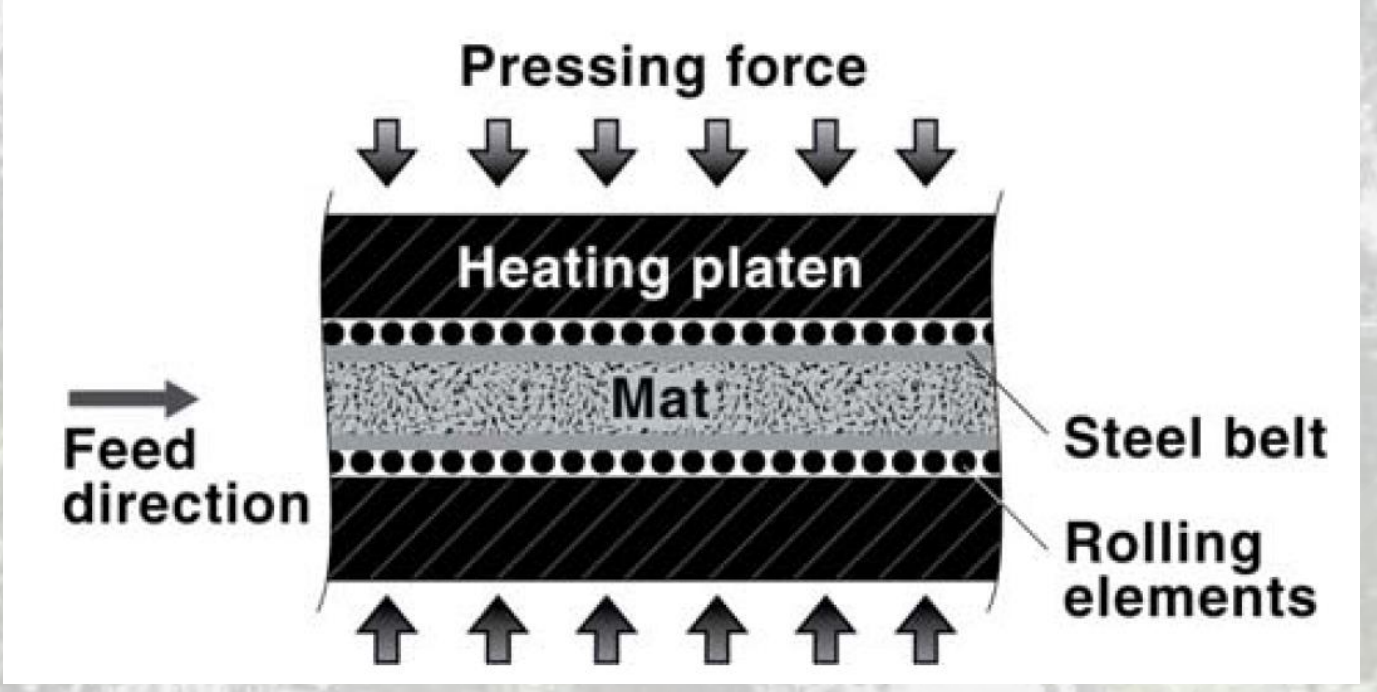


Figure above showing A diagram of the mechanism employed to minimise the friction between the stationary hot platens and the moving steel belts that carry the mat through the press (Thoemen and Humphrey 1999).

- The use of continuous presses for the production of particleboard, OSB and MDF around the world is a real success story.
- Typical press widths are between 1.8 – 3.0 m. Only a few plants exist with widths greater than 3.0 m.
- Pressure distribution, frame design, and mat de-aeration are the main reasons why presses wider are not made frequently.
- There is a continuing trend for greater press lengths and speeds.

Trimming and Cutting

Figure showing diagonal saw for cut to length panels after continuous hot pressing (Metso Panelboard).

Trimming and Cutting to Length

- Using a diagonal or flying saw composed of two circular saws the continuous press endless hot board is cut to length (normally no more than 6.5 m) to a so called master panel.
- The correlation between the press speed and the traversing circular saws is computer controlled.
- For thin panels, which are pressed at high speeds, both circular saws operate.
- Also this sawing equipment has to fulfil high precision for the panel length ±2 mm, squareness ±1.5 mm/m and straightness ±1.5 mm/m.

Conditioning and Cooling

Figure showing conditioning process using Star Cooler Machine

- Particleboards bonded with UF or MUF must be cooled after they have been taken out of the hot press.
- If the boards were stacked together immediately, the residual heat would cause thermal degradation of the glue.
- On exiting the press the boards are placed in a star cooler, which looks like a paddle boat wheel.
- The cooler is usually large enough to accommodate a sufficient number of boards so that as boards leave the cooler their surface temperature will have fallen to about 40 °C.
- Depending on the stack size and season, the temperature in the centre can be more than 55 °C after 3 days of storage.

Intermediary Storage

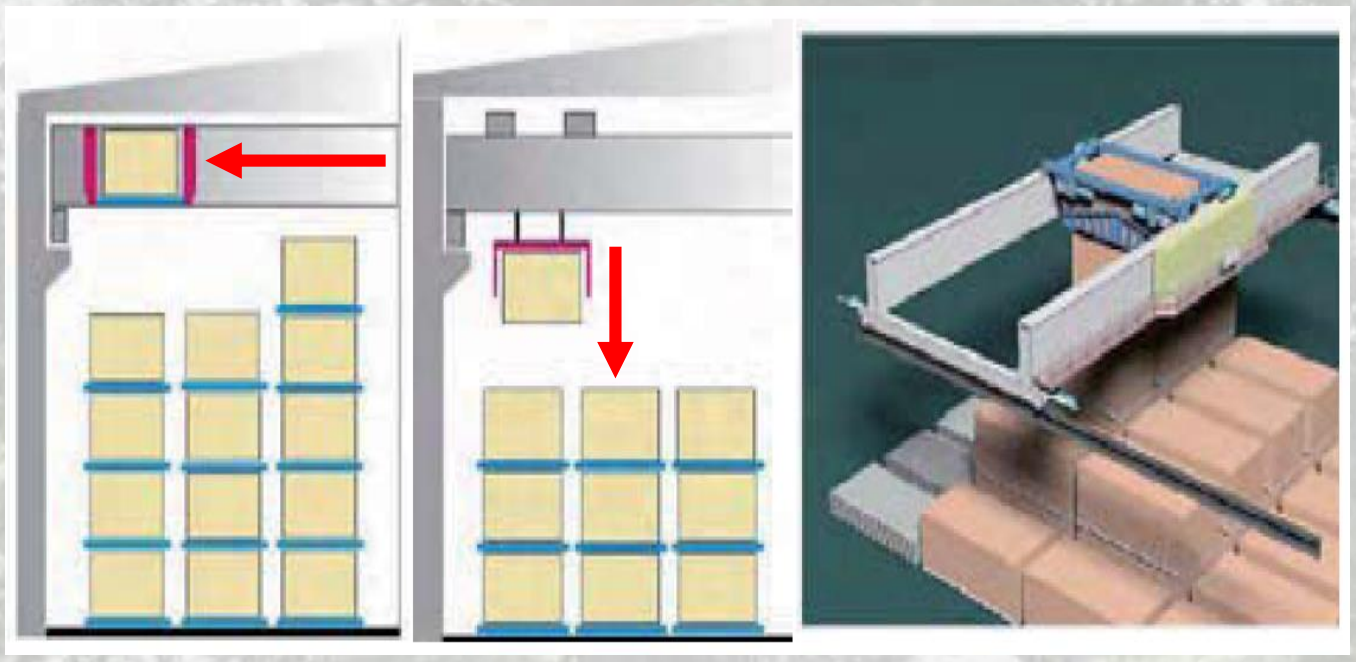


Figure showing full automatic intermediary crane based storage system (Metso Panelboard).

- After cooling and stacking, the panels are stabilized through additional cooling, curing and rehumidification in an intermediary storage.
- Although transportation based on fork lift trucks is still common place, it larger mills it has been replaced with fully automated systems (robots), which are able to handle the big stack sizes with the master formats (press width x 6.5 m x 1.5 m, weighing approximately 20 t) to an intermediary storage of some 0.5 ha or more.
- One type of such system in based on stack care crane bridges, rolling on overhead rails installed on building frame.
- Both movements cross- and lengthwise are performed simultaneously, which confer a high transferring rate capacities (transferring speed 3 m/s).

Sanding and Cut to size

Figure showing the Cut to size centre (MDF Hallein).

- There are two reasons why the panels are sanded after hot pressing and intermediary storage:
  a. To remove pre-cured surfaces that are often weak, fibrous and porous.
  b. To calibrate panel thickness because the panels springs back on release from the press and this varies from panel to panel and also within a panel.
- The sanding allowances depend on panel thickness, press precision and sanding machine (finishing quality).
- The thicker the panel is, the higher the requested sanding allowances (0.8-1.2 mm).
- Calculated for the whole panel production particleboard approximately 3 % of the line output is processed to sanding dust.
- Generally this dust results from the high densified (600-1000 kg/m^3) and high resin (i.e. 10-12 % UF resin) face layers of the boards.

WOOD COMPOSITE TECHNOLOGY

CHAPTER 5

Discussion

Figure showing the various types of particleboard end product.

- Particleboard is defined as a panel product manufactured from lignocellulosic materials, primarily in the form of discrete particles, combined with a synthetic resin or other suitable binder and bonded together under heat and pressure.
- The primary difference between particleboard and other reconstituted wood products, such as waferboard, oriented strandboard, medium density fiberboard, and hardboard, is the material or particles used in its production.
- The major types of particles used to manufacture particleboard include wood shavings, flakes, wafers, chips, sawdust, strands, slivers, and wood wool.
- The term particleboard sometimes is used generically to include waferboard and oriented strandboard, which are manufactured primarily with wood flakes and wafers.
- However, for the purposes of this report, particleboard pertains only to panels manufactured from a mixture of wood particles or otherwise from wood particles other than wafers and flakes.

CHAPTER 6

Conclusion

Figure showing the Cut to size centre (MDF Hallein).

- There are two reasons why the panels are sanded after hot pressing and intermediary storage:
  a. To remove pre-cured surfaces that are often weak, fibrous and porous.
  b. To calibrate panel thickness because the panels springs back on release from the press and this varies from panel to panel and also within a panel.
- The sanding allowances depend on panel thickness, press precision and sanding machine (finishing quality).
- The thicker the panel is, the higher the requested sanding allowances (0.8-1.2 mm).
- Calculated for the whole panel production particleboard approximately 3 % of the line output is processed to sanding dust.
- Generally this dust results from the high densified (600-1000 kg/m^3) and high resin (i.e. 10-12 % UF resin) face layers of the boards.

Recommendation

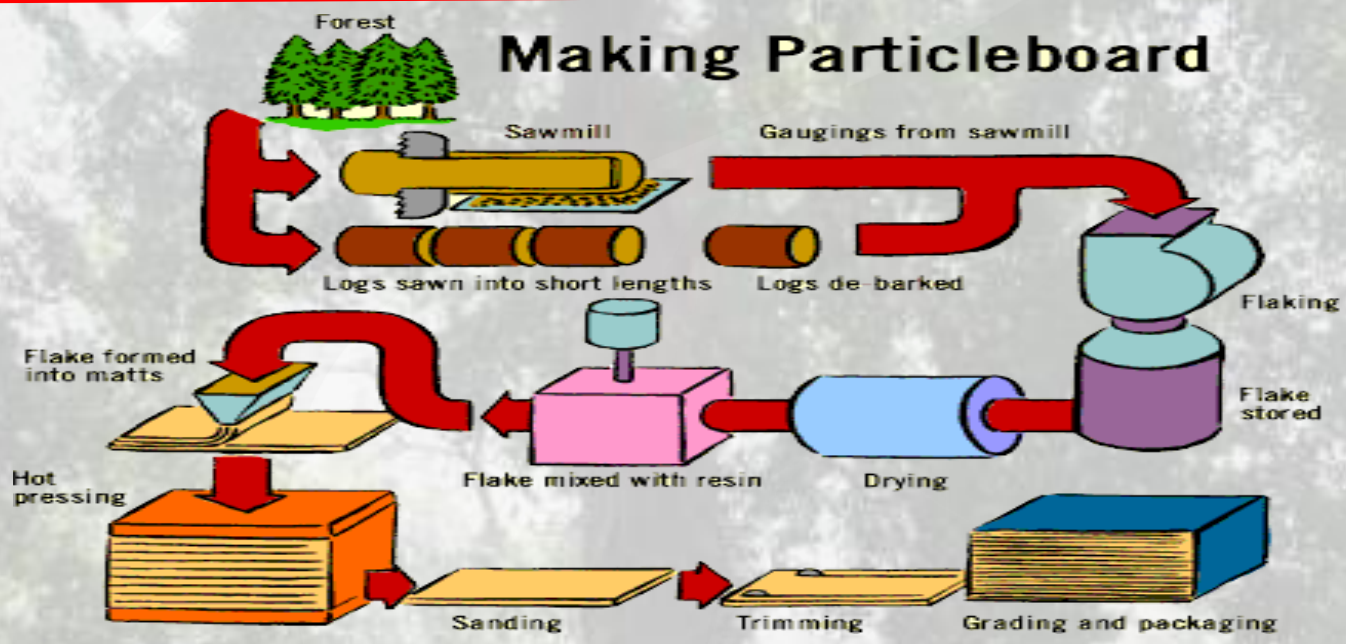


Figure showing the block diagram of particleboard making

- Moisture content of greater than 50 percent on a dry basis are labeled “green” dryers.
- A predryer may be used for initial drying of relatively wet furnish. Following predrying, the drying process is completed in a final dryer (which may be either a rotary dryer or a tube dryer).
- The dryer inlet temperature is adjusted based on the desired furnish moisture content at the dryer outlet.
- Core dryers generally operate at higher temperatures than surface dryers due to differences in core and surface particle characteristics and because a lower moisture content is more desirable for core material.
- After drying, the particles pass through a primary cyclone for product recovery and then are transferred to holding bins.
- Face material sometimes is screened to remove the fines, which tend to absorb too much of the resin, prior to storage in the holding bins.
- From the holding bins, the core and surface materials are transferred to blenders, in which the particles are mixed with resin, wax, and other additives by means of spray nozzles, tubes, or atomizers.
- Urea-formaldehyde is the resin most commonly used for particleboard manufacture. However, phenol-formaldehyde resin may be used for particleboard produced for exterior applications.

WOOD COMPOSITE TECHNOLOGY

CHAPTER 8

Products of Particleboard

Figure showing normal particleboard

Figure showing extruded particleboard

Figure showing laminated particleboard

Products of Particleboard

Figure showing flooring and sub-flooring

Figure showing insulation roofing

Figure showing external roofing

Products of Particlboard

Figure showing furniture shelving

Figure showing wardrobe and cabinet

Figure showing particleboard coffin

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POLITEKNIK MALAYSIA
SULTAN SALAHUDDIN ABDUL AZIZ SHAH

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