

# Design and Development of Process and Equipments for Production of Hardboard/Ply from Forest Wastes

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**Abstract:** - A Process of improving the strength and resistance to water absorption of Wood Hardboard along with a lessening in the number of conventional steps is disclosed. Hardboard is thereby produced with dry leaves fallen from the trees in residential or forest area can be collected by village people or rag pickers and then this collected waste to be crushed in a Grinder or crusher and mixed in Mixer to make the powder. The above Mixture is used to make, Chip Boards and other Wooden Products like Door Frames, Panels, Frames etc., using the Press by adding polymer to the powder. Here we learnt about how to use the forest wastes for useful purpose to clean the environment and most importantly to save the forest

**Key-Words:** - Forest waste, Hardboard, resin, Fly press, dry leaves, and mixer

## 1 Introduction

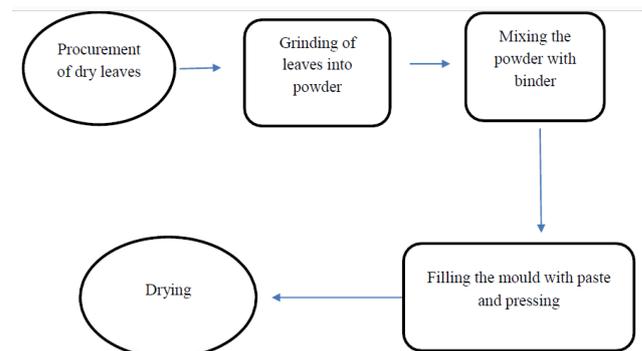
Hardboard is made of saw dust or rice husk. This also known as particle or fiber board. Hard board looks like wooden board wood products; this can be made by wet or dry process these hard boards are used for making furniture or in construction work.

The process of manufacture of hardboard from forest wastes include the following stages

- **Collection of raw materials:** This is first step of the process which involves the collection of raw materials such as dry leaves fallen from the trees in residential, shrubs, bushes, dry grass etc [5].
- **Crushing the dry wastes into powder in grinder**
- **Mixing the binder:** Suitable binder is mixed with the powder in proper ratios of hardener and binder in a mixer [1].
- **Filling and pressing:** The paste obtained after mixing the binder and hardener then forms a paste which is filled in the mould in required shape and size of desired thickness and then is pressed in the fly or hydraulic press with suitable pressure.
- **Drying:** This pressed paste gets the required shape and size which is then taken out of the mould and is then left overnight for drying at room temperature.

## 2 Schematic view of process

Detailed explanation of process in stages is shown in Figure 1:



**Figure 1:** Schematic view of process

### 2.1. Procurement of dry leaves /forest wastes

This is the first stage of hardboard manufacturing. All the dry leaves which fall from the trees in the residential areas and forest are collected by village people or rag picker. These can also include other forest wastes such as small shrubs, dry grass, stems etc. These leaves are then cleaned to make them free from dust and mud. The leaves are to be completely dry to ensure proper grinding and to obtain hardboard of excellent quality. Leaves are collected in large quantity as they reduce to very less volume in the powder form when crushed. . As the leaves have a free fall during autumn and summer these leaves falls on the ground and cause a rotten smell which in fact can also be used by drying. As these leaves fall in summer season and are available for months only, storage of the leaves may be needed to

have a continuous production of the hardboard throughout the year [3], [4].

The following Figure 2 shows the collecting leaves



**Figure 2:** Collecting leaves

## 2.2. Grinding

During grinding the collected leaves are ground to make powder using a grinder. A grinder is made of mild steel sheet that has blades with one or more cutting edges fixed to a rotating shaft that is rotate using an external source or power. The detailed explanation of the tool is discussed below and shown in Figure 3.



**Figure 3:** Grinder

### *Principle:*

The rotatory motion of the shaft is transferred to blades that have very less clearance and which cut the leaves into pieces as they struck the sharp cutting edge of the blades.

### *Parts:*

- Grinding Chamber
- Blades
- Bevel gear mechanism
- Rotating handle
- Outlet
- Lid
- Output

With help of the grinder dry leaves are crushed into powder as shown in the Figure 4 below.



**Figure 4:** Output

## 2.3. Mixing

This is the third stage of processing. The powdered leaves are collected in a collector and dumped into a mixer. A mixer is used to mix the powdered leaves with a binder [1].

### *Binder:*

A Binder is an adhesive material which is used to bond the leaf particles in the powder. The characteristics of the hardboard are mainly based on this binder as it gives the hardboard the required strength and density [2]. Based on the requirement or the type of usage of the hardboard being produced different binders are used. Urea Formaldehyde-20 is supplied as a fine white powder, which has the advantage of long storage life. It is recommended for the manufacture of chipboard. This resin is just a binding agent that keeps the particles together. This hardener reduces the setting time of the board. It is shown in Figure 5.



**Figure 5:** Urea Formaldehyde-20

#### 2.4. Filling and pressing

This is the fourth stage of the process. At this stage the required physical properties such as volume, thickness, density, shape etc. are adjusted as per the requirement. The paste thus obtained in the above stage of mixing is then filled in a mould of required shape and dimensions like a rectangular tray of dimensions 250x200x35 mm. After filling it the tray is then covered with a mould and placed under the pressing tool [6], [7].

##### *Pressing tool (Fly press):*

A press tool is a tool that is used for pressing operation. The mould after filling with the paste is placed in the press and is pressed at a require pressure. A detailed description of press tool is given below Figure 6.



**Figure 6:** Pressing Tool (Fly Press)

##### *Principle:*

Unlike some presses, in a mechanical press, the application of force varies in both speed and

magnitude throughout the distance of the stroke. When performing a manufacturing operation using a mechanical press, the correct range of the stroke is essential.

##### *Parts:*

- Base plate
- Top plate
- Rods with threading on top and bottom
- Washers
- Nuts
- Square hollow rods
- Shaft with threading
- Key
- Punch with bearing
- Flywheel
- Mould

#### 2.5. Shaping and drying

##### *Shaping:*

The die forms a board of rough and non- uniform sides due to pressing operation. Hence a shaping is required to chop off the uneven edges and give it a proper shape.

##### *Drying:*

Drying is the last stage of hardboard making. The pressed hardboard is dried for a duration which is based on the type of binder that is used at room temperature or in the sun. For example, if Urea formaldehyde -20 a binder is used minimum it requires drying span of 7.5 hours at room temperature.

##### *Output:*

Hence hardboard of required size, shape and dimensions is obtained. It is shown in figure 7.



**Figure 7:** Output of Hardboard

### 3 Applications and Advantages

#### 3.1 Applications

*Countertop:* Hardboard is commonly used as a material for countertops. We can put a number of different things on top of hardboard in order to form a durable surface. Many people put laminate on top to form a very hard countertop to work with. By doing this, one basically achieve any look that you are going for and copy any other type of material, like granite or marble, for a fraction of the cost. This type of countertop stands up well to knives and other kitchen utensils that you would be using to prepare a meal.

*Subfloor:* One of the best subfloors around is hardboard. It provides us with a very strong foundation on which to lay flooring, and we will not have to worry about it moving up and down as much as you do with other types of subfloor materials.

*Furniture:* Hardboard is commonly used as a construction material when building furniture. This provides a very strong piece of wood in order to build the frame for the furniture. It can be used in any number of furniture pieces and it will hold up well.

*Flooring:* Hard board is used for flooring. It provides some substance to the floor and keeps it from buckling or breaking.

#### 3.2 Advantages

- Residential area and forest wastes can be converted into useful products.
- Employment to rural and poor people can be generated. This can be done as follows:
  - Concerned central government agency i.e., your esteemed organization may write to the state government departments.
  - State govt. department can write to district level department then to village panchayats.
  - District level administration should train the village panchayats (people) by providing the technology, machinery and financial aid.
  - Bring the awareness to people. Open village cottage industries.
  - Small scale industrial institute, chip board industries, fuel pallet manufactures, mosquito repellent manufactures can help in sharing the experience in technology.
- Environment will be clean.
- Eco friendly.
- Reducing deforestation.
- Worth vast renewable energy resources going waste this is one of the best solutions to reduce waste contributing to Swatch Bharat and

reduces air pollution as they aren't burnt or allowed to rotten in open.

- One time investment on tools and the rest of the raw materials are available for free.

### 4 Conclusion

Hardboard from dry leaves and forest wastes is thus produced reducing the conventional steps of manufacturing and at low cost per unit production eliminating the wastes and contributing for the Go-Green and Swatch Bharat abhiyan. The thousands of hectares of forest land being cut down in the name of manufacture of hardboard are protected if this method or idea of producing the hardboard or ply is developed and small scale industrial units are established improvising this idea. The tools of this process can also be used for other purposes such as palletisation etc.

Future scope of this work could be analyzing the strength of produced hardboard and improvising its characteristic features such as waterproofing, increasing the strength etc. The effects of different binding agents can be studied and optimization of the process and the tools for large scale production can be done.

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