CHAPTER - 2

MANUFACTURING TECHNIQUE AND PROCESS

2.1 TYPE OF MACHINERIES USED
2.2 TYPE OF MATERIAL USED
2.3 PURCHASE PROCESS AND MATERIAL MANAGEMENT
2.4 GRADING OF PLYWOOD
2.5 PRODUCTION PROCESS OF PLYWOOD
2.6 REMAKE PROCESS FOR DAMAGE GOODS
CHAPTER - 2
MANUFACTURING TECHINQUE AND PROCESS

INTRODUCTION

Plywood is manufactured by gluing thin sheets of veneers. Veneer is thin sheet made of Wood by cross cutting into sizes. Veneers are boiled in steaming water for producing Quality of plywood, an odd number of veneers, Usually from a minimum of 3 to a Maximum of 15 are used perpendicularly. The plies, is that is, veneers, used in making Plywood has different names according to placement. The outside plies are called ‘Face’ and ‘back’ as the case may be while the center plies are called ‘cores’. The plies immediately below the faces are ‘Cross Bands’.

The quality of plywood is generally determined by the Arrangement made of cross-bands. Machines and equipments used in factories of Raipur are mostly old and appropriate for small-scale production. The technology used in manufacture of plywood in Raipur is conventional and labour intensive. Because of low rate of investment Return, Capital-intensive investment is unpopular.

2.1 TYPE OF MACHINERIES USED

Machineries are the main heart of the industries from which finished goods are used to manufacture. In any industry the sophisticated machinery present their goodwill and quality of production work. In

---

1 Based Industries, Indian Forester, 130 (1), 71-78.
2 V. Chandra, J.P., (2001), Scope of Poplar Cultivation. Indian Forester, 127 (1)
plywood industries the role of machinery presents the same concept. It has been observed that plywood industry of Raipur division adopt the new and latest technology and upgraded machines. For manufacturing of plywood following machines has been required.

2.1.1 GLUE MIXER MOTOR

This machine is used to mix the glue which is built up of chemical and resin. The technical specification of glue mixer is constituted with motor and electrical and the capacity for consumption of power is 3 H.P. this mixer is not required to import from other countries. It is fully available in Indian market with purchase and installation cost for Rs. 25000. (Fig. no.2.6 on pg.40)

2.1.2 GLUE SPREADING MACHINE

The function of this machine is to spread the glue when piles of core and veneer put on the table where sheets are prepared. This machine helps to show the glue line to be applied at the time of preparing the panel based on three ply, four ply and five ply ranging panels. The technical specification of this machine is with 56 inch rubber rollers, tank and accessories and with power consumption rating three H.P. motor. The estimated cost in Indian market is Rs. 100000. (Fig. no.2.7 on pg. 40)

2.1.3 THERMI FLUID BOILER

The boiler used in plywood industry is used to provide a steam pressure for the hot press. Therefore when the boilers are installed in
these industries proper care has been taken because over firing in boiler may result in blast and serious accident. Therefore this industry does not make compromise to purchase the quality boiler with respective capacity. The technical specification of the boiler is capacity of 4 lakh calories (agriculture or municipal waste conversation) that is such capacity of boiler can provide a steam pressure to operate 4 daylight hot presses and even 5 -10 daylight hot press. Cost of boiler as per the Indian market rate range from minimum 3 lakh to 12 lakh including all types of taxes and installation charges. (Fig. no.2.3 on pg. 40)

2.1.4 HYDRAULIC HOT PRESS

Hot press is the important machinery among all machines used inside the factory of plywood industries. The basic function of the hot press is to heat and bake the prepared panels of face, veneer and core. The hot press is fully functioning with a steam pressure provided by the boiler. It should be noted that if proper steam pressure is not provided at the time of pressing the panels then quality output can not be found. In fact the technical specification of the hot press is depending on annual production requirement of the industries.

The technical specification on the hot press is of 640 tones capacity complete with heating plates, bolt case, pressing table, electrical panels, and cylindrical ram unit with jack cylinder hydraulic power jack. The hot press now at Indian market is of variety i.e. at modern technology
decorative, particle board; MDF pressing hot press are available. Ahmedabad is the major centre for supply of hot press. The minimum estimated cost of hot press with 4 daylight is Rs. 12 lakh. (Fig. no. 2.11)

2.1.5 **DOUBLE DIAMOND SAW CUTTER MACHINE**

Double diamond saw machine have chain conveyor on both sides and self mechanical pressure system from the top for continuous cutting of plywood. The cutting Motors will be under the chain. One side of the cutting saw is fixed and other sides are adjustable for increase and decrease of size. The machine is fitted with necessary dust control hopper, to pass the dust to the bottom pit. The technical specification is complete with table, saw blade motors (5+5) total with 10 H.P. and accessories the Indian market rate of this machine is Rs. 75000. (Fig. no. 2.8 on pg. 40)
Section 3
Deck Dryer

(Fig. 2.1) 5 Section 3 Deck Dryer

(Fig. 2.2) Log Peeling Lathe Machine

(Fig. 2.3) Baby Boiler

(Rip Saw Machine)

(Fig. 2.4) Rip Saw Machine

(Fig. 2.5) Impregnation Plant for Treatment of Plywood

(Fig. 2.6) Glue Mixer Machine

(Glue Spreader Machine)

(Fig. 2.7) Glue Spreader Machine

(Fig. 2.8) D. D. Saw Machine

(Fig. 2.9) Belt Sander Machine

(Glue Kettle Machine)

(Fig. 2.10) Glue Kettle Machine

(Fig. 2.11) Hydraulic Hot Press

Source: Pictures obtained from plywood gazette monthly publication
2.1.6 **SANDING MACHINE**

It is a heavy duty belt sander machine consists of dust collection unit, iron sanding table, A.C. motor with sanding belt. This machine is used for sanding of plywood, block board & doors. Belt sander machine is used to quickly sand down wood and other materials for finishing purposes. It consists of an electrical motor that turns a pair of drums on which a seamless loop of sandpaper is mounted.

It can have a very aggressive action on wood and are normally used only for the beginning stages of the sanding process, or used to rapidly remove material. Sometimes they are also used for removing paints or finishes from wood. This is fitted with fine grit sand paper and assures completely smooth surface. The power consumption of this machine is approx. 5 H.P. of Indian made with estimated market rate Rs. 100000. (Fig. no.2.9 on pg. 40)

2.1.7 **5 SECTION 3 DECK DRYER**

This dryer have compact-dryer chambers, cooling section & single roller veneer feeding decks that are fitted with aluminum propellers, heating coils, double jet nozzles for top & bottom of each deck throughout the length of the dryer and complete with motors, starters, dynodrive (infinitely variable speed unit), digital temperature indicator, chain and gear box. The entire outside covering of the dryer is perfectly insulated with heat resisting insulated layer. (Fig. no.2.1, pg. 40)
2.1.8 IMPREGNATION PLANT FOR TREATMENT OF PLYWOOD

This plant is used for treatment of plywood with required chemicals to provide long lasting resistance against termites, borers and natural decaying tendencies. Impregnation plant consists of a pressure cylinder provided with a seal door, a vacuum pump, a pump for pumping preservative solution into the pressure vessel and measuring instruments.

The plywood to be treated is stacked vertically inside the cylinder. After closing the seal door tightly, the air inside is evacuated using a vacuum pump. The cylinder is then filled with the preservative solution and a steady pressure is applied for a certain period. Thereafter the preservative solution is drained off and the plywood is dried.(Fig. no.2.5)

2.1.9 WOOD SEASONING KILN PLANT

Wood seasoning kiln plant is used for drying and seasoning of wood that prevents from defects like warping, cracking, splitting etc. Seasoning is important as wood contains moistures that have to be removed in order to obtain satisfactory performance from the wood. We use kiln technology, which happens to be the most energy intensive amongst wood processing operations claiming an estimated 50-70 percent of the total energy consumed in manufacturing wood products.

The timber is stacked in the chamber and then with air blower heat exchanges in chamber at pressure. Timber is kept in chamber for 6 to 12
days as per its fiber property. This removes all possible unwanted moisture through fibers. (Fig. no.2.4, pg. 40)

2.2 **TYPE OF MATERIAL USED**

Material is the prime factor of production it is processed sheets of timber and Adhesive. Therefore, the basic raw materials required in the manufacture of plywood are timber and adhesive. The former nature input; the latter is the chemical processing of petroleum by products and extenders. Here the timber includes round logs, planks and veneers. Plank is the flat piece of timber and Veneer is the main sheet of processed timber. Ingredients are urea formal – in, each acid. Caustic soda, phenol, liquid ammonia, ammonium chloride, ammonium Sulphate melamine, UF powder resin, GNC, TSP, DSM, minose tannin Powder and others

2.2.1 **WOOD**

It is generally assumed that forests mostly produce long rotation hardwood and the individuals produce mostly short rotation plantation timber. Efforts have been made here to project the demand of plantation and hardwood separately for the Planning of plantations in forest and non-forests lands including private lands. Plantation timber and hardwood cannot be separated on the criteria of use because some industries use all types of wood subject to availability.

The plantation forestry or production forestry or industrial forest plantations or trees outside forest and growth of forest state wise has been
presented in Table 2.1 (pg.45) and Table no. 2.2 (pg.46) are synonymous to the extent that all the activities have one major function of generating tree resources.

The rationale behind encouraging forest plantation is to provide large quantities of wood and fiber from relatively small areas and thereby reduce the pressure on the natural forest, and also increasing the Government policy through the liberalization of import of logs from source countries is not considered a long term viable alternative for the growth of the industry and also cannot be taken into consideration for long term investment decision/calculation.

Current tax structure in India continues to flavor the Small scale, agro and recycled fiber based products against medium scale, large-scale mills which are using conventional raw materials such as wood. This has resulted into development of various composites based on agro and forest residues and bamboo in the market as a wood substitute.

However in view of its robust demand growth, large regional variation, and strong substitution pressure it is going to be the most rapidly evolving businesses in today’s forest industry. The speedy growth and changing supply and demand patterns will provide attractive opportunities for companies a breast with critical developments if the raw material situation is resolved appropriately. Insufficient wood supply and under developed logistic may limit the growth of the industry.
## TABLE NO 2.1
State/Union Territory-Wise Growing Stock of Wood within Forest Areas and Trees Outside Forest Areas

<table>
<thead>
<tr>
<th>State/UT</th>
<th>Geographic Area[Km2]</th>
<th>Recorded Forest Area[Km²]</th>
<th>Growing Stock [Volume in m³]</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>In Forest</td>
<td>In TOF</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>275,069</td>
<td>63,621</td>
<td>372.497</td>
<td>179.031</td>
</tr>
<tr>
<td>Arunachal pradesh</td>
<td>83,743</td>
<td>51,540</td>
<td>555.433</td>
<td>77.601</td>
</tr>
<tr>
<td>Assam</td>
<td>78,438</td>
<td>27,018</td>
<td>251.571</td>
<td>25.151</td>
</tr>
<tr>
<td>Bihar</td>
<td>94,163</td>
<td>6,473</td>
<td>20.468</td>
<td>32.915</td>
</tr>
<tr>
<td>Chattisgarh</td>
<td>135,191</td>
<td>59,772</td>
<td>245.446</td>
<td>63.165</td>
</tr>
<tr>
<td>Delhi</td>
<td>1,483</td>
<td>85</td>
<td>1.445</td>
<td>1.055</td>
</tr>
<tr>
<td>Goa</td>
<td>3,702</td>
<td>1,224</td>
<td>5.102</td>
<td>6.669</td>
</tr>
<tr>
<td>Gujarat</td>
<td>196,022</td>
<td>19,113</td>
<td>83.797</td>
<td>140.403</td>
</tr>
<tr>
<td>Haryana</td>
<td>44,212</td>
<td>1,558</td>
<td>2.370</td>
<td>15.363</td>
</tr>
<tr>
<td>Himachal pradesh</td>
<td>55,673</td>
<td>37,033</td>
<td>339.421</td>
<td>12.417</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>222,236</td>
<td>20,230</td>
<td>246.856</td>
<td>88.773</td>
</tr>
<tr>
<td>Jharkhand</td>
<td>79,714</td>
<td>23,605</td>
<td>96.932</td>
<td>48.231</td>
</tr>
<tr>
<td>Kamataka</td>
<td>191,791</td>
<td>43,084</td>
<td>356.796</td>
<td>131.061</td>
</tr>
<tr>
<td>Kerala</td>
<td>38,863</td>
<td>11,268</td>
<td>125.772</td>
<td>51.778</td>
</tr>
<tr>
<td>Madhya pradesh</td>
<td>308,245</td>
<td>95,221</td>
<td>216.998</td>
<td>99.818</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>307,713</td>
<td>61,939</td>
<td>216.652</td>
<td>144.617</td>
</tr>
<tr>
<td>Manipur</td>
<td>22,327</td>
<td>17,418</td>
<td>111.072</td>
<td>4.279</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Trade Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acacia</td>
<td>Albizia lebbeck</td>
</tr>
<tr>
<td>2</td>
<td>African white wood</td>
<td>Celtis africana</td>
</tr>
<tr>
<td>3</td>
<td>Arau (Timla)</td>
<td>Cephalomappa spp</td>
</tr>
<tr>
<td>4</td>
<td>Beli</td>
<td>Aegle marmelois</td>
</tr>
<tr>
<td>5</td>
<td>Cedar</td>
<td>Cedrela spp</td>
</tr>
<tr>
<td>6</td>
<td>Hnaw logs</td>
<td>Dina cordifolia</td>
</tr>
<tr>
<td>7</td>
<td>Htauuk kyant</td>
<td>Terminalia spp</td>
</tr>
<tr>
<td>8</td>
<td>Jatoba sawn timber</td>
<td>Hymenaea courbaril</td>
</tr>
<tr>
<td>9</td>
<td>Kapur</td>
<td>Dryobalanops spp</td>
</tr>
<tr>
<td>10</td>
<td>Kempas</td>
<td>Koompassia spp</td>
</tr>
<tr>
<td>11</td>
<td>Manau cane</td>
<td>Calamus manna</td>
</tr>
<tr>
<td>12</td>
<td>Meranti</td>
<td>Shorea spp</td>
</tr>
<tr>
<td>13</td>
<td>Mersawa/kaung</td>
<td>Anisoptera spp</td>
</tr>
<tr>
<td>14</td>
<td>Millettia logs</td>
<td>Millettia laurentii</td>
</tr>
<tr>
<td>15</td>
<td>Moabi logs</td>
<td>Baillonella toxisperna</td>
</tr>
<tr>
<td>16</td>
<td>Mora wood</td>
<td>Mora excelsa; Mora gonggrijpii</td>
</tr>
<tr>
<td>17</td>
<td>Osyris</td>
<td>Osyris spp</td>
</tr>
<tr>
<td>18</td>
<td>Rengas</td>
<td>Gluta spp</td>
</tr>
<tr>
<td>19</td>
<td>Resak wood</td>
<td>Vatica spp</td>
</tr>
<tr>
<td>20</td>
<td>Rose wood</td>
<td>Dalbergia latifolia</td>
</tr>
<tr>
<td>21</td>
<td>Sagawa</td>
<td>Michelia champaca</td>
</tr>
<tr>
<td>22</td>
<td>Sandal wood</td>
<td>Caesalpinia sappan</td>
</tr>
<tr>
<td>23</td>
<td>Sappan wood</td>
<td>Santalum spp</td>
</tr>
<tr>
<td>24</td>
<td>Caoba, Sapnish mahogany</td>
<td>Swietenia mahagoni</td>
</tr>
<tr>
<td>25</td>
<td>Maple / Sycamore</td>
<td>Acer pseudoplatanus</td>
</tr>
<tr>
<td>26</td>
<td>Tali</td>
<td>Dalbergia sissoo</td>
</tr>
</tbody>
</table>

Source: TIFAC (2005)
2.2.1. (A) WOOD SUBSTITUTES

- **EUCALYPTS AND CASUARINAS**

  Casuarinas was a species preferred by farmers in the coasts and southern plateau due to its quick rotation, remunerative prices for poles in urban construction industry, high calorific value of fuel wood for industrial fuel and salability of felling residues to meet urban and semi urban fuel needs.

  Introduction of Eucalyptus first in the Nilgiris (blue gum) changed the preference of farmers due to its ready acceptability for poles, pulping, particle board, urban fuel and prolific coppicing capability in quick short rotations etc. Eucalyptus has spread fast to all corners of India and become quite popular in the Indo-Gangestic plains due to high yields. Eucalyptus is used to some extent, though not by preference, as core in the block boards, by the particleboard and hard Board Industries. Only *Eucalyptus grandis* in southern high hills have good future for veneer logs.

- **POPLAR**

  Introduction of poplar in the Indo-Gangestic plains during the three decades has helped a great deal to veneering and plywood industry. Poplars will continue to be useful raw material to wood based industries, but can be grown economically only in the North Indian plains, mainly on farm bunds and canal sides. There has been quick proliferation of rotary
veneering units in the small-scale sector to help production of plywood in the country. Veneers and battens of poplar are sustaining plywood and blackboard production in large mills.

**Rubber Wood**

Availability of large quantities of rubber wood in Kerla, Karnataka and parts of TamilNadu and some innovative research has lead to its acceptance in the packaging, furniture and panel wood industry. But its use without proper treatment is likely to cause resentment among users. However, its continued use will be possible due to its ready availability at reasonable prices. Supplies can remain continuous if the latex and rubber prices remain attractive to farmers and large planters in the Western Ghats and NE states.

**Silver Oak**

This species is the most popular shade tree in Tea and coffee plantations and is available in bigger too. This species is very popular for lorry bodies; veneering, plywood and blackboard industries because of its popularity in the estates are bound to continue make its timer available to panel wood industry. Branch wood can be used for particleboards. It is fast grown enough to become a remunerative tree. One exotic species named Meiosis emeriti is becoming popular in coffee estates as a fast growing medium density tree.
Substantial investments in private sector are being made by many companies which have sprung like mushrooms on projection of unreasonable high returns, such investments may provide some good saw and slicer logs in the become unpopular. Many state forest departments have raised good teak plantations. Paucity of funds in forest management and discouragement to monoculture and clear felling of moist deciduous forest has lead to reduction in new planting and neglect of old plantings.

Many teak plantations of the past have now gone under nature reserves and are not available to users. But the high market and import prices for teak and its continued popularity in construction over a century have induced many farmers to plant teak for high returns. In fact the rotation system and economy of growing poplar, eucalyptus, teak and kadamba species has been presented in table no. 2.3

**TABLE NO. 2.3**

Economy of growing Poplar, Eucalyptus, Teak and Kadamba Species.

<table>
<thead>
<tr>
<th>Species</th>
<th>Poplar</th>
<th>Eucalyptus</th>
<th>Kadamba</th>
<th>Teak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation Years</td>
<td>7</td>
<td>10</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>No.of trees per ha.</td>
<td>500</td>
<td>1250</td>
<td>320</td>
<td>475</td>
</tr>
<tr>
<td>Expenditure per ha. Rs.</td>
<td>82292</td>
<td>113215</td>
<td>43776</td>
<td>209715</td>
</tr>
<tr>
<td>Benefit</td>
<td>272533</td>
<td>266220</td>
<td>68124</td>
<td>419961</td>
</tr>
<tr>
<td>B:C Ratio</td>
<td>3.31</td>
<td>2.33</td>
<td>1.6</td>
<td>2.0</td>
</tr>
<tr>
<td>IRR %</td>
<td>68</td>
<td>32</td>
<td>31</td>
<td>30</td>
</tr>
</tbody>
</table>

Source: Chhattisgarh forest project programme 2004
2.2.2 SELECTION OF VENEER AND LUMBER

The quality and usefulness of plywood depend largely upon the quality of the Veneer from which it is made, in plywood for aircraft or other structural Purposes, it is necessary to avoid or closely limit the defects that affect the Strength or durability to the plywood.

The strength properties of the wood species Used must also be taken into consideration. In plywood for the visible parts of furniture, interior trim, and similar purposes, the principal consideration is appearance, and hidden defects that do not impair appearance are generally acceptable.

The veneer commonly produced in this country consists of thin sheets of wood ranging in thickness from 1/100 inch to more than ¼ inch. It is cut from many kinds of wood, both softwood and hardwood species, and is classified by species and grade.

For plywood manufacture, veneer must be smoothly cut, uniform in thickness, flat, and uniformly dried, the desirable moisture content for veneer at the time it is glued varies with the type of glue used and with the conditions the finished plywood will encounter in service. In any case, however, the distribution of moisture should be uniform throughout the veneer.

Veneer for most kinds of plywood should have low moisture content at the time it is glued so that, when the glue sets, the moisture
content, which is increased by the moisture from the glue, will be near the average expected in service. In most parts of the United States, average moisture content of 8 percent is recommended for glued products for interior service.

In arid regions, this average will drop to 6 percent. In humid regions along the Gulf Coast and in the Coastal area of southern California, the average will be about 11 percent. For plywood that is used outdoors, the average moisture content in service in the United States is about 12 percent, except in the dry southwestern States where it is about 9 percent.

Ideally, the moisture content at the time the glue sets should be equal to the average expected in the normal service of the glued item. For cold pressing the moisture content of the veneer as delivered to the gluing operation should be such that, when increased by the water added with the glue, it will equal the average in service.

Plywood glued in a hot press is often laid up with veneer that is somewhat drier than may be used in cold pressing. This is to reduce problems with steam blisters that may form when the gluing pressure is released. A hot-pressed panel usually dries considerably during gluing and consequently, it is often desirable to add moisture by conditioning such panels. For fancy cross-grained veneer, gluing at low moisture content is of particular importance.
Since drying of the panel from high moisture content frequently results in checking of the face ply. Glues that set primarily by absorption of water by the wood, such as starch glues, generally require the use of veneers at lower moisture content than do glues, such as urea resin, that set in part by chemical reactions or other phenomena.

The moisture content of veneer is controlled by (1) drying the veneer in a regulated veneer dryer shortly before it is glued, (2) storing the veneer in temperature- and humidity- controlled rooms, or (3) running the veneer through re-dryers before it is glued.

The temperature of the veneer at the time it is glued is important. When veneer is taken directly from dryers or re-dryers and assembled into plywood at too high a temperature for the glue. There is danger of premature heating of the glue (procure), which may impair the quality of the plywood panel. Such procure is particularly critical with reactive thermosetting resin glues.

This condition can be controlled only by knowing the upper limits of temperature permissible for the glue and by holding hack any veneer that exceeds that temperature until it has cooled. Some types of thick plywood panels are made with a lumber core instead of being built up entirely of veneer. Such panels are known as “lumber-core plywood” or “veneered panels”.

52
A common construction is made up of a nominal 1-inch lumber core. Cross bands of veneer that are frequently 1/20 inch thick, and faces of veneer 1/24 or 1/28 inch thick. The core is sometimes composed of many small pieces or strips of lumber glued together into a larger piece, to avoid the cupping that may occur in wide, flat-grained core boards. Fiberboards and certain synthetic panel materials have also been used as cores.

2.2.3 ADHESIVES

The adhesives available for bonding veneers together to make plywood panels are classified according to their water resistance and the temperature at which they set. On the basis of setting temperature, these adhesives fall into three general groups: (1) most phenol- and melamine-resin glues, many urea-resin glues.

2.3 PURCHASE PROCESS AND MATERIAL MANAGEMENT

Material is the prime factor of production, on this point of view the plywood manufacturers of Raipur division takes a systematic process for materials to be kept in stock for various reasons like loss in weight, moisture in raining reason before the actual consumption. A proper storage, recording and issues system has taken very essential by these industries for successful operation of manufacturing plywood.

These have been acquired from the market and make a proper storage for proper preservation of material and have been used when ever
required round the clock for production, yet these should not be kept in stock for too long. A suitable and efficient purchase and inventory control system has, therefore, evolved and used.

The investment in inventories constitutes the most significant part of current assets or working capital in most of the undertakings. Thus it is very essential part for plywood industries to have proper control and management of inventories.

The purpose of inventory management is to ensure availability of materials in sufficient quantity as and when required and also to minimize investment in inventories. In other words, too much materials cause idle funds, storage and obsolescence problems and marketing difficulties, therefore proper budgetary estimates are made by plywood industries of Raipur division.

On the other hand, if the material are not adequate to meets the needs of the operating and distribution segments of the plywood industry, efficiency suffers, costs skyrocket, manufacturing delays are frequent and broken delivery promise will be inevitable, therefore diligence care has been taken by M/s Kech boards of Rajnandgoan and M/s Swastik panels, Mahavir plywood, Ajanta wood products of Raipur district to avoid all such barriers and to minimize the cost of production and to maximize the profit in cut throat competition of plywood.
The term 'materials' denote the commodities or substances supplied to factories for the sake of converting them into finished goods and the term ‘stores’ is often interchangeably used to denote the materials.

However, it is used in a broader sense to include sundry supplies, maintenance, stores, tools and jigs in addition to raw materials used in the production process. Sometimes, materials are also denoted by the term ‘inventory’ which is used in the broadest sense. Inventory includes raw materials, partly finished goods and finished goods.

According to Black Champion and Brown\(^3\) "the term ‘inventory’ refers to items of tangible personal property which are being held for sale in ordinary course of business are being produced for sale or are to be consumed in near future in producing goods or service for sales”.

The purchase department of plywood industry plays a very important role in an organization because purchasing has its effect on every vital factor concerning the manufacture, quality cost, efficiency and prompt delivery of goods to customers. Its function is to procure materials, suppliers, services, machines and tools at the most favorable terms consistent with maintaining the desired standard of quality.

Purchasing is the most important function of material management as the moment an order is placed for the purchase of materials, a

\(^3\) Kotler Philip, Marketing & Material Management, North Western University
substantial part of the company's finance is committed which affects cash flow position of the company. Thus, if the size of a business concern per unit, there should be a separate purchasing department and the responsibility for all types of materials should be entrusted to this department.

The head of department is usually known as the purchase manager or the supply manager or the chief buyer. The plywood industry of Raipur division, follow the function of centralized purchasing i.e. according to centralized purchasing all the purchase are made by single department to avoid duplication, overlapping and non uniform procurements.

Although the details of a purchase procedure may differ from concern to concern, the important procedures in purchasing and receiving of materials are as follows; assuming that purchases are centralized:

- Purchase requisition
- Selection of suppliers
- Purchase order and follow-up
- Receipt of materials
- Inspection and testing of materials
- Return of rejected materials
- Passing invoices for payment

Purchases of materials in plywood industries are initiated through purchase requisitions. It is a formal request by the head of the department
or other authorities to the purchase manager to purchase the specified materials. Such requisitions and selection for supplier is made by appropriate rates and quotations.

When the supplier has been selected, the most common procedure adopted by plywood industry of Raipur division is the preparation of a purchase order. The purchase order is the form used by purchasing department authorizing the suppliers to supply the specified materials at a price and terms stated there in. A purchase order has been carefully prepared as it forms a basis of legal contract between the parties concerned. For this reason, authority to sign purchase orders should also be restricted to selected responsible officials.

M/s Kech boards of Rajnandgoan and M/s Swastik panels, Mahavir plywood, Ajanta wood products of Raipur district prepared by these industries in five copies of the purchase order. The original is sent to the supplier. Second copy is retained by the purchase department for its own file and reference. Third copy is sent to the receiving department as advance intimation to expect the materials. Fourth copy is sent to the cost accounting department for entry in the ordered column of the stores ledger account. Last copy is sent to the department requisitioning the material as an intimation of the order.

On receipt of materials like veneer, core has been inspected for quantity and sizes according to thickness for which measured with
Vermeer calipers to ensure that supply has been made according to the order placed with specifications stated on the purchase order. Where technical or laboratory inspection is necessary, the materials are passed to laboratory which will provide a report on the quality of materials.

An inspection report is prepared to show the results of the inspection. This report is either prepared separately or incorporated in the materials received note. In either case, the report is forwarded to the purchasing department.

Where materials received are damaged or are not in accordance with the specification, these are usually returned to the supplier along with the debit note, informing him that his account has been debited with the value of materials concerned. When such a claim is accepted by the supplier, he signifies his acceptance by the issue of a credit note. The rejected materials may be returned to the supplier immediately or they may be held pending his instructions.

The debit note may be prepared by the purchase department on the basis of the inspection report. Original copy is sent to the supplier one copy is sent to accounts department for adjustment entry and one copy is returned for purchase department file.

On above all the aspects material management play significant role for function of material process where it has been seen in proper way of plywood industry in Raipur division, especially in Raipur district where
Store keeping is the basic function of receiving of materials, storing them and issuing these to workshops or departments.

As a substantial amount of units of plywood industry working capital is invested in stores, store keeping acquires special importance. The stores department is under the control of a person known as 'store-keeper' or stores superintendent. His function is of undoubted integrity, suitably trained and experienced and well used in the principles of good store-keeping.

2.4 GRADING OF PLYWOOD

Plywood's are graded in quality of MR (Moisture Resistant), BWR (Boiling Water Resistant) and BWP (Boiling Water Proof) over the years the Bureau of Indian Standards has brought out a number of standards of plywood for various end uses. In fact there are as many types or grades of plywood as required for a number of specific end uses. This is often confusing to a user or specified and will be discussed in some details here. Grades of plywood are mainly based in this country on end use requirements and the type of adhesive used in making plywood.

Although grades of plywood are further based on types of face veneer or its appearance, in reality this is not as important as the type of adhesive used. In other words grades of plywood is mainly based on the type of adhesive used which determines whether the plywood is MR, BWR or BWP grade and the end use requirements further specify
whether a type of plywood is used for general purposes, marine applications, structural purposes, concrete shuttering, etc.

For example in situations where plywood is required to withstand hazards of decay or insect attack, one might take precautions to guard against this attack by specifying preservative treated plywood. Such a situation often occurs when plywood is used under exterior conditions or exposed to weather.

Similarly fire retardant plywood is specified for situations requiring protection against spread and penetration of flame for a specified limit of time. General purpose plywood can be practically used for all interior purposes like paneling, ceiling, door inserts, furniture, etc. gives grades of plywood available in this country and their possible major end uses.

The quality of MR grade is used in internal plywood commodities like furniture’s, partitions, paneling and packaging. This grade is also used for semi exposed areas, ceiling and barrels. For preparation of these grades it has been treated with fire retardant.

Likewise the quality of BWR grading is made based on IS: 303-1989. Approximately 90 percent of ten sample units of plywood industry of Raipur division manufacture the BWR and MR grade plywood with a not much a difference in costing to the customers. Table no 2.4(pg.61) is evident for grading of plywood in Raipur division.
<table>
<thead>
<tr>
<th>Type/Grade Of Plywood</th>
<th>Relevant Indian Standard</th>
<th>Bond Quality treatment</th>
<th>Strength Criteria</th>
<th>End uses</th>
<th>Suggested applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Purposes Plywood</td>
<td>IS:303-1989</td>
<td>MR,BWR untreated</td>
<td>Glue shear strength</td>
<td>MR grade for internal Uses like furniture, Partitions, paneling, Packaging etc. BWR Grade for semi exposes areas, ceiling, drums and barrels, door panel inserts, vehicle seats and backs. Floor underlay, etc.</td>
<td>BWR general purposes can be treated with fire retardant or preservatives to extend its use in construction, semi exposed application outdoor furniture, fire resistant ceiling partitions etc.</td>
</tr>
<tr>
<td>Decorative plywood</td>
<td>IS:1328-1996</td>
<td>MR</td>
<td>Glue shear strength</td>
<td>Interior uses and dry I Locations-furniture, Paneling, partitions, Ceiling, etc.</td>
<td></td>
</tr>
<tr>
<td>Aircraft Plywood (medium Density)</td>
<td>IS:709-1974</td>
<td>BWP</td>
<td>Glue shear Strength. Flexibility in bending</td>
<td>Gliders, Trainer Aircraft parts, Aero Models, etc.</td>
<td></td>
</tr>
<tr>
<td>Marine Plywood</td>
<td>IS:710-1976</td>
<td>BWP- Preservative treated</td>
<td>Glue shear Strength. Modulus of Elasticity</td>
<td>Concrete form work</td>
<td>Structural uses, Prefabs, outdoor Furniture, kiosks, fascia soffit, etc. grain storage silos</td>
</tr>
<tr>
<td>Structural plywood</td>
<td>IS:10701-1983</td>
<td>BWP- Preservative treated</td>
<td>Glue shear strength, bending, tensile, compressive, shear strength, modulus of elasticity &amp; rigidity modulus</td>
<td>For all types of load bearing applications and structural uses, web beams, underlay stressed skin construction arches folded plates, grain storage bind, etc.</td>
<td>For any type of load bearing application vehicle building containers foot bridges shelter for disaster areas.</td>
</tr>
</tbody>
</table>

Source N.S.Adkoli, wood panel products for 21st century, paper presented in panel 10th may 2002

2.5 PRODUCTION PROCESS OF PLYWOOD

Plywood, block boards and flush doors are made from a similar process, the difference between block board/flush door and plywood is only that the solid core of block boards and flush doors is made up of wooden battens frame. Following are the procedure for preparation of plywood.
2.5.1 APPLICATION OF GLUE IN FACE, VENEER AND CORE

The application of glue in panels of plies made up of veneer face and core is the first process, where as the plywood is made from veneer gluing on one another. Plywood consists of three or more sheets veneer glued together, with the grains of alternate sheets usually laid cross wise.

The resulting material has distinct advantages for many uses as it is strong and free from war page etc. There are many gluing materials available in the market but urea formaldehyde is normally used and phenyl formaldehyde is used in plywood or block boards for exterior uses as this type of gluing material provides water or weather resistance properly to the boards.

2.5.2 HOT PRESSING

Most plywood is now being glued in hot presses, particularly when the synthetic resin glues are used. At the present time, all gluing with film glues, practically all gluing with phenol-resin glues and much gluing with urea-resin glues is done in hot presses. Blood glues and blends of soybean and blood glues are used to some extent in hot-plate presses for moisture-resistant Douglas-fir plywood. Resin blood glues also give their best results when they are hot pressed.

When thin plywood is hot pressed, two or more panels may be placed together between the heated plated. Only one thick panel is pressed in each opening. Hot presses usually have many plates and
openings between them, so that a number of panels can be glued in one pressing operation. Particularly when panels with thin faces are being glued, the press must be closed promptly after the panels are inserted in order to avoid partial setting (procure) of the glue before pressure is applied. Automatic loading and unloading equipment is widely used to reduce time lags in hot pressing and to reduce such procure.

**TABLE NO 2.5**

Hot Press for Plywood and Decoration Board Technical specifications

<table>
<thead>
<tr>
<th>Mode</th>
<th>Size (inch)</th>
<th>Dimension of Hot Platens (mm)</th>
<th>Nominal Pressure (MN)</th>
<th>Max Service Opening (mm)</th>
<th>Number of Daylights</th>
</tr>
</thead>
<tbody>
<tr>
<td>YDH5-500</td>
<td>4x8</td>
<td>1400x2600</td>
<td>5.0</td>
<td>80</td>
<td>5</td>
</tr>
<tr>
<td>YDH7-500</td>
<td>4x8</td>
<td>1400x2600</td>
<td>5.0</td>
<td>80</td>
<td>7</td>
</tr>
<tr>
<td>YDH10-500</td>
<td>4x8</td>
<td>1400x2600</td>
<td>5.0</td>
<td>80</td>
<td>10</td>
</tr>
<tr>
<td>YDH10-630</td>
<td>4x8</td>
<td>1400x2600</td>
<td>6.3</td>
<td>80</td>
<td>7-10</td>
</tr>
</tbody>
</table>

Source: Details from consult with production manager of M/s Swastik Panels, Raipur

The time required in the hot press (presented in Table no 2.5) depends on the thickness of the material being glued and on the glue being used. Some glues require setting temperatures in the neighborhood of 300 F; while others can be cured at 212 F, or below most hot press glues require platen temperatures in the 240-285 range, Since the innermost glue line must be heated to the required temperature, the pressing time depends on the distance the heat must travel from the plates to reach this glue line.

The time may vary from 2 or 3 minutes for vary thin panels to an hour or more for panels 2 or 3 inches thick. The time required could be calculated by the use of mathematical formulas that consider wood
thickness. Species, moisture content, press temperature and setting temperature of the glue. The rate of heating of a panel has been described in chart form. Glue manufacturers can usually furnish specific recommendations for obtaining best results with their respective glues.

The amount of pressure required in hot press gluing varies with the kind of wood being glued. Heavy, dense woods can withstand higher pressures than lighter, softer woods. In any panel assembly, the maximum pressures to be used are controlled by the species of lowest density in the assembly.

For woods of low density, such as basswood, yellow poplar, and spruce, pressures of 100 to 150 pounds per square inch are used. With medium-density woods, such as sweet gum, walnut, Douglas-fir, and mahogany, the pressures to be used lie between 150 and 200 pounds per square inch, and for high-density woods, such as yellow birch and hard maple, the pressures may be from 200 to 250 pounds per square inch or even higher.

In any case, the pressure must not be so great as to crush the wood or produce excessive compression in panels under the conditions of heat and moisture prevailing in the panel, nor so low that the glue will not be pressed out into a thin, continuous film in complete contact with surface to be joined precautions must be taken to be certain that total pressure is adequate and that it is uniformly distributed over the entire joint area.
Pre pressing is now being used by M/s Rohini panels, Ajanta wood products, Hitech boards as a separate operation preceding hot pressing of panels. In this process a stack of panels is assembled and pressed for a few minutes in a cold press.

Later the panels are then individually pressed in a conventional hot press. Advantages of pre pressing claimed are: better transfer of glue from the coated to the uncoated surface, reduction in slippage of individual veneers in the panel assemblies during subsequent loading and pressing, and reduction in the amount of opening ("daylight") between platens because assemblies are already partially bonded and are therefore thinner.

2.5.3 COLD PRESSING

It is the third stage in process of plywood which means cold pressing. The process of cold pressing is based on two methods. First cold-pressing method is used extensively to apply and maintain pressure on the panels. The one applicable to all cold-press glues consists of applying the pressure with a hydraulic press and then keeping the panels under pressure with retaining clamps.

The hydraulic press is usually equipped with a gage to show the total amount of pressure applied. The panels are left in the press just long enough to apply the proper load and to tighten the retaining clamps in place. The bundles of panels are then removed on a truck and stored in
the factory until the next day. It is important to make sure that the temperature for the glue used throughout the required pressure period.

By the other method, currently used with certain types of glues, the panels are placed in presses and left a few minutes until the glue takes an initial set. The panels are then carefully removed from the press and stored undisturbed at the necessary temperature. The curing of the glue proceeds to completion under no pressure except that of the stack of panels.

Control of pressure is important in cold-pressing operations, just as it is when hot presses are used. In general, the pressures suggested previously are applicable. Crushing of the wood by excessive pressure is less likely to be encountered in cold pressing than in hot pressing.

The determination of the amount of pressure applied per square inch of panel by a hydraulic press equipped with a pressure gage is simply a matter of calculation. The principal factors that determine the amount of pressure applied are: the area of the panel, the area of the piston or ram of the press, and the pressure-gage reading. The area of the piston in square inches multiplied by the pressure-gage reading in pounds is approximately equal to the total load exerted by the plates.

2.5.4 CONDITIONING AND FINISHING OF PLYWOOD PANELS

Once the cold pressing has completed the panels may then be ready to trim and sand at once, or they may require further curing or redrying
before further work is done on them. Particularly in the softwood plywood industry, conditioning is common practice with hot pressed panels made in large multiple-opening presses.

In this process the entire output of the press is removed rapidly and close stacked for a hour or more during this period the residual heat continues the cure arid strength development of the glue lines such a “hot stacking” period is the important part of the curing process.

Results of kiln-drying experiments have indicated that the essential requirements of minimum injury to panels, convenience, and economy of operation can be met by maintaining a constant temperature of about 120 F. and a constant maximum relative humidity that will permit the stock to dry down to the desired moisture content in a relatively short time but which will not allow appreciable drying below that point.

The use of constant temperature and humidity that will dry the panels to definite moisture content makes the drying simple and safe. Panels of three- and five-ply veneer, of or veneer laces, cross bands, and a thick core, that are glued at a low moisture content, may be dried at 120 F. and a necessary humidity in few hours or overnight.

Temperature above 120 F has the advantage of decreasing the drying time, but they are most likely to lower the quality of the panel by including checking, warping, and open joints unless the humidity is
carefully controlled. Panels dried from a high to an extremely low moisture content are likely to wrap unless they are dried relatively slowly.

2.5.5 TRIMMING AND SANDING

The plywood panels are trimmed a standard ripping and cut-off equipment the equipment must be in good condition and accurately set up, otherwise the panels will not be square.

The trimmed panels are usually sanded, and this too critical operation must of the care used in making a perfectly balanced panel by selecting veneer of uniform thickness, moisture content, and suitable species is wasted if one face is sanded appreciably thinner than other.

2.5.6 STORAGE

Plywood should be stored under conditions that will not appreciably change the moisture content of the panels. Stacking in solid piles with the panels directly over each and with a solid cover over the top of each pile protects the panels against rapid changes in moisture content, warping, dust accumulation, and discoloration by light.

Direct drafts of heater air from hot air ducts or unit heaters, or of cool humid air from open windows or humidifiers, should be avoided because they may bring about rapid moisture content changes at panel edges. Wrappings covering the edges and ends of the panels may retard moisture change and will help protect edges from dirt and mechanical damage.
2.6 REMAKE PROCESS FOR DAMAGE GOODS

The remake process of damaged plywood varies with the species; the rations of ply thicknesses, the number of plies, and the combination of species. Three-ply panels, with all plies in any one panel of the same thickness and species, were dried from a soaked to an oven dry condition at the Forest products Laboratory.

Measurements showed about 0.45 percent shrinkage parallel to the face grain and 0.67 percent shrinkage perpendicular to the face grain, with ranges of from 0.2 to 1 percent and 0.3 to 1.2 percent, respectively. The panels tested ranged in thickness from 1/10 to ½ inch. For all practical purposes, shrinkage of plywood in thickness does not differ from that of solid wood.

2.6.1 BALANCED CONSTRUCTION

A plywood panel must be symmetrically constructed to retain its dimensions and form when the moisture contents changes. Balance is obtained by using an odd number of plies. The plies should be so arranged that, for any ply of a particular thickness, there is a parallel ply of the same thickness and of the same species so properties on the opposite side of the core and equally distant from the core.

A change in the moisture content of plywood will either introduce or relieve internal stresses because of the great difference in the shrinkage of wood in the directions parallel and perpendicular to the grain. When
the grain of the core is at sight angles to the grain of the faces, the normal shrinkage of all plies across the grain is largely prevented by a very small change in dimensions of the adjacent ply or plies in the direction of the grain. If the faces are of the exactly the same thickness, of like density, and otherwise balanced the stresses are symmetrically distributed and no cupping will result.

2.6.2 WARPING OF PLYWOOD

The tendency of plywood to warp as a result of stresses caused by shrinkage and swelling is largely eliminated by balanced construction. On the other hand, if one face of a three-ply panel has been glued with the grain in the same direction as the core and the moisture content of the panel is reduced, the internal stresses will no longer be symmetrically distributed, because one face ply does not restrain the core from shrinking while the other ply does. Cupping takes place as a result.

If veneered panels are built up of five plies, the direction of the grain of the cross bands is the most important factor in preventing twisting. The faces of five-ply veneered stock by exert some influence in causing or preventing twisting, but their influence is not so marked as the influence of the cross bands.

A change in the moisture content of a panel may introduce occupying and twisting if the panel is not carefully constructed. Hence, it
is highly desirable that all plies, particularly the faces and the cross bands, be at about the same moisture content before they are glued.

Numerous tests have shown that then the moisture content of plywood panels is varied; warping is least for the panels made of low-density veneer, such as basswood, poplar, and cedar, and that warping increases with increasing density.

A high proportion of core thickness to total plywood thickness helps to maintain a flat, unwrapped surface. In general, the core of a three-ply panel should be one-half to seven-tenths of the total thickness of flatness is an important consideration.

2.6.3 THE FACE CHECKING OF PLYWOOD

Because the face veneers on plywood panels are restrained from shrinking and swelling by the cross bands or core of the panel, stresses resulting from changes in moisture content may develop to the point where checks open in the surfaces.

The checking pattern may vary greatly, and what might be considered objectionable checking for an exacting use, such as finely polished furniture, might be unnoticeable in a satin-finished surface.

Checking tendencies vary with species, and depend on the inherent characteristics of the wood, such as shrinkage and density. Edge-grained face veneers shrink less in width then flat-grained veneers of the same species, and consequently are less likely to check deep knife
checks, which may develop when the veneer is cut on the lathe or slicer, may affect the early development of face checks.

In general, the tight or unbroken side of the face veneer is used for the outer panel surface. This is advantageous, unless subsequent sanding removes much or all off the unbroken wood surface. When the loose side is out, Checking is likely to occur early the sanding removes all of the knife – checked surfaces.