



Development and Prospects of Plywood Industry with Reference to Raipur Division

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ABSTRACT

Over the past two decades the plywood industry of Raipur Division past through different phases of growth. Despite natural and men made constraints, especially on the forest front, the industry has continued to grow. Infact the credit of this growth goes to private individual who had been taking a lot of pains since its (Industry's) inception. However the present study attempts to analyze bearing the growth and development of plywood industry of Raipur Division.

The consumption rate of plywood is increasing progressively therefore this industry has its own eminence among the other industries of Raipur Division.

KEYWORDS: Boiling Water Resistance [BWR], Moisture Resistance [MR], Indian Standard IS, Room temperature PF and PRF adhesive

I. INTRODUCTION

“What does Plywood means”? Means: Plywood is a wood based panel product. It is manufactured by gluing together a number of thin sheets of veneers or piles of soft wood or hard wood makes- Plywood.

There are always an odd number of veneers and each ply is at right angle to one below, this gives the material its strength. The more veneers used, the stronger the Plywood becomes. Both the type of glue and veneers determine the suitability of a sheet for a particular application.

II. HISTORY OF THE INDUSTRY

The history of Plywood industry in India is old. It is more than 75 year that this industry was started here on a very modest scale. It was in the year 1906-1907 that Plywood was imported in India for the first time-valued at Rs.32 lacs. Imports rose steadily and by 1924-1925 it were worth Rs. 90 lacs. Tea Industry in Assam, West Bengal and Kerla was steadily developing and it was thought that Plywood industry in the form of Tea Chests production mainly for export should be developed.

Accordingly two Plywood factories were started in Assam in 1923-1924 but their development was steady and slow and not phenomenal. These were the pioneers and the resourcefulness and courage shown by them in the early stages of growth of Plywood industry was remarkable and the industry owes gratitude to these courageous entrepreneurs. With the outbreak of Second World War, necessity of manufacturing tea chests locally was very much felt and Plywood industry in from of Tea chests industry started on a large scale.

It will not be exaggerated that Plywood industry in India is a gift of Second World War. Now those tea Chests must be produced, Forest Departments in different states started thinking in terms of finding suitable timber for manufacturing tea chests.

Experiments were made at Forest Research Institute, Dehradun and it was found that Plywood made form Indian timbers were as Good as imported products and therefore advised forest entrepreneurs to set up modern factories in different states.

Accordingly well-equipped factories were started in different places viz. sitapur, Bangalore, Baliapatam, Dandeli and Coochbehar. Some of these Factories suffered setbacks in the post war years, as after cessation of war the vested Interests tried to sabotage this industry by trying to restart import of tea chest. Tariff Board enquiry was held and the Government imposed a lien on the importers to purchase Indian products equivalent to the quantity allowed being imported.

During 1970 there was clear-cut definition of small-scale sector and units having an investment of less than 7.5 Lakhs in plant and Equipment Were covered under the definition of small-scale sector, which would be registered with the respective State Director of Industries. At that particular stage some of the unit with such investment got them transferred to small-scale sectors. Meanwhile there were Modern technology and machinery equipped

Plywood units coming up in different places In India like North Eastern Zone. In 1997 the Government of India totally delicensed Wood based industry as a result more than 2000 small – scale units coming up.

III. POTENTIALITIES OF THE INDUSTRY

The potentialities of the industry can be judged from the many uses to which Plywood can be put on the base of demand for the following articles from the consumers

- Shuttering Plywood
- Packaging Plywood
- Plywood drums
- Flush doors
- Commercial & Decorative Plywood
- Block Boards
- Molded Plywood furniture's and chair seats
- Laminated picking sticks for cotton and jute textile industry
- Sliced decorative veneers of walnut, teak, rosewood etc.

Plywood has got several advantages over the natural wood. Ordinary wood has the tendency to Shrink and swell at varying humidity and temperature conditions. Further, it has got certain other Defects also, such as, knots, irregular grains etc. These defects are removed in Plywood. It is dimensionally stable in changing atmospheric conditions due to cross lamination or the veneers.

Plywood can be prepared in larger and requisite sized also. Its appearance can also be made more that it is used for making furniture, packing cases, and bodies of cars, buses and wagons. It is also used for making ships, boats, aircrafts, sports goods, and textile accessories and for hundreds of other uses.

The quality of Plywood is generally assessed by the quality of the glue bond. In Indian standard Specification for general-purpose Plywood IS: 303-1989, the glue bonds requirements of Boiling Water Resistance [BWR] and Moisture Resistance [MR] grade Plywood have been specific.

Aircraft Plywood (medium and high strength), marine Plywood & structural Plywood should conform to Boiling Water Proof grade. Preservative treated Plywood and fire retardant Plywood should conform to BWR grade. Decorative Plywood using plurality of veneers should conform to BWP and MR grades. Adhesive used in all Plywood should conform to the requirements Indian Standard Specification for a synthetic resin adhesive IS 848-1974

In addition to glue bond requirements other mechanical strength tests, tests for preservations, tests for fire retardant are prescribed in their respective Indian Standard Specification. The methods of Tests for all types of Plywood are given in Indian Standard IS: 1734-1989.

Generally the high cost of structural Plywood and shuttering Plywood has made their use limited to certain type of construction like kiosks, portable cabins, web girders, etc. and the real potential for structural Plywood is fir large span structures like arches, beams, folded plate roofing, rigid frame and this has yet to be exploited.

The lightweight of glued Plywood structure systems makes them particularly suitable for disaster-prone area, corrosive environment and structures requiring minimal foundation as are required for terrace constructions. For instance Plywood houses can be built on existing terrace without requiring foundation.

There is good potential for structural Plywood if production of BWR & BWP grade Plywood is increased in place of moisture resistant or general-purpose Plywood/block board. Then the engineers and architects can make use of these materials for constructional uses in areas like Northeastern regions, Andaman, Himachal Pradesh and Kashmir where wood construction is prevalent and accepted. It can also be used for earthquake prone area, minimum strength requirement of Plywood for structural purpose are given in Table No. (1.1)

Table No: 1.1

Minimum strength requirement of Plywood for structural purpose (IS: 10701-1983)

Property		Strength requirements(N/mm ²)	Suggested permissible stress (N/mm ²)
Tensile Strength	Along	54	18
	Across	34	11
Compressive Strength	Along	34	11

	Across	29	10
Modulus of elasticity	Along	49	16
	Across	29	10
Panel Shear Strength		12.5	1.0
Modulus of Rigidity		588	588
Rolling Shear Strength		3	0.6

Permissible stress has been arrived at on a tentative basis by giving a factor of safety of 3 for all properties except property 7, where a factor of safety of 5 has been used for properties 5 Dn 6 no factor of safety is used. Marine application, concrete formwork, roof sheathing, cooling towers, etc. Like solid wood, Plywood can be given preservative treatment after its manufacture.

Plywood can be pre-finished with surface coating or overlaid with metal sheets resin impregnated paper, plastic laminates, RP etc. to further increase its strength, resistance to operation, impact of chemicals, weathering etc. this may not be needed for many Application and should only be considered for special Application and to meet certain specifications. Further some overlays provide better surface for finishing Plywood with paints and lacquer. In Plywood because of the presence of lathe checks finishing may pose problem under exposed situation.

However, experience has shown that preservative treated Plywood surface provides excellent surface for finishing with semi opaque and pigmented finishes. For other applications, Plywood is generally finished with high or low-pressure laminates and decorative veneers. Summarizing it is seen that Plywood is really a do-it-yourself material amenable to working methods as applicable to solid wood with the additional advantage of using already seasoned or dried material.

Having discussed the properties and techniques of Plywood it will be interesting to examine major areas where Plywood is used at present. There are no detailed statistics available on this important aspect. Based on experience and demand, major end use areas for Plywood may be broadly classified as follows: Furniture, building interiors including joinery construction, structural marine, packaging, industrial and vehicle building. A few of them, which are of interest to civil engineers and builders, are discussed briefly:

A) BUILDING INTERIORS

Paneling, ceiling, partitions, cubicles, counters, display, flooring are some of the major elements of the interiors of building. Although Plywood/block board is widely being used for these purposes, many newly introduced materials are gradually replacing Plywood/block board at least for some major uses.

Decorative Plywood and block board with decorative face veneers is still popular for paneling and partitions with Interior Designers. Interior of offices, shops, reception areas in buildings and banks are the main locations for wide use of Plywood/block board.

Pre-finished and pre-laminated and veneered particleboards are now being widely used in construction with aluminum framing for interiors. However, where resistance to moisture, decay and insects are needed preservative treated Plywood and fire retardant Plywood may be preferable to these newly introduced materials.

Another major use of BWR and BWP grade Plywood is as panel inserts in paneled doors. BWP/BWR grade has also been suggested as face skin in hollow core flush doors. Somehow this type of door has not found favor with consumers. BWP/BWR or preservative treated Plywood can also be used as panel inserts in door for bathrooms and for exposed areas.

Exterior grade veneered particleboard is now increasingly being used as an alternative to Plywood. An excellent application for Plywood is, as light suspended flooring which does not require heavy structural framework or foundation. This is suitable for shop, offices, restaurants, and hotels. Here Plywood can act as base for carpets and floor coverings. Normally tongue and grooved (19 mm thick BWR/BWP/structural) Plywood is recommended for this purpose. Plywood is supported on wooden runners, which can be supported by, steel joists, masonry or RCC. Plywood sub floor can also be finished with parquet tiles as a wearing surface.

Tongue and groove joint provides continuity in distributing concentrated loads. As self-supporting partition systems, dividers, doors, it is possible to have sandwich panels comprising thin Plywood skins (3 mm thick) with various light cores materials-polystyrene, paper or aluminum honeycomb, rigid polyurethane, etc. However, high cost of this core material has discouraged these developments. Probably a low cost core material made of lignocelluloses material or agricultural residue may be appropriate for sandwich construction. By using sandwich panels and construction systems it is possible to dispense with or minimize use of wooden framework required for such applications.

Other suggested interior uses of Plywood can be for stairs comprising of raisers, treads and stringers for any type of interiors. This type of stairs being light can be constructed inside a building as an afterthought, unlike RCC stairs, which is heavy and requires columns. Interior designers can make use of this possibility for houses, restaurants, etc.

B) RCC CONSTRUCTION

One of the major uses of Plywood is as a shuttering material in RCC construction. Plywood has replaced solid wood in this respect and is used as temporary support for casting slabs, columns/beams, and RCC tanks, bridges, Walls, High strength/weight ratio, easy workability, resistance to high humidity. Alkalinity and possibility of number of repeated uses has made Plywood popular with builders. Flexibility of Plywood makes it suitable for curved forms also.

As the modulus of elasticity of Plywood is relatively high (80.000 to 100.000 kg/cm²) load bearing capacity based on permissible deflection of $l / 180$ to $l / 240$ is adequate for any type of formwork. Plywood formwork is designed to take concrete pressure in vertical from such as columns and walls and weight of poured concrete, men and machinery on horizontal formwork. Concrete shuttering Plywood as per IS: 4990-1981 is preservative treated BWP grade Plywood, which can be considered as structural Plywood without assigning certain strength values.

Normally shuttering Plywood is used directly with suitable releasing agents. For fine architectural concrete finish shuttering Plywood also comes with resin impregnated paper film faces. Of course surface quality of shuttering Plywood depends on thickness of face veneer and weight of resin overlay (80 gm/m² to 120 gm/m²). For high class architectural finishes Plywood form work is preferred even to steel shuttering since fabrication of steel form work is more labor consuming and expensive than Plywood formwork. Fabrication of Plywood formwork can be carried out on site using simple carpentry tools and hardware. With proper care and maintenance shuttering Plywood can easily give more than 20-25 reuses.

Efficiency of Plywood formwork depends upon how well it is supported and prepared with wooden members and is of proper thickness for a given purpose. Normally 12, 15 and 19 mm thickness Plywood is popular among builders. In designing care should be taken to avoid excessive deflection, which may result in uneven concrete surface. Shuttering grade Plywood and preservative treated Plywood can also be used for a variety of constructional uses such as site officer's booths, soffits, and fascias in sloped tile roof houses, stairs.

They can also be used for heavy shelving, attics, lofts, and many other uses. Shuttering Plywood has performed well as lightweight roof sheathing. Of course joints in roofing should be properly detailed and surface protected with either bitumen mastics or membrane. The Designer should normally check with the manufacturer regarding strength data as regards bending strength (MOR) and Modulus of Elastic-Plywood in load bearing application.

C) STRUCTURAL USES OF PLYWOOD

In major Plywood producing countries- USA, Canada and Australia- Plywood is mainly used for load bearing applications and building construction, as already explained strength properties of Plywood and its moisture resistance characteristics make it particularly suitable for sheathing in wood framed houses. Here Plywood is used as well, roof and floor sheathing providing high over-all-rigidity to wood frames against wind and even earthquakes.

The efficiency of sheathing or diaphragm action depends upon how Plywood is fastened to wood. As explained earlier Plywood is either nailed or nail glued to wood. For our country where wood frame construction is not the usual way of constructing houses, use of Plywood for structural purposes mainly for secondary elements like web beams, arch panel, folded plate roof, rigid frames, etc. may be considered. These components can be used either as roof supporting elements or roofing itself. Flexibility and high strength of Plywood also makes it suitable for cylindrical bins for rain storage.

It is interesting to note that the bulk of structural Plywood in the world is manufactured from softwood, although mixed hardwoods are now being used in limited quantities. Obviously for us structural Plywood has to be necessarily made from mixed hardwood.

Further Plywood has been successfully used as stressed skin panels as wall and roof elements in prefabs, where 6 mm thick Plywood is glue nailed to longitudinal wooden runners. The composite action between Plywood and wood in these panels results in multiple T beam action leading to considerable saving of wood raw material.

D) PLYWOOD AS AN ENGINEERING MATERIAL

Plywood in short can be considered as a layered veneered, cross-grained composite. Material Strength/stiffness, density and water resistance of Plywood vary considerably depending upon Species of individual veneer, their physical/mechanical properties (strength and density), Thickness, number of layers, type of adhesive used to bond veneers and total thickness of finished Plywood.

In real sense there is hence great flexibility to alter design properties of Plywood to meet specific end use areas in practice however as bulk of Plywood in this country is still used for mundane interior applications this advantage is not taken a manufacturer generally uses such thickness and species of sacrificing requirements as stipulated by national standards.

For instance thin face veneer of 0.8mm is often used resulting in low bending strength/stiffness and glue shear strength in general, urea formaldehyde resins are used to make MR (moisture resistant) grade and phenol formaldehyde resins are used for making BWR & BWP grades of Plywood.

Well-made Plywood is really a pleasure to use and exhibits high strength/stiffness and resistance to moisture for many ends uses bending deflection (stiffness) is more important than bending strength. Besides, specific strength/stiffness of Plywood (strength and stiffness as compared to density of the material) is much higher than many materials like steel, aluminum, plastic, and practical board, MDF (table no.1.2) Besides the shear strength of Plywood perpendicular to its plane (panel shear strength) and modulus of rigidity are very high. This fact, which permits use of thin Plywood as vertical or horizontal sheathing of "diaphragm", on the other hand shear strength of Plywood in the plane of plies (glued surface) is low and to some extent it depends upon the adhesive used.

Room temperature PF and PRF adhesive can be used for gluing Plywood to wood for applications requiring high strength and durability. Thicker Plywood can be easily nailed or screwed edgewise, whereas particle board/ fiberboard require special type of fasteners and hardware. Panel edges of Plywood require suitable protection by clipping and other devices.

TABLE NO 1.2

Specific strength of selected materials

Material	Density Kg/m ²	Bending deflection Modulus of elasticity (kg/cm ²)		Bending load Modulus of rupture (MOR kg/cm ²)	MOR/D4
Mild steel	7.80	211.000	4.425	4650	76.4
Duraluminium	2.80	703.000	32.020	3860	492.3
Concrete	2.30	175.000	14.380	50	9.5
Polypropylene	0.9	14.066	19.295	492	607
PVC	1.4	35.164	12.815	984	502
HD Polyethylene	0.95	7.032	8.200	70	77
Hardboard (Tempered)	1.08	61.500	48.820	550	471
Particle Boards (Medium Density) Hard wood	0.70	22.800	60.470	150	300
*Plywood (BWR or BWP)	0.60	75.000	347.222	500	1388
MDF (Fiber board)	0.70	25.000	72.886	280	571
Teakwood	0.67	119.600	397.655	969	2136
Eucalyptus hybrid Wood	0.74	100.800 248.757		866	1581

IV. Hypothesis and Research Methodology:

The hypothesis of this research work is to provide a detail concept regarding the capital structure, manufacturing. Therefore the present study is based on both primary and secondary data by distributing it into seven chapters which define the complete study of the work. The secondary data have been collected from Plywood industries of Raipur division and Directorate of industries-government of Chhattisgarh, directorate of Economics and Statistics-government of Chhattisgarh. It is to be pointed out here that the secondary data so collected have used for ascertaining and analyzing the function and performance of the Plywood industries, starting from capital investment to marketing function. Use of preservative treated Plywood with edges properly sealed in glued Plywood structures makes them practically maintenance free. Besides structural grade Plywood, which has definite assigned strength values, shuttering, marine and BWP grade Plywood can also be used in construction. Present experience has shown that preservative treated and shuttering grade Plywood has given more than 15 years of trouble free service.

5. Findings and Suggestions

Forestry and agriculture are the two most important land uses in the country, the latter competing with the former under relentless pressure of an even increasing population, which has grown from 361 million in 1951 to 1028 million in 2001. The per capita availability of forest has, thus, declined to a poor 0.08ha, which is one the lowest in the world.

Deforestation has become a major environmental concern, as it can destabilize the earth's temperature, humidity, and carbon dioxide levels. As per formal estimates, forestry and logging contributes roughly 1.5% of the total GDP of the country. However, since most of the trade and use of forest product is informal and if one takes into account all the kinds of removals of forest production, the estimate of the contribution from forest is greatly enhanced.

It increases even further if the non tangible benefits, e.g. ecological services of which there has been renewed interest and increasingly demand in recent years, are also taken into consideration.

Forest is increasingly being looked upon as major performers in poverty alleviation programmes. Prior to 1988, many panel wood and match industries were granted concessional and assured supply of wood. Marking of tree for selection felling was done in accordance with prescription under approved scientific management plans (working plans); extraction and transport were done under the control and supervision of the forest department. Similarly, the pulp industries were granted bamboo and pulpwood from the natural and manmade forests respectively by the forest department.

These industries did help department in maintaining health and hygiene of forests, fire protection, natural regeneration, raising and supply of seedlings etc. These concessions were withdrawn after the new national forest policy was announced in 1988. The pioneering efforts to raise quality for supply to farmers with assurance of buy back timber at an assured floor price was made by a leading match industry in India around 1981. From 1983 onwards, many pulp, and plywood industries have seriously taken up promotion of farm forestry, tree improvement through clonal and micro-propagation harvesting method etc.

6. CONCLUSION:

Foreign collaboration for technology acquisition in specialized areas must continue. Once the requisite technologies have been developed, the need for collaboration may cease and only specific components of technology may need to be imported. The factors influencing the choice of technology, equipment and collaborator like

- Experience in the line
- Cost of equipment and services,
- Energy, utilities, resins and other inputs per ton of end products.
- Feed back on the experiences in similar projects from the entrepreneurs elsewhere in the world.

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