FPRDI-DOST

UTILIZATION OF SMALL DIAMETER LOGS FROM SUSTAINABLE SOURCE FOR BIO-COMPOSITE PRODUCTS
PROJECT CODE: CFC/ITTO 62 – PD 40/00 REV 4(1)

ADDRESS TECHNICAL GAPS IN PRODUCING BIO-COMPOSITE PRODUCTS

ACTIVITY 2.1.2. IDENTIFY MILLING ISSUES

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I. INTRODUCTION

In the Philippines and other tropical timber producing countries, one area of deep interest is the utilization small diameter logs (SDL) although much has been said about Lesser Known Species (LUS) and their introduction in world market since the late 1960s,. The call to use SDL to conserve our timber resources and to augment the timber supply or find substitute/alternative species for fading traditionally-known species and commercially-known species has become a cliché in the wood industry. Most of the timbers being processed locally into lumber, plywood and other wooden products comprise mostly of imported species. It is unfortunate that local utilization of SDL is still far from being desirable.

Small diameter industrial plantation species planted for the pulp and paper industry, (Acacia, Gmelina and Eucalyptus plantations) in Indonesia and the Philippines currently cover about 700,000 ha and, if maintained and enhanced could be contributing reasonable quantities of timber raw material by the year 2010. (Outlook Study On Wood Based Panels Production, Consumption and Trade...FAO Corporate Document Repository)

One of the pillars of the Philippine economy that has contributed substantially to employment generation is the wood-based industry. It has always been considered to be one of the top ten import and export commodities. There had been remarkable changes in the immediate past due to the problems on raw material sustainability. The country has been importing logs to complement the needs of the plywood industries. The use of SDL was introduced more than a decade ago but its utilization has not been without problems and there are some milling issues to be addressed. The following discussions will describe the issues and concerns as regards to the use of SDL. On the other hand, the technical information of using SDL for composites like plywood, wood wool cement board and particleboard are mentioned in this report.

The methods used to develop this study are based on literatures, previous technical papers and field evaluation.

Primary processing and subsequent milling issues of small diameter logs (SDL)

One of the pressing problems in the utilization of SDL is converting them into conventional products such as lumber and veneer. Most of the present primary processing equipment of the wood industry are designed for large-diameter logs (Rojo 1990). The use of inappropriate equipment for processing entails low mill recovery, low productivity and high processing costs.

Lumber products produced from small diameter species and logging residues are 25 and 50-mm thick boards with widths of 10 to 40 cm plantation species and a maximum of 15 cm wide and 1.8 m long for logging residues. Small sized logs have low lumber yield and high labor costs when processed in sawmills designed for large logs. Sorting into diameter classes prior to sawmilling increases lumber production rate and sawmill efficiency in small log processing by 5% to 11%. (1998 Compendium on low cost houses from small diameter logs, thinning, tops and branches)

Mechanical properties of lumber produced from some small diameter logs.

Name	Static Bending		Compression		Hardness		Toughness	
	MOR MPa	MOE 1000 MPa	Max crushing strength MPa	MOE 1000 MPa	Side grain kN	End grain kN	Shear parallel to grain MPa	Av. of radial and tangential Joule/ specimen
Diospyros pyrrhocarpa	69.30	10.50	32.40	13.20	4.94	4.98	8.50	40.40
Amoora ahemiana	71.40	12.80	36.90	15.80	5.89	5.86	8.58	34.90
Swintonia foxworthyi	66.10	11.80	32.60	16.50	4.59	4.80	9.16	38.00
Lithocarpus llanosii	66.90	9.02	35.70	12.70	6.04	5.77	10.40	33.30
Ziziphus talanai	72.10	9.80	34.60	11.60	4.95	5.29	10.10	49.00
Celtis luzonica	55.70	8.32	25.20	10.20	3.09	4.25	8.70	40.80
Gmelina	45.90	6.18	24.80	7.84	3.84	3.80	8.91	27.70

arborea								
Duabanga moluccana	43.00	7.80	19.60	7.33	2.02	2.56	5.74	21.60
Octomeles sumatrana	31.60	6.81	16.70	8.25	1.44	1.57	3.70	18.90
Erythrina subumbrans	24.60	4.03	11.90	4.77	1.01	1.24	3.65	11.50
Endospermum peltatum	35.50	5.08	17.20	7.51	1.39	1.82	5.47	14.90

Source: 1998 Compendium on low cost houses from small diameter logs, thinning, tops and branches

Internal defects on the logs cause conversion problems and reluctance to convert some SDL species. Fluting, buttressing and high tapering of some SDL also make milling difficult. Blunting of saws and other cutters in subsequent machining operations are affected by density and high strength properties. Grain characteristics also affect other processing operations. Interlocked grain, which characterizes some SDL, are often more difficult to machine, finish and kiln dry (prone to warping)

Retooling of equipment

A number of mini-bandmills in the country have been installed particularly in Mindanao to cope with the problems in sawmilling SDL. Some companies are also using spindleless lathe for the rotary cutting of veneers from veneer log cores. The conventional lathe entails a log core with about 20 to 25 cm diameter after peeling while in the spindleless lathe, the diameter of the log core is reduced to about 5 cm. Thus, if the two spindleless lathe are used in tandem, veneer recovery per log will be higher. The spindleless lathe can also be used for veneering SDL but the raw materials should first undergo the rounding process to have a cylindrical form.

The known users of spindleless lathe in the Philippines are PICOP in Bislig, Surigao del Sur; M&S in Recodo, Zamboanga City; UCP in Malungan, El Salvador Misamis Oriental; EverSun Plywood in Cotabato City and C. Alcantara and Sons (ALSONS) in Davao City.

Small Diameter Logs Widely Used in Veneer and Plywood Manufacture

Species	Remarks
Bagras (*Eucalyptus deglupta*)	• substitute material for face veneer • must be peeled within 3 days after harvesting to prevent curling of veneer during drying
Duguan (*Mynstica phil*)	• for veneer production
Igyo (*Dysoxylum decandum*)	• for veneer production
Loktob (*Duabanga moluccana*)	• for veneer production
Tangisang bayawak (*Ficus sanyata*)	• for veneer production
Anabiong (*Trema orientates*)	• for veneer production
Moluccan sau (*Paraserianthes falcataria*)	• one of the most widely planted introduced species in the Philippines. • Peeler logs from old-growth plantations (4 years and up) produce smooth face veneers, otherwise, veneers are wooly usually for corestock veneer
Yemane (*Gmelina arborea*)	• can be easily sliced and peeled into veneers and are mostly used for face stock • veneer sheets are easy to handle and resistant to tear.
Mangium (*Acacia mangium*)	• proper grading of veneer logs is essential to produce good quality veneers due to prevalence of knots • used for face and core veneers
Gubas (*Endospermum peltatum*)	• a potential source of veneer for plywood in the Philippines
Big-leafed mahogany (*Swietenia macrophylla*)	• sliced and peeled into fine decorative veneers without preliminary treatment. • wooly surface in veneer is experienced in small diameter logs with off- centered pith, indicating presence of reaction wood.

Kaatoan bangkal (*Anthocephalus chinensis*)	• smooth, uniform in thickness and moderately tight 1 mm thick veneers are produced with this species
Malapapaya (*Polyscias nodosa*)	• smooth, uniform in thickness and moderately tight 1 mm thick veneers are produced with this species

Source: Strategies for enhancing the growing and utilization of lesser known species. Paper presented at the National Symposium on Forestation Research and Practices, April 2002, CFNR-UPLB, College, Laguna, Philippines

In a study conducted on veneer production, it was recommended that the process needs to be altered to accommodate the properties of alternative raw materials such as SDL and logging wastes. There is thus a need to develop production or processing equipment and techniques appropriate for these materials. For the economic benefits, producing veneers from SDL using 60-cm lathe was shown to be feasible. The 60-cm lathe is suitable for logs which have small diameters, short lengths and with crook and sweeps. (1998 Compendium on low cost houses from small diameter logs, thinning, tops and branches)

Wood Wool Cement Board (WWCB)

WWCB is a panel product made-up of wood excelsior bonded with a General Purpose Portland Cement. It is versatile because of its various applications such as exterior and interior paneling; it can be used in dry and wet construction; it can be used as ceiling and eaves; and it can also be used as cabinet and furniture components. WWCB is considered dimensionally stable and termite resistant. Dimensionally stable because it does not swell even when immersed in water for at least 24 hours. At FPRDI, an on-going study on its termite resistance indicates that WWCB is not attacked by termites after seven (7) years of termite exposure test.

Milling issues for the four (4) wood species studied (Component 2.1 Address technical gaps in producing bio composite products Activity 2.1.1 Identify suitable species and evaluate physical and mechanical properties) revealed that the high densities of *E. citriodora and E. urophylla* will affect handling of these species during harvesting and transport operations. Higher costs will be incurred as more man (and

animal) power is required during felling, skidding the logs to roadside, and hauling as less volume is transported per truckload. Overall cost of raw material will be higher for high density (*E. citriodora and E. urophylla*) than low density species (*A. macrophylla and P. nodosa*). This situation is typical in a developing country like the Philippines where the use of mechanical equipment is limited.

As indicated by the relative densities of the four (4) species investigated, *Eucalyptus citriodora and E. urophylla* would pose problems during shredding operation preparatory to WWCB production while *Alstonia macrophylla and Polyscias nodosa* would be easily shredded into excelsior. Shredding cost is higher since production per hour is less due to downtime in blade replacement and sharpening, loading (mounting of wood blanks on shredding machine) and during actual shredding where there is greater resistance in the vertical (or horizontal) movement of the blanks against the knives. However in this study, *E. urophylla* has been considered and used in WWCB production (Component 2.1: Address technical gaps in producing bio composite products - Activity 2.1.4: Evaluate the appropriate properties of products manufactured form SDL)

The following table shows the different wood species used in the production of WWCB.

Relative density of different wood species in the Philippines (Alipon et al. 1987, Alipon & Floresca 1991) and their respective bending strength when manufactured in to WWCBs (Mallari et al. 1994, Cabangon 1997, Pablo & Cabangon 1997, Eusebio et al. 2002a & 2002b, Eusebio et al. 2003)

Common Name	Scientific Name	Relative Density (Green)	Bending Strength* (MPa)
Antipolo	*Artocarpus blancoi* (Elmer) Merr.	0.42	5.7
Auri/Earpod Wattle	*Acacia auriculiformis* A. Cunn. Ex Benth	0.50 – 0.65**	5.4
Banilad	*Sterculia cosmosa* Wall	0.32	4.5
Binuang	*Octomeles sumatrana* Miq.	0.27	6.0

Binunga	*Macaranga tanarius* (L.) Muell. Arg.	0.30 (12%)	6.2
Gubas	*Endospermum peltatum* Merr.	0.3	6.4
Kaatoan Bangkal	*Anthocephalus chinensis* (Lamk.) A. Rich. Ex Walp.	0.34	6.4
Loktob	*Duanbanga moluccana* Blume.	0.37	5.5
Big-leafed Mahogany	Swietenia macrophylla King	0.54	5.7
Mangium	*Acacia mangium* Willd.	0.46	6.5
Moluccan Sau	Paraserianthes falcataria (L.) Nielsen	0.25	8.2
Rarang	*Erythrina subumbrans* (Hassk.) Merr.	0.24	7.1
River red gum	*Eucalyptus camaldulensis* Dehnh.	0.68	5.9
Rose gum	*Eucalyptus grandis* W. Hill ex Maiden	0.42-0.50**	6.1
Ulaian/Celebes oak	*Lithocarpus celebicus* (miq.) Rehd.	0.67	3.3
Yemane/ Gmelina	*Gmelina arborea* Roxb.	0.41	7.3

*Obtained from 12-mm thick boards manufactured at a density of 750 kg/m3 (except for E. camaldulensis with a board density of 600 kg/m3), wood/cement ratio of 40/60, 3% addition of CaCl2 and using wood wool soaked in tap water for 24 hours.

** Data obtained from species not grown in the Philippines (Shikaputo et al. 1986, Anonymous 1996)

Particleboard

Particleboard is a made-up of small wood particles and other fibrous materials. These are bonded together with a suitable adhesive and cured under heat and pressure.

In the Philippines, there is only one commercial plant that is operational. It uses wood wastes from furniture manufacturers, sash factory, veneering wastes or any type of wood wastes available in their vicinity. It never used industrial plantation species or small diameter logs.

At FPRDI, laboratory studies on particleboard production and technology were conducted several years ago. Industrial plantation species such as Kaatoan bangkal (*Anthocephalus chinensis*), giant ipil-ipil (*Leucaena leucocephala*), molulucan sau (*Albizia falcataria*), Yemane (*Gmelina arborea*), balobo, magabuyo, and gubas (*Endospermum peltatum*) were found to be technically feasible for the production of resin bonded particleboard.

CONCLUSION AND RECOMMENDATION

The various techniques of addressing the milling issues relative to SDL utilization are not new. There had been previous studies to expand the use of SDL but it would entail cost to the manufacturers. There are some however who adopted the recommended methods or did some retooling in order to accommodate SDL in the production.

The use of SDL in the processing of veneer and plywood should be promoted in order to cut down on log importation.

It has been observed that only *Gmelina arborea* is widely used in the commercial production of wood wool cement board (WWCB). Other SDL should be recommended for WWCB production like what had been presented in this report. The use of other SDL that were not studied for WWCB production should be considered in order to expand the raw material base.

REFERENCES

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