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SCRIMBER FROM SUSTAINABLE MALAYSIAN BIO-RESOURCES

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Introduction

Scrimber is a type of structural composite lumber (SCL) - a group of engineered wood products which also includes laminated veneer lumber(LVL), parallel strand lumber(PSL) and laminated strand lumber(LSL) - manufactured primarily for building construction. Scrimber was invented by John Coleman, a scientist in CSIRO, Australia during the 70s (Jarck & Sanderson 2001). Its manufacturing technology was refined in 2003 and the system was patented by Timtek LLC, a US company who bought the scrimber worldwide IP rights, in collaboration with Mississippi State University (MSU) (Anonymous 2004).

Loblolly Industries LLC, a timber company from Mississippi, acquired Timtek licence in 2005 covering east of the Rockies in the US and Canada, and has been planning since to establish scrimber manufacturing factory and to market the product as Scrimtec.

The Forest Research Institute Malaysia (FRIM) is the first research organisation, from outside of the US, that collaborates with Timtek to develop scrimber using the bio-resources abundantly available in Malaysia (Wan Tarmeze & Jarck 2015). Scrimber is also known as steam pressed scrim lumber (SPSL) (Linton et al. 2008).

Figure 1 a) Stack of scrimber billets made at Timtek Pilot Plant; b) a 20-feet long scrimber billet from oil palm trunk; c) close-up of scrimber from Southern Yellow Pine

Scrimber Manufacturing Processes

SCL are differentiated by the type of wood materials they are made of : veneers, clipped veneers, flakes or scrims for LVL, PSL, LSL and scrimber, respectively. Scrim is a loose mat of long interconnected fibre strands averaging about 6.35 mm (¼ inch) in diameter (McCafferty 1990) and shall not exceed 19.1 mm (¾ inch). It is produced by crushing small diameter logs, *e.g.* plantation thinnings, and separating log length fibre strands using a series of rollers that do crushing and scrimming. These fibre strands are then dried, resinated and redried to suitable moisture content for pressing (Figure 2).

To manufacture scrimber, the fibre strands are composed into a bundle that is adequately sized to achieve the product dimensions and density before inserted into the press. In the press, the bundle is then heated to the setting temperature of the resin by steaming the fibres before the press platens are closed. At set temperature, the bundle is compressed to final billet thickness while the platens continue the heating. Steam is exhausted and the billet is allowed to degas prior to opening of the press. The steam press machine for a commercial plant would produce billets that are nominally up to 178 mm (7 inches) thick, 1219 mm (48 inches) wide and 14.6 m (48 feet) in length.

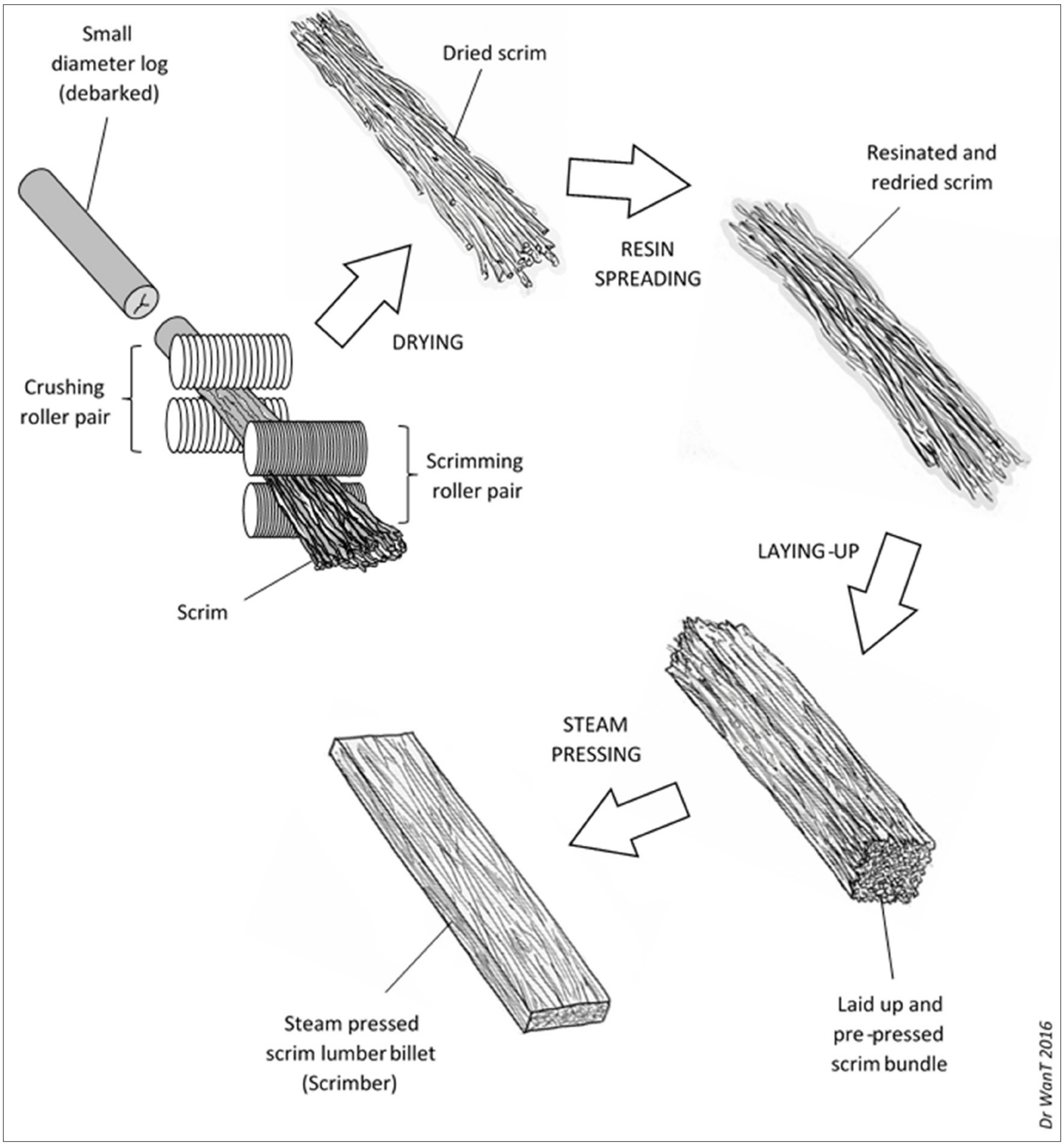

Figure 2 Log scrimming and scrimber making processes
Note: Details of the production system are shown in US patent 7537669 (Jarck 2006)

Scrimber manufacturing is generally a simple and relatively low cost process because it does not involve any cutting tool, unlike other SCL that need knives or blades to produce veneers or flakes. Due to this circumstance, the production cost of scrimber is deliberated as at least 30 % lower than that of the LVL, PSL and LSL (Jarck 2006b). According to studies conducted by BC Hydro, an electrical services company in British Columbia, Canada, manufacturing of scrimber uses 30 % less electrical energy and 28 % less thermal energy than manufacturing of LVL (Kryzanowski 2012). Moreover, the cost of setting up a scrimber factory is comparable to that of MDF and particleboard, thus scrimber manufacturing is an affordable investment, especially in countries that already have many commercial MDF and particleboard factories.

Potential Usages of Scrimber

As of the other SCL, scrimber can be used as building components which include columns, beams, girders, wall studs, door and window frames as well as roof trusses. In addition, due to its look that is closer to that of wood, scrimber would also be suitable for furniture components, worktops, doors and windows, stair elements, decorative panels and floorings.

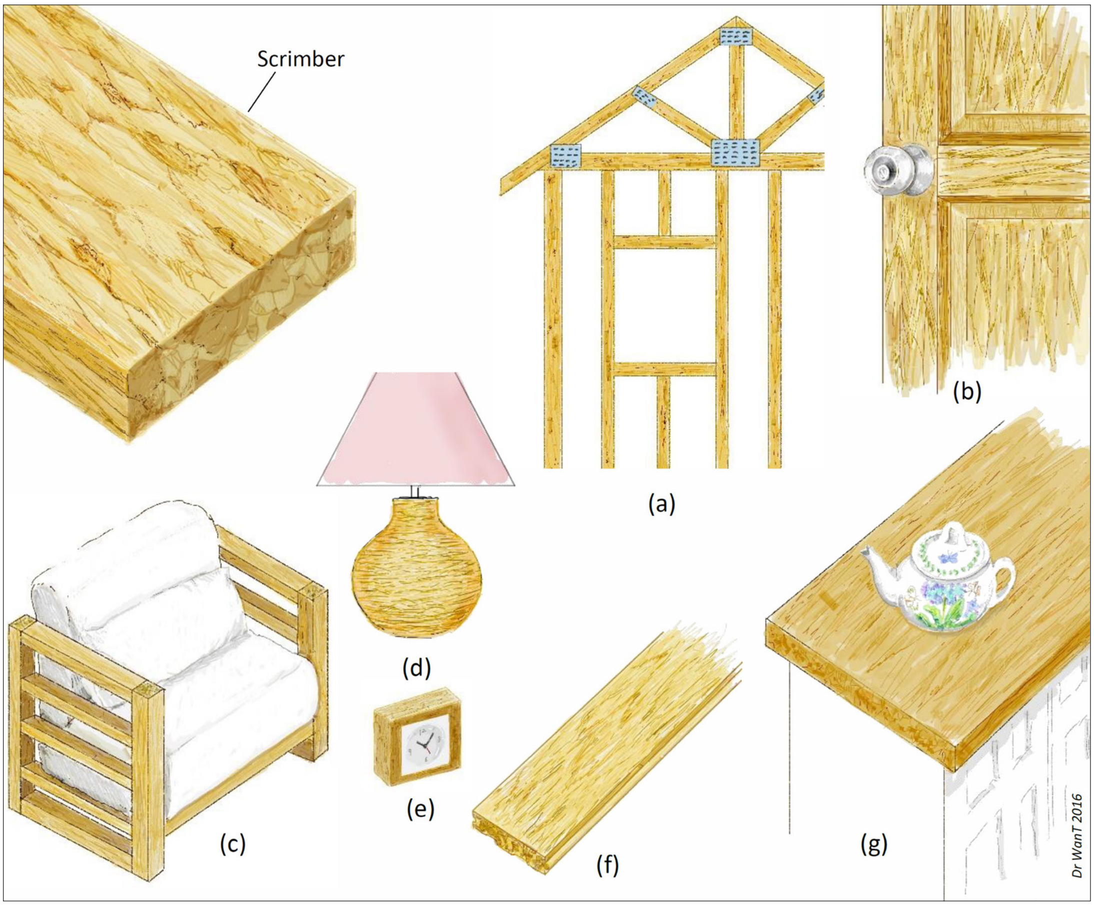

Figure 3 Some of the products that can be made from scrimber a) house frame; b) door; c) sofa or chair; d) lamp base; e) table clock; f) floorboard; g) kitchen worktop

Scrimber Development at FRIM

Forest Research Institute Malaysia (FRIM) started to collaborate with TimTek LLC, officially in July 2009 (Figure 4a), to develop scrimbers using timber from sustainable sources : oil palm trunk (OPT), coconut trunk, bamboo and juvenile (less than 5 yr old) trees of *Acacia mangium* and sesenduk (*Endospermum* spp.). The raw materials : debarked logs and crushed strands (in the case of bamboo and palms), were shipped in batches, from 2009 to 2012, to the Timtek Pilot Plant located at the MSU in Starkville, Mississippi to be converted into scrimber billets.

The scrimber (codenamed as "MYScrim") billets, such as those shown in Figure 4b, were shipped back to FRIM and evaluated both in terms of mechanical properties and potential applications. Generally, it was intended that MYScrim scrimber to be used as a raw material for furniture, floorings, doors and windows as well as building structural components.

The mechanical test results showed that the maximum modulus of elasticity (MOE) values were 9,500 MPa for MYScrim-OPT, 10,500 MPa (MYScrim-coconut), 11,700 MPa (MYScrim-acacia), 13,300 MPa (MYScrim-sesenduk) and 15,000 MPa (MYScrim-bambuseae) with densities ranged from 756 kg/m^3 to 830 kg/m^3 (Table 1). For comparison, the stiffness properties of scrimber from various species tested by Timtek, MSU and Loblolly are given in Table 2.

Furthermore, during the project, there were two patent pendings on methods related to MYScrim-OPT manufacturing processes (Wan Tarmeze & Jarck 2014, 2015).

Figure 4 a) FRIM-Timtek collaboration agreement signing in Atlanta, July 2009; b) 20-footer MYScrim-OPT and MYScrim-coconut (reddish in colour) billets pressed at the Timtek Pilot Plant

Table 1 Stiffness properties of scrimber developed by FRIM

Species	Age, year	Codename	MOE, MPa
Oil palm (trunk) [1]	25	MYScrim-OPT	9,500
Coconut (trunk) [1]	Above 30	MYScrim-coconut	10,500
Bamboo [1]	3	MYScrim-bambuseae	15,000
Acacia mangium [2,3]	5	MYScrim-acacia	11,700
Sesenduk [3]	5	MYScrim-sesenduk	13,300

Notes: [1] Wan Tarmeze et al. 2015, [2] Wan Tarmeze 2012, [3] Wan Tarmeze et al. 2014

Table 2 Stiffness properties of scrimber manufactured in the US and Canada

Species	Age, year*	Codename	MOE, MPa
Southern Yellow Pine [1]	10	Timtek	15,860
Ponderosa Pine [2]	10	SPSL	9,669
Lodgepole Pine [2]	10	SPSL	12,123
Trembling Aspen [3]			
White Birch [3]	10	Scrimtec	12,400 – 15,900
Black Spruce [3]			
Jack Pine [3]			
Balsam Fir [3]	10	Scrimtec	11,700
Southern Pine [4]	10	SPSL	15,400 – 17,700

Notes: [1] Jarck 2006b, [2] Linton et al. 2008, [3] Anonymous 2013, [4] Barnes et al. 2010, *estimated age of first thinning

Figure 5 Some of the products made from MYScrim a) display cabinet (OPT); b) school furniture (OPT); c) turnery table leg (OPT); d) solid door (bamboo); e) dining chair (OPT); f) floorboards (coconut & OPT); g) linear Noguchi table (Acacia); h) distressed look cupboard (OPT)

Figure 6 A 2x4 MYScrim-OPT in 4-point bending test

Conclusion

Malaysia could take advantage of scrimber technology, which has been reckoned worthy by FRIM to be further researched, developed and promoted as a new high income manufacturing industry for the country. This cost-efficient technology enables bio-materials such as oil palm trunk, wood from juvenile trees, and wood from lesser known or fast growing trees to be made into a high quality construction and furniture material. Malaysia has plenty of oil palm trunks that are felled for replantation, juvenile trees from the forest plantation thinning activities and fast growing trees in secondary forest with benefits that have yet to be explored. The success of establishing scrimber manufacturing industry that fully utilizes the above materials would not only offer high-paying jobs but also provide the much needed wood to the furniture and construction industries that have been facing shortage of wood supply from the natural forests. Moreover, the ability to make use the bio-materials from non-conventional sources also means to relieve the burden on the natural forests as the source for timber.

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