Machining Properties of 25 and 50 Year Old Treated Oil Palm Lumber

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Abstract

Wood had become one the most important material in furniture industry. Nowadays, with the decreasing supply of good timber for furniture industry and the increasing cost of wood materials, oil palm lumber can become one of the replacement materials resources to support the demand in industry. This research is to determine the machining properties of oil palm lumber with different age which are 25 and 50 year old and different layer of oil palm lumber which are outer, middle and inner. Several types of testing have been used on this research which are planing, sanding, boring, mortising, moulding and turning. Different results have been recorded after those testing are applied to the samples because of the several factors that influence their machining properties. 50 year old oil palm lumber give better performances than 25 year old oil palm lumber and outer layer give good machining properties than middle and inner layer. However, 25 year old oil palm lumber also can be used in machining process if better machining technique is adopted in further study.

Keywords: oil palm, lumber, machining properties.

1. INTRODUCTION

Nowadays, with the decreasing supply of good timber for furniture industry and the increasing cost of wood materials, there must have the replacement materials and sources to fulfil the need for furniture industry. Oil palm can become one of the replacement materials resources to support the demand in industry. 39 % of world palm oil production and 44% of world exports is accounted for Malaysia. Malaysia is one of the biggest producers and exporters of palm oil and palm oil products, also as an important role to play in fulfilling the growing global need for oils and fats sustainably (MPOC, 2012).

Machining test is carried out to determine the working qualities and characteristics of wood under a variety of machine operations. The presences of wood defects after machining process represent the working quality of the wood. These defects can be observed as raised grain, fuzzy grain, torn grain, chip mark, tear cut, scratching and surface roughness. Any surface defects due to improper machining process will reduce the quality of the final products. It was important to evaluate the machining parameters and relate them to raw material characteristics (Davis, 1962).

2. MATERIALS AND METHODS

2.1 Materials

The material used in this experiment is 25 and 50 years old oil palm trunk obtained from oil palm plantation at Felda Ulu Jempol, Maran. The ethanol was provided by wood industry workshop, UiTM Pahang.

2.1.1 Raw material preparation

Preparation of raw material was begun with brought the log to UiTM Pahang workshop to primary breakdown process. After resawing oil palm lumber process, the bottom part was marked as layer 1, layer 2 and layer 3 (outer, middle and inner layer). The lumber was dried by immersed it into the ethanol solution for four days and put it in oven drying until it got below 14% of moisture content. 60oC of temperature was applied during the drying process. Then, these lumbers were cut into required size with based on the biggest sample size. After that, the lumbers were cut into sample size based on machining testing standard required. All machining testing was proceeded at FRIM, Kepong and the data and result has been recorded.

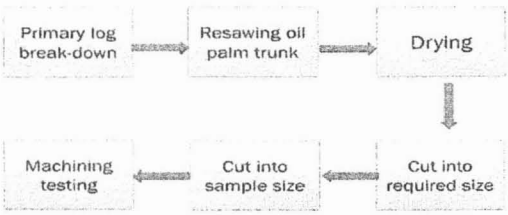

Figure 1: Flow chart of Material preparation

2.2 METHODS

2.2.1 Planning testing determination

Knives shall be freshly ground at the outset and jointed to a point where each knife shows a hairline land for the entire length of the blade. When the land or jointed portion of the edge becomes as much as 1⁄32 in. (0.80

mm) wide, as a result of repeated jointing, the knives shall be reground before continuing with the test. All cuts shall be 1/16 in. (1.6 mm) deep. When several species are being tested, mix them well to equalize the effect of the gradual dulling of the knives. Feed the specimens into the machine, so that half are machined with the grain and half against the grain. Make four runs with knives at cutting angles of 15, 20, 25, and 30°. Adjust the feed rates and cutterhead speeds to give 20 knife marks/in. (0.8/mm). Visually examine each test specimen carefully for planing defects after each run. For each specimen, grade any planing defect that may be present according to degree and record on prepared forms.

2.2.2 Sanding testing determination

The test specimens take from material left after planning test. The machine should be a two-head, wide-belt sander. If such a machine is not available then the machine shall be fully described. Sanding operation conducted using a contact roll or drum. The first head should carry an 80-grit, aluminium-oxide cloth or paper-back belt. The second head should carry a 120-grit, aluminium-oxide cloth or paper-back belt. Feed rates shall be 20 ft. /min (6.1 m/min). Examine the specimens and grade them for scratching and fuzzing, and the basis of comparison shall be the percentage of specimens that are free from defects.

2.2.3 Boring testing determination

The borer shall be a single-spindle electric machine equipped with power feed. The bit shall be a 1-in. (25-mm) sizes of the single twist, solid-center, and brad-point type .Sharpen it lightly at intervals of not more than one hour of work. The test specimens shall be conditioned to 6 % EMC or such other moisture content as may be specified. The borer shall be run at a spindle speed of 3600 r/min. The rate of boring shall be low enough to enable the drill to cut rather than tear through the specimen. Bore two holes through each specimen.

2.2.4 Moulding testing determination

The machine shall be a commercial size, hand feed spindle shaper with either one or two spindles. The knives shall be ground, and maintained in good cutting condition. The specimens shall be bandsawn to pattern. Make a preliminary roughing cut with the shaper making use of the jig and taking care to cut with the grain as far as possible. Make a finishing cut 1/16 in. (1.6 mm) deep. The speed shall not be less than 7200. Grade the test material piece by piece for raised, fuzzy, and chipped grain and rough-end grain and record the results on prepared forms. Keep a separate record for side-grain and end-grain cuts.

2.2.5 Mortising testing determination

Use the same specimens used for the maulding and boring tests also for mortising. The mortising machine shall be of the hollow chisel type equipped with power feed and spindle speed of 3600 r/min. Resharpen both the bit and the chisel at intervals of not more than one hour of work. Operate the machine at a spindle speed of 3600 rpm/min. Make two mortises in each specimen extending through into a hardwood backing. Cut the mortises with two sides parallel to the grain and two sides perpendicular to it. They need not be placed in any specific part of the specimen. The defects to be considered in grading the mortises are crushing, tearing, and general smoothness of cut.

2.2.6 Turning testing determination

The lathe shall be a well-made machine of the hand lathe type with a swing over the bed of not less than 12 in. (305 mm) and with several speeds, the maximum being not less than 3200 r/min. It shall be equipped with a compound rest, such as is used in metal turning. A one-piece, milled-to-pattern knife, together with a suitable tool holder should have to hold this knife in place on the compound rest. The knife may be hardened to reduce the amount of sharpening that will be necessary. Lathe centers, are desirable if a large number of turnings are to be made. They are made with square recesses 3/8 in. (9.5 mm) deep which taper from 13/16 in. (21 mm) on the entrance end to 5/8 in. (16 mm) at the bottom.

2.3 Experimental Design

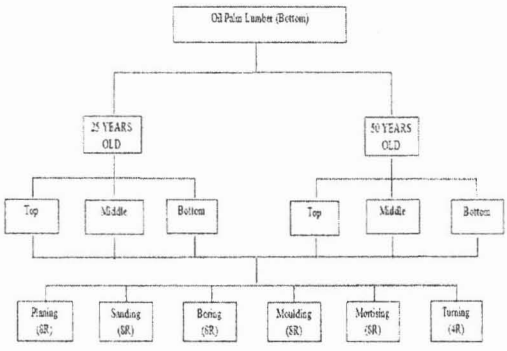

Figure 2: Experimental Design

3. RESULTS AND DISCUSSIONS

The samples of oil palm lumber has been through the machining testing and been determined their quality by the presence of defects occurs on the samples such as raised grain, fuzzy grain, torn grain, chip grain, the smoothness and crushing. To evaluate the level of the quality, visual method has been used to grade the surface of samples. From 1 to 5 grade according to the standard which mean 1 is excellent, 2 is good, 3 is fair, 4 is poor and 5 is very poor. After all the samples were evaluated,

SPSS has been used to determine the significant level of the result. All the machining testing result has been record for references.

3.1 Statistical analysis

The result shown there is significant between the ages and the layer of oil palm lumber which is 2.24, 2.33 and 2.46 for 25 years old oil palm lumber. Meanwhile, for the 50 years old oil palm lumber is 2.05, 2.15 and 2.22. There is also significant result for the overall layer which is 2.15, 2.24 and 2.34. The layer 1 is outer layer, layer 2 is middle layer and layer 3 is inner layer. Only bottom part has been used in this study.

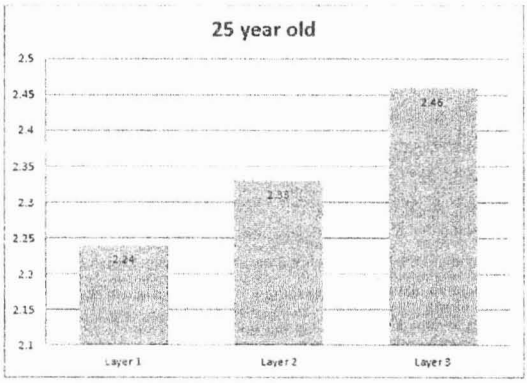

Figure 3: The significance between the layers of 25 year old oil palm lumber

Figure 3 summarizes that the layer 3 has the highest mean compare to layer 1 and 2.From that situation this obviously can be said that the layer 3 is less good machining properties than the layer 1 and 2. Layer 3 has more defects like fuzziness, crushing, torn grain and chip grain than layer 1 and 2. This is because, layer 3 has more silica than others layer. Killman and Lim (1985) said, poor machining properties of oil palm lumber are caused by high presence of silica. It was very difficult to work with, depending on the machining process used and gives very rough machine surfaces (Ho, 1985).

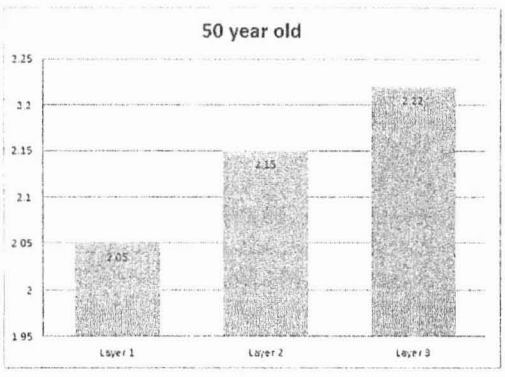

Figure 4: The significance between the layers of 50 year old oil palm lumber

From figure 4, the graph showed the significance level between the layer 1, 2 and 3 for the 50 year old oil palm lumber. The lowest mean is layer 1 with 2.05 compare to other layer which mean layer 1 have good machining properties than others layer. Layer 2 and 3 has more defects than layer 1. It was because middle and inner layer of oil palm lumber are more soft due to high moisture content than outer layer. Moisture content on inner layer makes the surface of lumber poor than outer layer. Their condition is spongier and gives more effect on surface during machining process.

Table 1: The significance between layer of oil palm lumber

Between layer	p-value	Significance	Conclusion
25 year old	0.023	YES	Means grade not equal
50 year old	0.025	YES	Means grade not equal

Figure 5 shows significance difference between the ages which is 25 and 50 year old oil palm lumber. In figure 5, showed that 50 year old of OPL is the lowest mean compare to 25 year old OPL. That means 50 year old OPL is has more good machining properties than 25 year old OPL. Because of 50 year old OPL are older, it have more high of vascular bundles presence on the trunk compare to 25 year old OPL. Vascular bundles can give more stability then good machining properties in machining process.

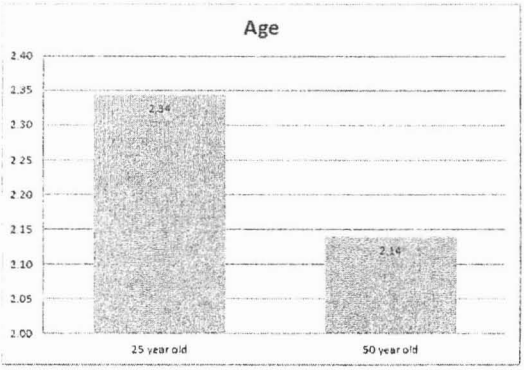

Figure 5: The significance between the ages of oil palm lumber

Table 2 showed that there is significant for the layer 1, 2 and 3 which is the means are not equal. There is highly different between all the layers as graph showed before. The mean for 25 year old OPL for layer 1 is 2.24, layer 2 is 2.33 and layer 3 is 2.46. The mean for the layers of 50 year old OPL also obviously different which is layer 1 is 2.05, layer 2 is 2.15 and layer 3 is 2.22.

Table 2: Significance level for the layers between the 25 and 50 years old OPL.

25 50	p- value	Significance	Conclusion
Layer 1	0.047	YES	Means grade not equal
Layer 2	0.037	YES	Means grade not equal
Layer 3	0.044	YES	Means grade not equal

For the both ages, there is significant between the layer which is there are highly different mean among the layers for both ages. It can be concluded that every layer of both ages have different characteristics and condition that effected the machining properties of oil palm lumber. The presence of vascular bundles is the prime factor that gives the effects of each layers and ages.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

As a producer of furniture product based of wood, Malaysia is well-known around the world. A shortage of wood material in the coming future could impact the furniture and wood-based industry in Malaysia. Further then, this study finds the alternatives to recover the problems by carry out the machining properties of oil palm lumber. The oil palm lumber are reported to be difficult to work with and the finish quality also poor (Ho, 1985). The difficulties are due to the presence of vascular bundles and silica that make the cutter knives blunt easily.

The result showed there is significant between the layers of oil palm lumber on machining properties. For 25 year old OPL, the result is 2.24, 2.23 and 2.46 for layer 1, 2 and 3. Meanwhile, for 50 year old OPL is 2.05, 2.15 and 2.22 for layer 1, 2 and 3. The result also showed there is significant between the ages which the mean result is 2.34 and 2.14 for 25 and 50 year old oil palm lumber. Overall result showed that oil palm lumber have ranked 2 which mean it have a good machining properties according to (ASTM D1666-87) but 50 year old OPL have good machining properties compare to 25 year old OPL. Between the layers, layer 1 which is outer layer has good machining properties compare to middle and inner layer for overall result.

4.2 Recommendations

For further study, middle and top portion could be investigate for further research, the probability this section might be have a good machining properties after a proper treat and apply a good machining skill. Manufacturer can use all part of oil palm lumber without need to separate it. Because of the machining properties of 25 year old OPL also on rank number 2 which is good, it was highly recommended that manufacturer can use that lumber and they no need to wait for palm oil tree to reach 50 years old.

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