Industrial Moulding of Oil Palm Particles I. Suitability of Oil Palm Trunk and Frond for Moulded Table-Tops

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RINGKASAN

Partikel dari batang dan pelepah sawit didapati boleh digunakan untuk pembuatan bahagian meja-atas secara komersial. Kajian menggunakan peralatan pemprosesan partikel kayu yang sedia ada, menunjukkan bahawa meja-atas yang diperbuat dari batang kelapa adalah lebih kuat dari pelepah sawit. Sungguhpun begitu, meja-atas yang diperbuat dari kedua-dua bahan tersebut memenuhi keperluan piawai British Standard, B.S.5569:1979(Type I).

INTRODUCTION

The low utilization of oil palm resources such as trunk and frond by the wood-based industry is due to their existing material forms and sizes, and also the presence of parenchymatous tissues which results in density variations especially in the radial direction (Killmann, 1985). In addition, oil palm trunks are prone to high seasoning degradations such as collapse, cupping and twisting (Gan et al., 1991). These defects have till now virtually excluded oil palm trunk from being commercially exploited, in spite of their ready availability.

At present, vast areas of oil palm have reached their economic fruiting and harvesting age. Kamarudin and his co-workers (1993) estimated that more than 44,000 hectares of oil palm area will undergo replanting in 1993/94. Considering the average planting density of 136 palms per hectare, more than 6 million oil palm trees would be felled during this period. To safeguard our environment against pollution and to eliminate the ideal breeding ground for pests and diseases, the felled trees need to be salvaged into value-added products on commercial scale.

A joint research study was initiated to assess the suitability of commercializing these oil palm resources. The primary objective of this study was to investigate the suitability of OPT and frond as a source of particles in the commercial manufacture of moulded table tops.

MATERIALS AND METHOD

Felled OPT and fronds were chipped using a Chugoku-chipper (model CKS 603), air-dried to about 70 percent dry content and passed through a Wiley-mill. OPT particles were first passed through a homogenizer to separate its parenchyma prior to grinding. This process was omitted for the fronds. The resulting ground particles were hand-sieved into the required particle size and dried in a Memmert oven (model UL40) to about 2 percent moisture content.

About 60 kg (oven-dry weight) of the respective OPT or frond particles were individually sprayed with an aqueous urea formalde-
hyde adhesive in a drum mixer with a calculated amount of resin solid to oil palm particles of less than 18 percent. After blending, a known weight (depending on table top model) of the resin-coated particles was hand-distributed into preforms. The preform dies were then mounted in a cold press and subjected to a pressure of 230 kg/cm² for five minutes (Figure 1). Upon releasing the pressure, the surface of the resulting table-top was covered with a sheet of tissue paper to prevent the transfer of any loose resin-coated particles onto the upper hot dies during hot pressing (Figure 2).

The preformed table-top was then transferred to hot dies (which were mounted in a steam heated hydraulic hot press) and cured at 140°C and pressure 230 kg/cm² for 10 minutes. The table-top density will be approximately 730 kg/m³ (Figure 3). Within this pressing cycle, the cured moulded table-top was surfaced with paper impregnated with melamine-formaldehyde or with exotic wood veneer. Finally, the cured laminated table-top was conditioned for 5 minutes and its edges sanded lightly (Figure 4). Figure 5 illustrates the process flow of moulding of oil palm particles into a table-top.

RESULTS AND DISCUSSION

Particle Size Distribution

The distribution of OPT and frond particles size (at 30 percent moisture content) were given in Table 1. Basically, the distribution of particle size of OPT was comparable to that of frond (more than 80 percent of the respective particles ranged from 825 microns to 425 microns).

Surface Quality

The OPT table top possessed uneven vertical density and a 'telegraphic' surface with numerous surface voids compared to the frond table-top. This indicated that the product performance, surface appearance as well as manufacturing processes of moulded table-tops were greatly influenced by the particle configuration of the individual oil palm components. It was noted that the particle configuration of OPT devoid of parenchyma was splinter-like whereas that of frond was chip-like.

Mechanical Properties

Howard (1974) mentioned that particle-board produced from low density species had greater bending strength, internal bond and modulus of elasticity. In contrast to the findings of Howard, the strength properties of frond table-top were lower than those made from OPT. This was probably due to the presence of parenchymatous tissues and damaged particles from the severe compaction received by frond particles. The compaction ratio of OPT and frond table-top was found to be 1.37 and 2.15, respectively.

The modulus of rupture, modulus of elasticity and internal bond of OPT table tops averaged 14.90 Mpa, 2577 Mpa and 1.71 Mpa whereas those from frond averaged 12.79 Mpa, 1813 Mpa and 1.62 Mpa, respectively (Table 2). Based on the physical analysis conducted at PORIM, the finished density of OPT and frond was found to be 0.51 g/cm³ and 0.32 g/cm³, respectively. Since, the resulting table-top density exceeded its respective furnish density, both the oil palm table tops were suitable for general use (Larmore, 1959; Vital et al., 1974; Hse, 1975) and could meet the minimum strength requirements as stipulated in British standards, BS 5669:1979 (Type I).

CONCLUSION

The results of this study showed that particles from oil palm resources could be bonded
Figure 1. Preforming of Oil Palm Particles into Moulded Table-top.

Figure 2. Preformed Oil Palm Table-tops.
Figure 3. Curing of Oil Palm Table-top.

Figure 4. Conditioning of Finished Table-top.
TABLE 1. OIL PALM PARTICLE DISTRIBUTION (%)

<table>
<thead>
<tr>
<th>Particle Type</th>
<th>Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>850μm</td>
</tr>
<tr>
<td>Trunk</td>
<td>62.54</td>
</tr>
<tr>
<td></td>
<td>(0.88)</td>
</tr>
<tr>
<td>Frond</td>
<td>67.50</td>
</tr>
<tr>
<td></td>
<td>(1.90)</td>
</tr>
</tbody>
</table>

( ) denotes standard deviation.

TABLE 2. STRENGTH PROPERTIES OF MOULDED TABLE TOPS MADE FROM OIL PALM PARTICLES

<table>
<thead>
<tr>
<th>Properties</th>
<th>Moulded Table-top</th>
<th>British Standard BS 5669:1979 (Type I)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trunk</td>
<td>Frond</td>
</tr>
<tr>
<td>Table top density, kg/m³</td>
<td>697</td>
<td>689</td>
</tr>
<tr>
<td>Modulus of rupture, Mpa</td>
<td>14.90 (6.97)</td>
<td>12.79 (3.20)</td>
</tr>
<tr>
<td>Modulus of elasticity, Mpa</td>
<td>2577 (715)</td>
<td>1813 (201)</td>
</tr>
<tr>
<td>Internal bond, Mpa</td>
<td>1.71 (0.70)</td>
<td>1.62 (0.52)</td>
</tr>
</tbody>
</table>

( ) denotes standard deviation.
Figure 5. Process flow of oil palm moulded table top.

into moulded table-tops commercially. The resulting table-tops could meet the minimum strength requirements of Type I board (Standard Board) as stipulated in B.S. 6669:1979. The moulding processes of oil palm particles into moulded table top minimizes or eliminates the successive conventional processing steps of the same products produced from oil palm lumber. Thus, this process will reduce time and energy, and hence, result in cost-saving operations.

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REFERENCES


