PROPERTIES OF PARTICLEBOARD MADE FROM RECYCLED POLYSTYRENE AND Cocos nucifera STEM PARTICLES

[1]AJAYI B., [1]ADENIRAN A. T., [2]OMOLE A., [3]AKINLALU O.

[1]Department of Forestry and Wood Technology, Federal University of Technology Akure, Akure, Ondo State, Nigeria

[2]Department of Forest Production and Products, Faculty of Renewable Natural Resources, University of Ibadan

[3]Department of Forestry and Wood Technology, Rufus Giwa Polytechnic Owo

ABSTRACT

Recycled Polystyrene (RP) and senile coconut was used to produced Particleboard at 2 levels of Particle Size (PS), 3 levels of Board Density (BD) and 3 levels of Mixing Ratio (MR). The Modulus of Rupture (MOR), Modulus of Elasticity (MOE), Thickness Swelling (TS) and Water Absorption (WA) were investigated. TS and WA decreases as the PS, BD and MR increases, while MOR and MOE increases proportionately. MOR and MOE initially increases as MR increases from 1:1 to 2:1 and later decreases. Board produced at BD 1200 kg/m^3 and MR 2:1 is the strongest, stiffest and most stable. This study proves that RP can substitute formaldehyde based resin.

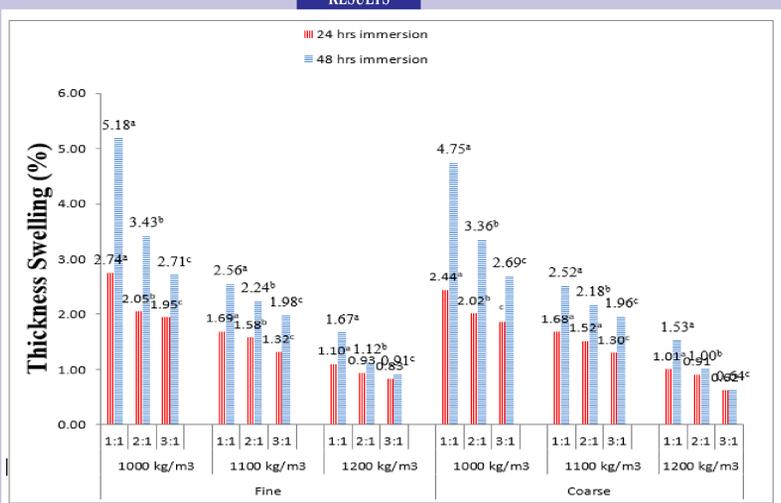Keywords: Recycled polystyrene, particleboard, coconut stem particles.

RESULTS

Figure 1: Effect of PS, BD and MR on TS (%) after 24hrs and 48hours Water Treatment
Superscripts on means shows significant differences (p≥0.05)

Thickness Swelling (TS)

· TS at 24 hours ranged from 0.83±0.01% to 2.74±0.02% and 0.62±0.01% to 2.44±0.01% for fine and coarse particles respectively, while TS at 48 hours ranged from 0.91±0.01% to 5.18±0.01% and 0.64±0.01% to 4.75±0.01% for fine and coarse particles respectively.

· TS decreases with increase in PS, BD, and MR. (Figure 1).

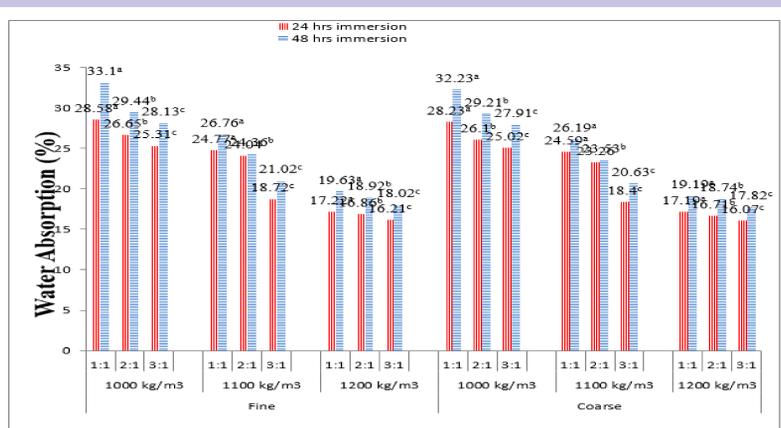· Board with lowest TS value was produced with coarse particles, BD 1200 kg/m^3 and MR 3:1

Figure 2: Effect of PS, BD and MR on WA (%) after 24hrs and 48hours Water Treatment

Water Absorption (WA)

• WA at 24 hours ranged from 16.21±0.01% to 28.58±0.1% and 18.40±0.01% to 28.23±0.01% for fine and coarse particles respectively

• WA at 48 hours ranged from 18.02±0.01% to 33.10±0.78% and 20.63±0.01% to 32.23±0.01% for fine and coarse particles respectively.

• WA decreases with an increase in PS, BD and MR. (Figure 2).

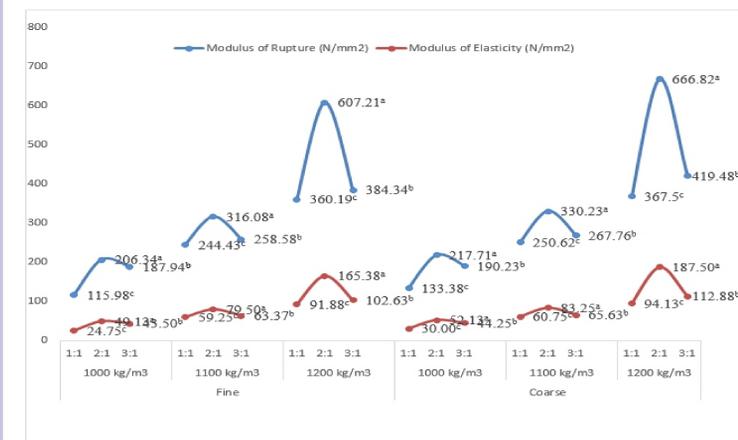• Board with the lowest WA is produced with coarse particles, BD 1200 kg/m^3 and MR 3:1.

Figure 3: Effect of PS, BD and MR on MOR and MOE
Superscripts on means shows significant differences (p≥0.05)

Modulus of Rupture (MOR) and Modulus of Elasticity (MOE)

• MOR values ranged from 172.21±4.68 N/mm^2 to 906.56±21.91 N/mm^2 and 180.19±2.34 N/mm^2 to 1105.91±37.26 N/mm^2 for fine and coarse particles respectively (Figure 3).

• MOE values ranged from 24.75±0.00 N/mm^2 to 165.38±5.83 N/mm^2 and 30.00±2.12 N/mm^2 to 187.50±20.15 N/mm^2 for fine and coarse particles respectively (Figure 3).

• MOR and MOE increases with increase in PS and BD.

• MOR and MOE increases from 1:1 to 2:1 and decreases to 3:1 (Figure 3).

• The most durable board was produced with coarse particles, BD 1200 kg/m^3 and MR 2:1.

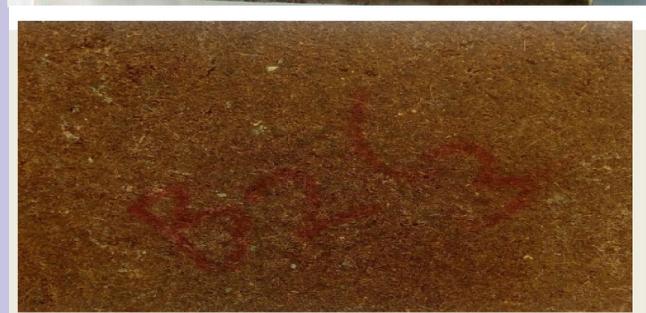Table 1: The Analysis of Variance for MOR, MOE, TS, and WA of Composite Particleboard.

Sources of Variation	df	TS (24 hrs)	TS (48 hrs)	WA (24 hrs)	WA (48 hrs)	MOE	MOR
				F-values			
Particle size	1	513.422*	213.158*	62.182*	34.672*	69.329*	303.6
Board Density	2	69515.239*	14834.336*	16684.317*	8151.753*	2864.108*	50.3
Mixing Ratio	2	14241.406*	1893.875*	2095.107*	1007.638*	534.234*	2958.6
Particle size * Board density	2	42.272*	23.349*	2.922^{ns}	0.808^{ns}	37.535*	509.0
Particle size * Mixing ratio	2	29.106*	19.717*	1.509^{ns}	0.632^{ns}	15.181*	5.9
Board density * Mixing ratio	4	2338.256*	158.000*	367.875*	76.302*	248.132*	119.6
Particle size * Board density * Mixing ratio	4	52.806*	22.579*	1.646^{ns}	1.037^{ns}	15.193*	550.2
Error	18						
Total	35						

Analysis of Variance (ANOVA)

• PS, BD and MR had significant (p≥0.05) effect on the TS, WA, MOE and MOR (Table 1).

• 2 factors and 3 factors interactions had significant (p≥0.05) effect on TS (Table 1).

• For WA only the 2 factor interaction between BD*MR have significant (p≥0.05) effect on WA.

• 2 factors and 3 factors interactions had significant (p≥0.05) effect on MOR and MOE (Table 1).

• DMRT shows significant (p≥0.05) differences on the properties at different levels of BD and MR (Figure 1, 2 and 3).

CONCLUSIONS

• Coconut stem particles and recycled polystyrene are suitable for the production of particleboard.

• Increase in PS, BD and MR caused decrease in TS and WA.

• MOE and MOR increases with increase in PS, BD and MR.

• The strongest, stiffest and most stable board was produced at PS coarse, MR 2:1 and BD 1200kg/m^3

Board Specimens