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ASSESSMENT OF MODULUS OF RUPTURE (MOR) OF CBPB CEILING BOARDS PRODUCED FROM A LOCALLY DEVELOPED MACHINE

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ABSTRACT

MOR is an index used for determining the quality of Cement Bonded Particle Board (CBPB) ceiling boards. In this work the CBPB was a mixture of Cement, Sawdust and Paper in 10:12.5: 7.5 proportions. A locally produced machine was used to make the ceiling boards. Specimens were prepared and subjected to compressive test in a universal testing machine (UTM) at the Engineering Materials Development Institute (EMDI), Akure using standard procedures. Results of MOR obtained from tests showed an increase of 0.215, 0.051, 0.0514 over standard minimum of 94.57 Pa specified by EN. 654.2 for composite products and it is therefore recommended for use in construction work.

KEYWORDS: Board; Bonded; Ceiling; Cement; Particle

INTRODUCTION

Studies conducted by Alvia (1983) and Badejo (2001) showed that only 50% to 55% of wood converted at sawmills and other wood conversion machines end up in the market. The remaining end up as waste. The need to provide safe alternative to asbestos ceiling boards as well as reduce wood waste has led many researchers to explore the suitability of wood-cement admixture (cement bonded particle board). Ceiling board making machine is a machine used to compress the mixed particle board materials into required size and shape.

Particle board bonded with cement was first discovered in Austria 1914 (FAO, 1973). Industrial utilization of cement bonded particle board, started in the 1930's. However, most of the innovations have been done in the last 40 years. The research was promoted by problems related to asbestos (Moslemi, 1999). Ceiling boards are of various types depending on size, materials they are made of, and production processes. Their acceptability will be governed by aesthetics, physical properties, mechanical properties, acoustic properties, cost, and health related factors. The most common type; asbestos ceiling board has been adjudged by the World Health Organization (WHO) as carcinogenic (Moslemi, 1999), hence the need to produce safer alternatives). Most research in the field of cement bonded wood composite deals with cement bonded particle board (Fan et al., 2006). Portland cement was successfully used as a binder in 1928 in the production of wood cement board (Kollman et al., 1985). The term particle board includes a number of different panel types sometimes referred to as "chipboard" "flake board" "strandboard" or "waterboard" depending on the size and shape of the wood particle used (Weather, 1964). Particle board is one of the strongest reconstituted panel product and is considered an ideal substitute to wood and

plywood for building, interior work, and furniture (Carl, 1986). Akpen and Tyagher (2006) produced ceiling boards from sawdust, cement, paper mash and starch which had satisfactory comparative properties to asbestos ceiling board with an added advantage of health and environmental friendliness.

The properties of grades of particle board are usually determined and such properties either suggest or limit its use as described in standards (Okiro et al., 2005). These properties include: Modulus of Elasticity (MOE), Modulus of Rupture (MOR), tensile stress (TS) and Yield Stress (YS). MOR is the ability of a material to resist deformation under load (Giaccio et al., 2007).

In this work a locally produced hydraulically powered ceiling board making machine was used to produce sample of ceiling board from mixture of cement, saw dust, paper mash and water. The samples were tested using universal testing machine.

MATERIALS AND METHOD

Material

The materials include: saw dust, paper mash, cement and starch. Saw dust was soaked in hot water for three hours to remove adverse chemicals and then dried. Paper mash was soaked mashed and dried. These were mixed together with cement and water to produce the mixture for the mat.

Machine

The locally fabricated machine consists of hydraulic press, molding box, four bolts for clamping the cover. See plate 1.

Production of the Boards

After mixing the constituents, the material was poured into the mould box which was covered and pressed under the ram of the machine, bolted and removed. The mat was left to cure in the box for 24 hours before removal. The board was thereafter left for 28days for it to gain full strength.

Determination of Modulus of Rupture (MOR)

A sample each was taken from five boards chosen at random. These samples were loaded between the jaws of Universal Testing Machine. The specimens were under increasing compressive stress until failure.

RESULTS AND DISCUSSION

Table 1 shows the results of compression test on the CBPB samples. Inference from the table shows that sample D has the least MOR value of 0.54 Mpa which is still greater than the American Society of Testing and Materials, ASTM C120 minimum of 0.38 pa. Fig.1 shows the mechanical response of the samples under compression loading. Inference from the fig shows that sample D has the least maximum compressive stress of 0.45kN. This will inform the safe stress to subject the ceiling boards to in practice. MOR is an important criterion for determining the quality of CBPB. From the inference from the results above, all the boards tested have MOR above the required limit specified by the standard.

CONCLUSIONS AND RECOMMENDATIONS

The results from the three tests showed that the modulus of rupture (MOR) of all the specimen (0.2156 Mpa, 0.051499 Mpa and 0.051 Mpa) were higher than the modulus of rupture (MOR) of 652000 psi (94.565Pa) specified by EN 634.2. The boards produced met the standard requirement of particle boards and is therefore suitable for use in various applications of particle boards including use as ceiling board. Therefore, the boards are recommended for use in various applications as ceiling board.

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Table 1: Results of the compressive test of the CBPB samples

S/No	Parameter Evaluated	Unit of the parameter	Sample description with the parameter evaluated values A	B	C	D
1.	Maximum Load	KN	1.01	0.67	0.59	0.43
2.	Max. Comp. Stress	MPa	1.43	0.93	1.03	0.92
3.	Energy at maximum comp load	J	4.49	1.28	0.36	0.64
4.	Area	cm^2	7.08	7.23	5.70	4.69
5.	Anvil height	mm	9.79	8.33	8.20	5.78
6.	Modulus of rupture (automatic)	MPa	1.89	2.49	11.43	0.54

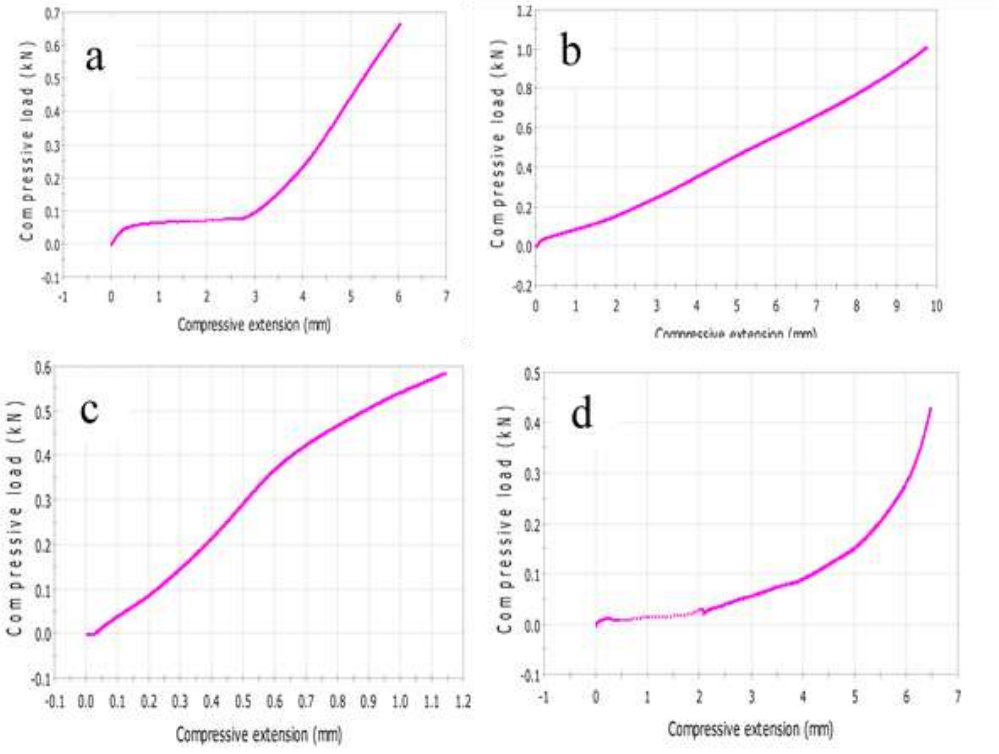

Figure 1. Mechanical response of the samples under compression loading

(a) Pouring and Spreading of mixture

(b) Pressing of Board

(c) Curing of boards

(d) Cured ceiling board.

Plate 1. Production of CBPB ceiling board