



## Performance Characteristics of Medium Density Fibre Board (MDF) for Household Interior Uses

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### ABSTRACT

The high demand and usage of medium density fibre board (MDF) is on the increase due to its societal and attractive characteristics in the Home furniture and decorative industry. There is a need for wholistic investigation of its strength, durability and physical properties as well as its health hazard concerned. The research tends to explore the general behavioural characteristics and performance to household uses, safety caution and health hazard implications. MDF boards are mostly used for home interior furnitures and decorative purposes offering attractive and more realistic finishes. MDF has an advantage of being less-expensive or cheaper and easier to use compared to other different woods. The MDF physical and strength properties determined are moisture content, water absorption capacity, swelling in thickness, modulus of rupture, density and compressive strength. The investigated properties obtained are moisture content 8.31%, water absorption capacity 79.5%, swelling in thickness 15.6%, modulus of rupture 61.2Mpa, density 0.6g/cm<sup>3</sup> and compressive strength 2.2Mpa respectively. The MDF having some deficiencies as discovered being weak under severe stress, high water absorption capacity also containing chemical (Urea-formaldehyde) which can be harmful to human health, yet it can serve as an alternative wood board in most household interior decorations and furniture industry. The use of MDF board will adds value to general wood usage and also reduces environmental pollution in recycling the wood fibre, saw dust waste in producing medium density fibre board (MDF) board.

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### INTRODUCTION

The use of timber for different purposes has been an ancient norm in various ways and societies as the demand may arise. Timber is one of the most valuable raw material which offers preference for weight, strength colour and texture. It can be bent, screwed, nailed, even attached with glove iron or metal, plastic and fastened to another piece of timber. (Dublin et al, 2021). Timber is generally considered as a good construction material and performs vital role in construction industry, household interior furniture and industrial furniture, also other decorative uses.

Medium density fibre (MDF) board is a unique produced board used as alternative wood material for special purposes. The medium density fibre board is a type of engineered composite wood product or

manufactured board made from residues of hardwood and softwood glued together with wax under extreme pressure and temperature (W. Gul 2017). MDF is made up of small fibres, strands and particles, the board is designed to meet application – specific requirements due to its versatility and availability in a wide variety of thickness, smooth surface, with defined edges as well as realistic finishes (Buyoskari 2012).

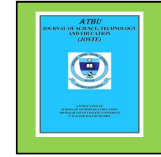
The medium density fibre board (MDF) has become a generic name for any dry-processed fibre board, typically made up of 82% wood fibre, 9% urea-formaldehyde. The density and classification could either be light-standard or high density board. There are different types of MDF board like ultra-light MDF board, moisture-resistant board, and fire retardant mostly red or blue in colour (Karegarfard 2015).

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In practice and maintaining consistency in terms of composite production, MDF is more compact than other engineered wood like plywood, few years back MDF was less durable than solid wood, but technology and manufacturing have advanced and high-end MDF boards are as durable as natural wood. Different classes of engineered wood are based on the size of board, its consistency, the type of glue and of course the type of fibres used. (Kara et al, 2017).

The medium density fibre board is denser and stronger compared to particle board mostly preferred for office, kitchen and general interior furniture. The board can absorb water faster than natural wood and prone to swelling up causing damages, investigations reveals that the chemical used in the production of the board urea-formaldehyde is harmful to human eyes and lungs, also during the production there is a lot of dust released into air which can also be harmful to human system (K. Li, 2013).

Strishti Jain (2021) suggested the use of MDF boards for construction of bookshelves, wardrobes, and shoes racks because of its uniqueness and durability characteristics that can be utilized for interior purposes. Further investigations reveals that MDF has some weakness includes absorbing up water and other liquids like a sponge and swells, if not sealed well. The MDF board being made up of fine fibre it does not hold screws or nails very well and it suffers damages and sags if not handled with care. In comparing MDF board and plywood or other natural wood, plywood is commonly used for outdoor projects being made up of banded veneer wood sheets together into one solid piece having visible wood grains free from other wood defects while MDF is suitable for indoor uses as decorative panels or furniture of different shapes and sizes. MDF is ideal for cutting, machining and drilling since it does not chip easily with sharp cutting tools.

Medium density fibre (MDF) boards are produced in panels with a variety of physical properties and dimensions, providing the opportunity to design the end product with the specific MDF characteristics and density needed. The use is extensively as core stock in furniture and cabinet panels, it can also be used for over-layered and power-coated mill work. The board is being mostly preferred due to its

advantage over particle board with smoother surfaces, void-free edges (Kamke, 2004).

Kubba, et al. (2010) highlights the process and procedures of MDF production as a composite wood product traditionally formed by breaking down softwood into wood fibres, often in a delimitator, combining it with wax and a synthetic resin binder such as urea formaldehyde resins (UF) or other suitable ironing system, and forming panels by applying high temperature and pressure. It was discovered that MDF is not the same and will vary in texture, density colour etc, depending on material it is made of. Today many MDF boards are made from variety of materials. These include other woods, scrap, recycled paper, bamboo carbon fibres and polymers, steel, glass, forest thinning and sawmill off-cuts.

MDF's qualities make it an ideal replacement for plywood or particle board especially in paneling and partition work. The production is dense, flat, and stiff, has no knots and is easily machined to different specifications. It consists of fine particles and provides dimensional stability without a predominant grain as is the case with natural wood.

## MATERIALS & METHODS

The MDF board was obtained from Bauchi Timber Market with full size of 2440mm x 1220mm x 18mm. The board was selected and used according to Bsl EN. 622 : 2003 – Fibre board's specifications and general requirements.

### **Moisture Content Test**

Determination of moisture content of the fibre board as stipulated by BS 322:1993 code. The moisture content was determined and expressed in percentage.

### **Density Test**

Density of the medium density fibre board was determined in accordance with BS EN. 323:1993 code for timber or board density.

### **Water Absorption Capacity**

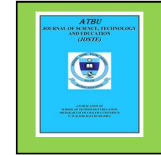
Determination of water absorption capacity of medium density fibre board was conducted in compliance with the BS EN 382 – 2:1994 code where the board sample

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representative of a 230 x 250 x 18mm three pieces in number were immersed in water for 48 hours in order to determine the absorption capacity of the board.

#### Swelling in Thickness

The deformation in size, shape and edge due to exposure to moisture was determined after 24hrs immersion of the fibre board of size 200 x 250 x 18mm in water. Veneer caliper and measuring tape was used to measure the change in size and thickness of the board. In compliance with BS EN 324 – 1:1993 code for Determination of Dimensions of boards, thickness, width and length.

#### Modulus of Rupture (MoR)

Three specimens of size 300 x 70 x 18mm of each MDF board was used in determining the modulus of rupture subjecting the board under axial loading perpendicular to the entire part of the fibre board member.

#### Compressive Strength (Internal Bonding Test)

Determination of internal bonding by compressive strength test of the fibre board was carried out in compliance with BS EN 789:2004. Three specimens of size 100 x 600 x 16mm were used to determine the strength of the fibre board.

### RESULTS PRESENTATION

**Table 1:** Moisture Content (MC)

MDF Specimen Mark	Values (%)
MDF Specimen A (230 x 250 x 18mm)	7.85%
MDF Specimen B (230 x 250 x 18mm)	8.18%
MDF Specimen B (230 x 250 x 18mm)	8.90%
	<b>Av. 8.31%</b>

**Table 2:** Water Absorption Capacity (WAC)

MDF Specimen Mark	Values (%)
MDF Specimen A (230 x 250 x 18mm)	77.3%
MDF Specimen B (230 x 250 x 18mm)	70.9%
MDF Specimen C (230 x 250 x 18mm)	90.4%
	<b>Av. 79.5%</b>

**Table 3:** MDF Density Test

MDF Specimen Mark	Values (g/cm <sup>3</sup> )
MDF Specimen A (230 x 250 x 18mm)	0.62
MDF Specimen B (230 x 250 x 18mm)	0.60
MDF Specimen C (230 x 250 x 18mm)	0.59
	<b>Av. 0.60g/cm<sup>3</sup></b>

**Table 4:** Modulus of Rupture (MoR)

MDF Specimen Mark	Values (MPa)
MDF Specimen A (300 x 70 x 18mm)	66.7
MDF Specimen B (300 x 70 x 18mm)	64.9
MDF Specimen C (300 x 70 x 18mm)	51.9
	<b>Av. 61.2MPa</b>

**Table 5:** Compressive Strength (Internal Bonding Test)

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MDF Specimen Mark	Values (MPa)
MDF Specimen A (100 x 60 x 18mm)	2.5
MDF Specimen A (100 x 60 x 18mm)	2.0
MDF Specimen A (100 x 60 x 18mm)	2.0
	<b>Av. 2.2MPa</b>

**Table 6:** Swelling in Thickness

MDF Specimen Mark	Values (MPa)
MDF Specimen A (230 x 250 x 18mm)	15.6
	<b>Av. 15.6MPa</b>

The result of Medium Density Fibre (MDF) board for moisture content determined is presented in Table 1. It shows the average moisture content of 8.31% obtained and falls within ASTM D 4442 specification of acceptable moisture level for lumber or board meant for interior usage.

Table 2 shows the result of water absorption capacity determined with an average value of 79.5% which reveals how susceptible and prone the MDF board is to water or any motorized prone area. The MDF board if exposed to a damp or moisture prone area, may weaken the board due to its high rate of water absorption.

Table 3, the result of the MDF density as presented was determined and average value of 0.60g/cm<sup>3</sup> or 600kg/m<sup>3</sup> obtained and this falls within the specification of the MDF density that range from 500kg/m<sup>3</sup> in accordance with BS EN 150 12572.

Table 4, the result and findings of the Modulus of Rupture (MoR) averaged 61.2MPa obtained is higher than the stated values by the BS EN 310 code of practice EN 310 ≥ 30 MPa. The MDF board examined is stronger from the production and this suggest that the production temperature was higher above 160 °C that yields this result. (W. Gul 2017).

Table 5, the result obtained for the internal bonding investigation is 2.2MPa as average value of the specimen obtained. The findings in accordance with BS EN 319 recommend values for internal bonding, 0.43MPa – 1.02MP for medium density fibre board. The result obtained is higher than the state values of the standard this can also be attributed to higher temperature at the production stage of the MDF board.

Table 6, the result of the swelling in thickness obtained is averaged 15.6% which is

above the required standard value BS EN 317 is < 12 for MDF boards.

### CONCLUSION

The results shows that the mechanical properties of the MDF board which are modulus of rupture, internal bonding, and strength are satisfactory and values obtained are higher than the stated by the BS EN 789:2004. The water absorption and swelling in thickness test have duly revealed the weakened characteristics of the MDF board of high rate of water absorption also subsequent size or thickness deterioration when exposed to water or in a damp area. However, some observations worth noting are:

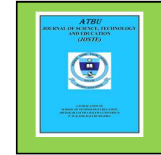
1. The health implications involved mostly during the machining process of the MDF board due to the chemical used in the production which may affects human lungs, throat and eye if necessary safety precautions are not observed.
2. The MDF board is strictly main for internal usage such as home furniture, office and institutional furniture not likely to be expose to moisture.
3. The MDF board should not be subjected to heavier loads directly or indirectly.
4. The MDF board is recommended for home decorative furniture, cabinet and esthetics designs.
5. The edges of the MDF board must be properly seal using the recommended edge tape with adhesive.
6. Unlike solid wood or plywood furniture, MDF furniture is not very strong and durable but is resistant to termites. It has to be handle with care. In case it gets damaged, it is difficult to repair it. Note

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that the drawer of MDF furniture cannot hold excess weight

7. What you need is a high quality wood varnish, sealant or stain – Ronseal Quick Drying Woodstain is a great option that is highly water repellent and able to withstand the threat of moisture and humidity. ... Once you've got your ideal sealant, apply a few coats and you're good to go.

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