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THE EFFECT OF VARYING SAND AND PLASTIC ADDITIVES ON THE MECHANICAL PROPERTIES OF CEMENT MATRIX TILES

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INTRODUCTION

In Nigeria, tiles are an essential part of aesthetics in decorating residential houses, shops and offices etc. Tiles have been in existence since the twentieth century and are presently used all over the world (Amoo, 2016).

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- Several materials (construction and agricultural wastes) have been used in the development and manufacturing of various types of tiles to meet certain characteristics and functions. It is beneficial to explore ways of utilizing plastics as substitutes in the production of cement matrix tiles.

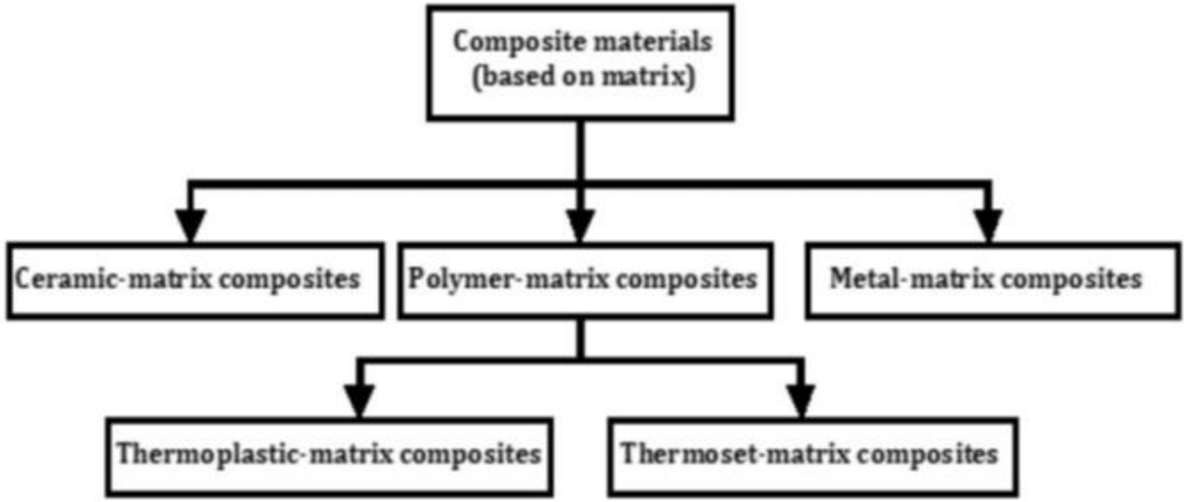
Composite materials

Composite materials are materials formed by two or more components so that the properties of the final material are better than the properties of the components separately.

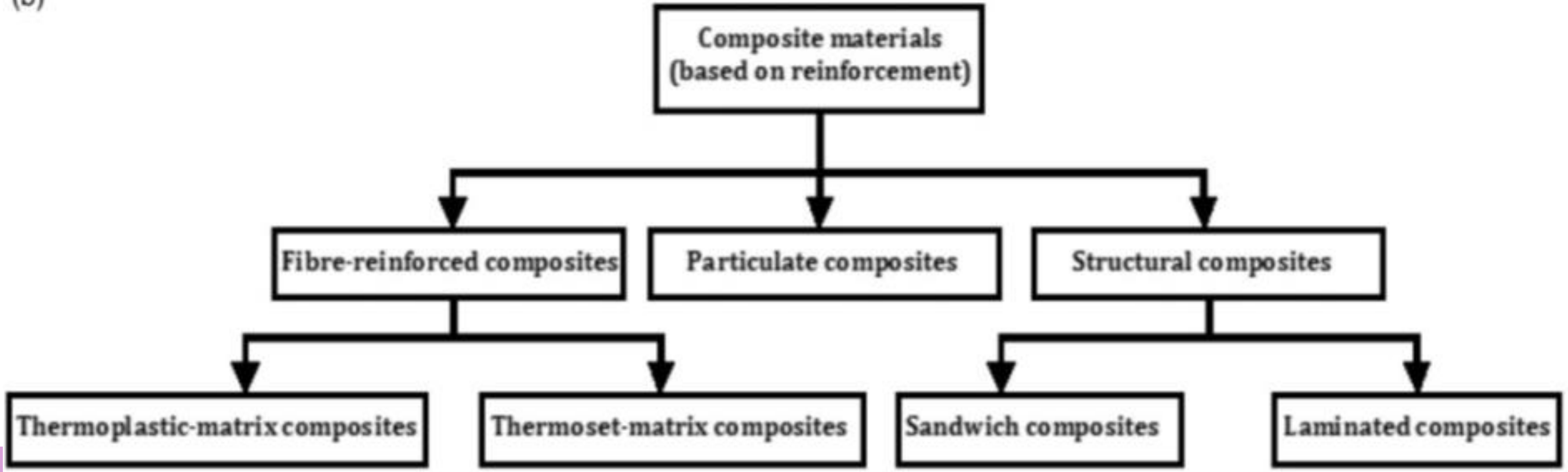
Which may be matrix or reinforcement

Types of composite materials

(a)



(b)



Additives

- Additives are substances used to enhance the either the physical or mechanical properties of a material or both.

- Additives are materials applied to the surfaces of articles or mixtures to join them permanently by an adhesive bonding process (Arthur, 2009).

Recycled plastic

- Plastics are typically organic polymers of high molecular mass (Abioye, 2018)

- They are good fillers and could be used as binders

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- Tiles are expensive due to high exchange rates used for imports.

- Cost of firing tiles is very high due to high energy cost

but

- Our work focuses on utilizing recycled plastics and cowhorn additives

to

- Reduce environment pollution,

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Various types of Tiles
Source http://www.nairaland.com/1397773/construction-6-bedroom-duplex-owerri/13

LITERATURE REVIEW

AUTHOR(S)	WORK	RESULT	GAP
• Ohijeagbon (2003)	Properties of Clay/Silica/Cement Tiles.	• High quality tiles are produced with Silica sand (40% to 50%) • 15% to 20% cement are recommended to produce clay/silica/cement tiles	An increase in the silica content increased the percentage water absorption

LITERATURE REVIEW CONTD.

AUTHOR(S)	WORK	RESULT	GAP
• Olusegun *et al.* (2011)	Composite Analysis of Laterite-Granite Concrete Tiles	Good adhesive bond between laterite and granite	Unfired tiles had better mechanical properties than fired tiles while the water absorption rate was better with fired than unfired tiles

LITERATURE REVIEW CONTD.

AUTHOR(S)	WORK	RESULT(S)	GAP(S)
• Amoo. (2016)	Development and Evaluation of Cement-Bonded Composite Tiles Reinforced with Cissus populnea Fibres	The tiles were dimensionally stable with low sorption and swelling rates and had moderate strength suitable for non-load bearing indoor and outdoor applications.	The application of 2% $CaCl_2$ significantly enhanced only the dimensional stability of the composite tiles.

LITERATURE REVIEW CONTD.

AUTHOR(S)	WORK	RESULT(S)	GAP(S)
• Yakovlev *et al.* (2017)	Modification of Cement Matrix Using Carbon Nanotube Dispersions and Nano silica	provided a strong binding matrix	was ensured only with the directed influence on the hydration Processes

LITERATURE REVIEW CONTD.

AUTHOR(S)	WORK	RESULT	GAP(S)
• Olusegun *et al.* (2009)	Modelling characteristics of laterite and granite composite tiles	Characteristic models of properties of composite tiles was found to be very reliable for future experimental design due to the relatively high values of the coefficient of determination	lower values of coefficient of determination for modulus of rupture and compressive strength

Materials and Methods

Materials in consideration:

- Silica sand (beach sand)
- Cement (binder)

- Laterite (matrix)

- Pulverized recycled plastic (additive)

Materials and methods: objective 1.

- Addictive samples (plastic) are in pulverized forms
- Each sample was sieved to allow for homogenous material.
- Each sample was weighed using an electronic weigh.
- They were mixed by different mixing ratio and categorized in different groups.

Materials and methods (Rule of mixture): objective 2

Percentage variation of Sand and Plastic Additives

Sand:plastic	Laterite %	Cement %	Silica %	Plastic %	Compaction Load (KN)
$A^{30:35}$	30	5	30	35	25
$B^{20:45}$	30	5	20	45	25
$C^{10:55}$	30	5	10	55	25
$D^{0:65}$	30	5	0	65	25

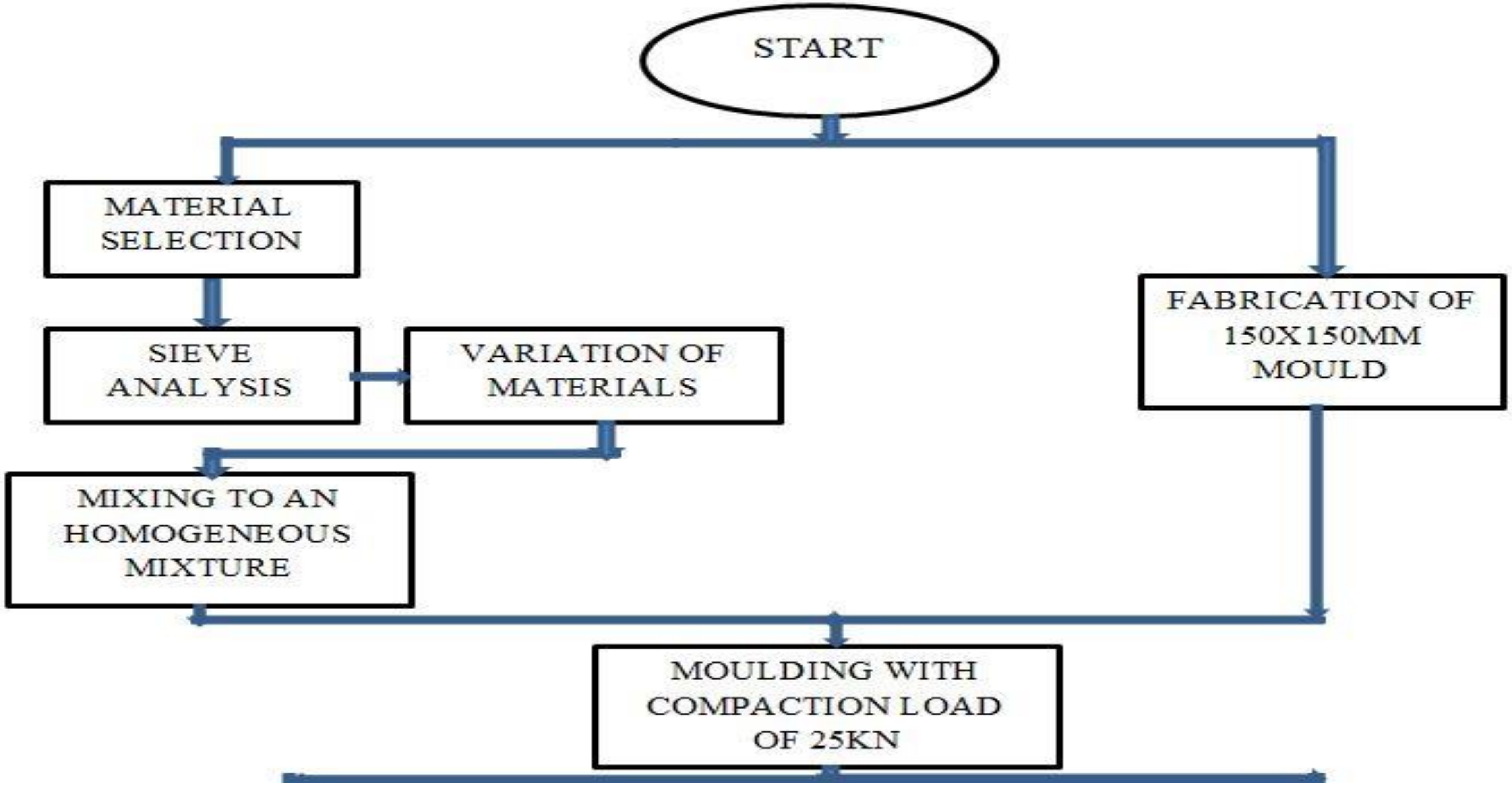
Mould

Moulding Plate

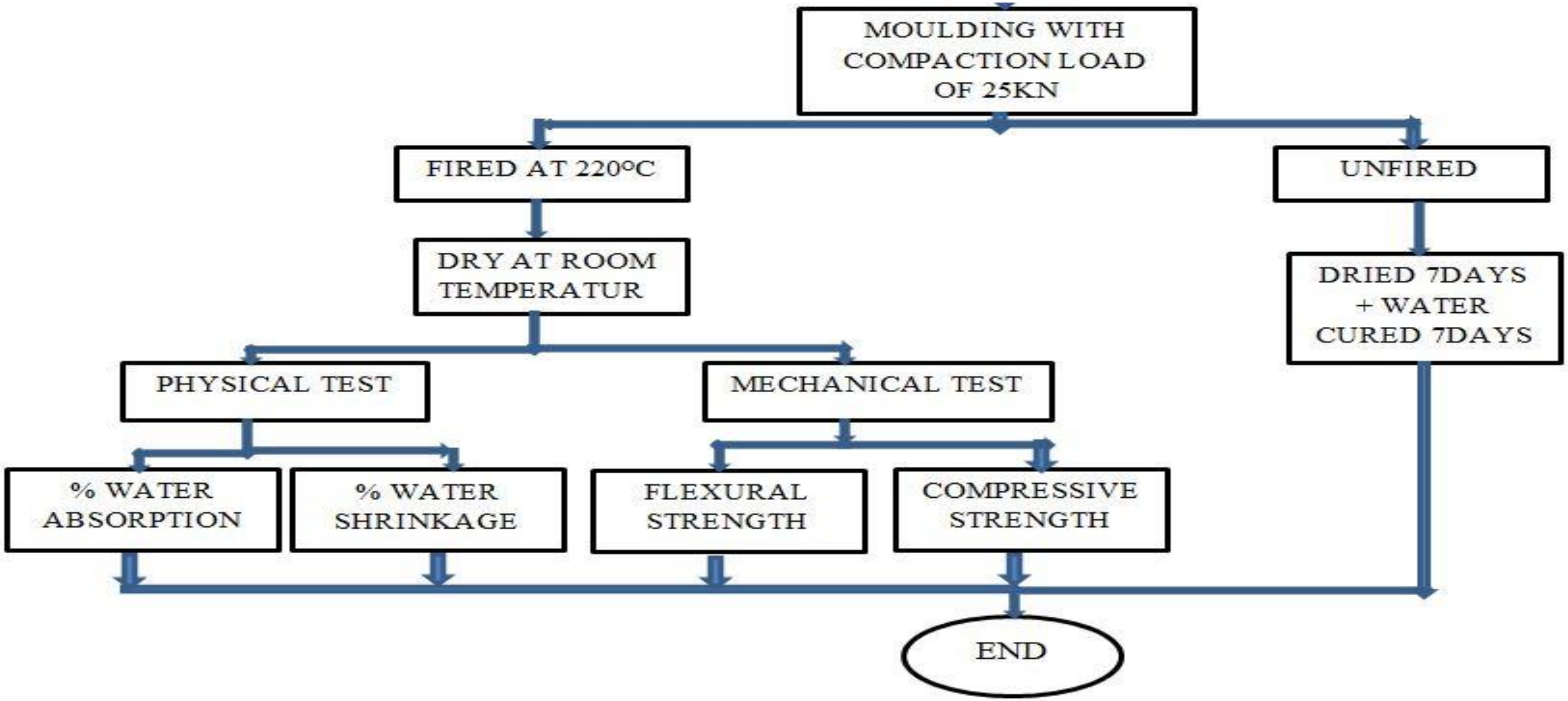
Moulding box

Punch

Materials and methods: contd



MATERIALS AND METHODS: CONTD



MATERIALS AND METHODS: EQUATIONS

- Physical properties tests of experimental tiles
  - Determination of water absorption

$$A = \frac{M_s - M_d}{M_d} \times 100\% \qquad (1)$$

  - Determination of water shrinkage

$$\frac{\text{Wet mass} - \text{dry mass}}{\text{wet mass}} \times 100 \qquad (2)$$

Where M_s = saturated mass

M_d = dry mass and V = volume

MATERIALS AND METHODS: EQUATIONS

- Mechanical properties tests of experimental tiles
  - Flexural strength

$$M = \frac{8PL}{\pi T^3} \qquad (3)$$

  - Compressive strength

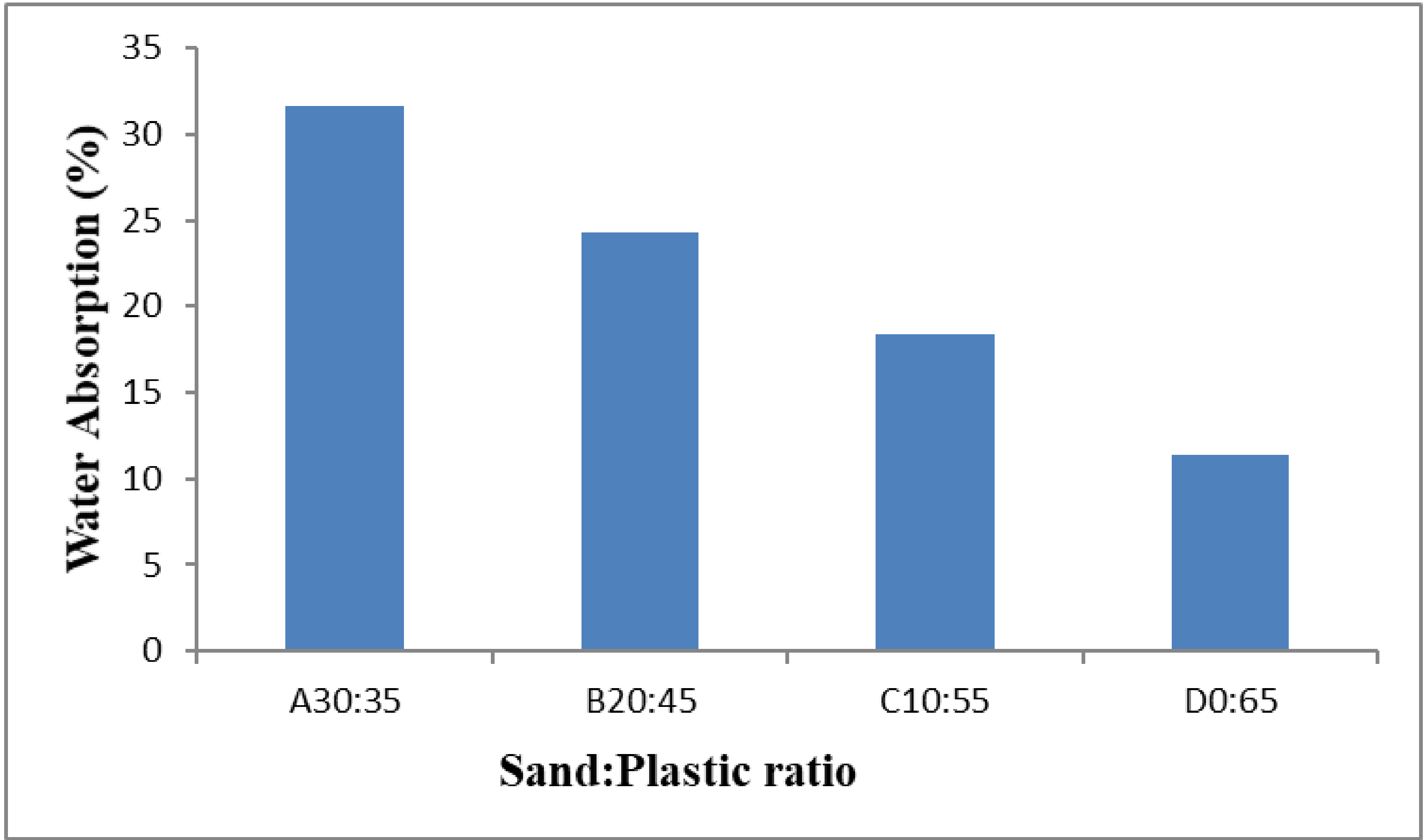
$$C_s = \frac{P_c}{A_C} \qquad (4)$$

Where, Cs = Compressive strength of the specimen, MPa

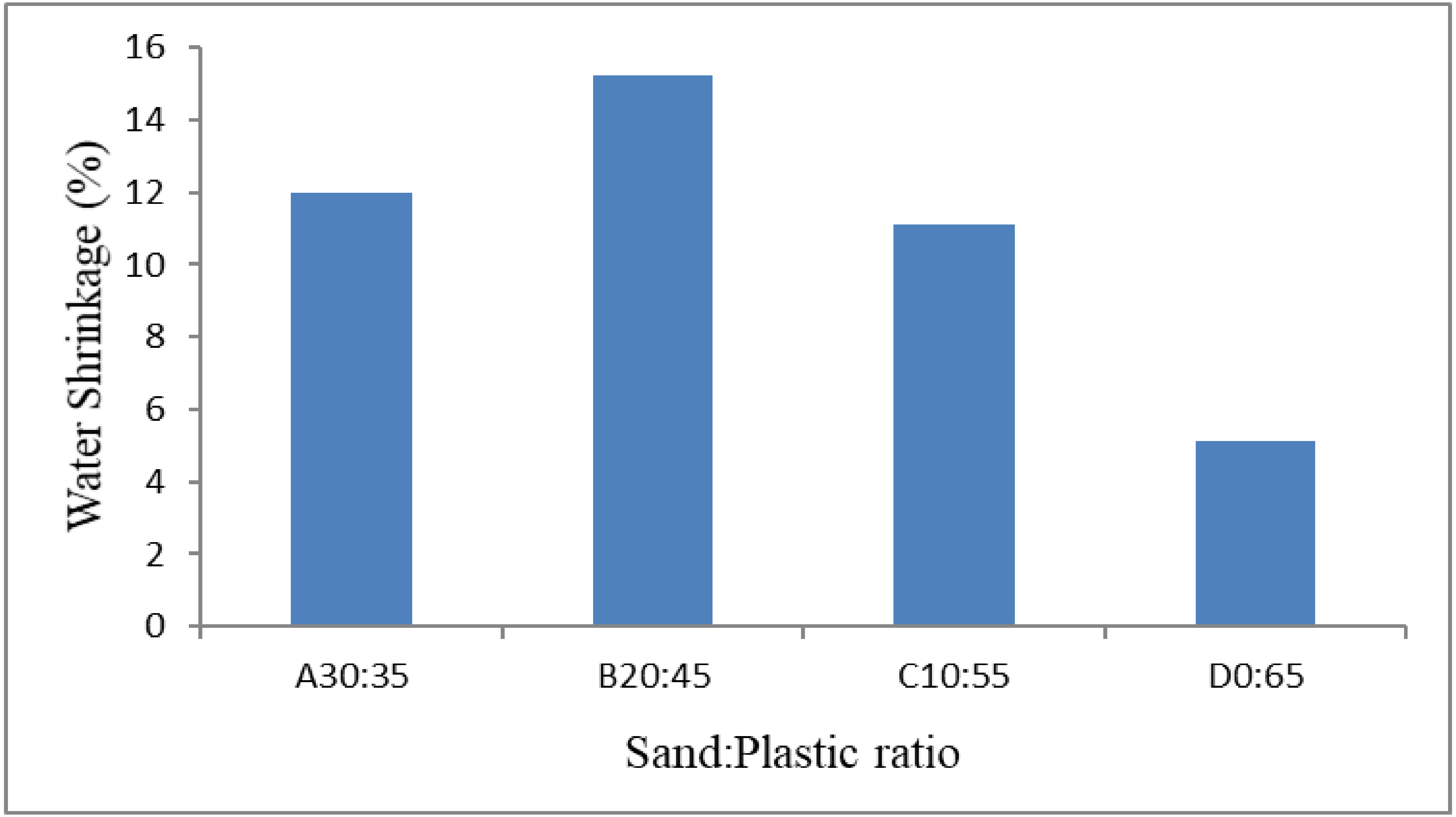
Pc = Average load on the specimen at failure, N

- Ac = Calculated area of the bearing surface on the test specimen, $[\![mm]\!]$^2

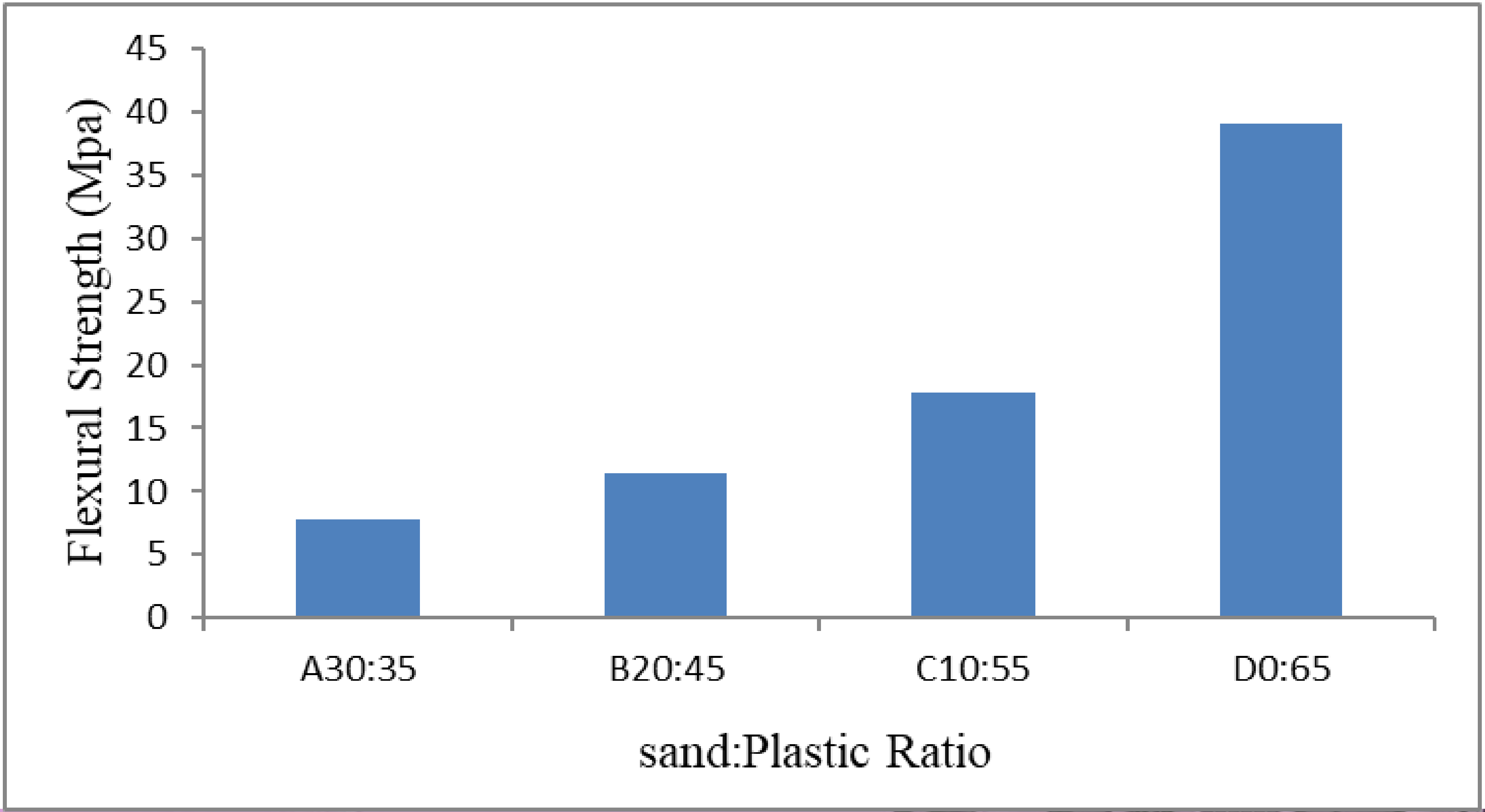
RESULT AND DISCUSSION: WATER ABSORPTION



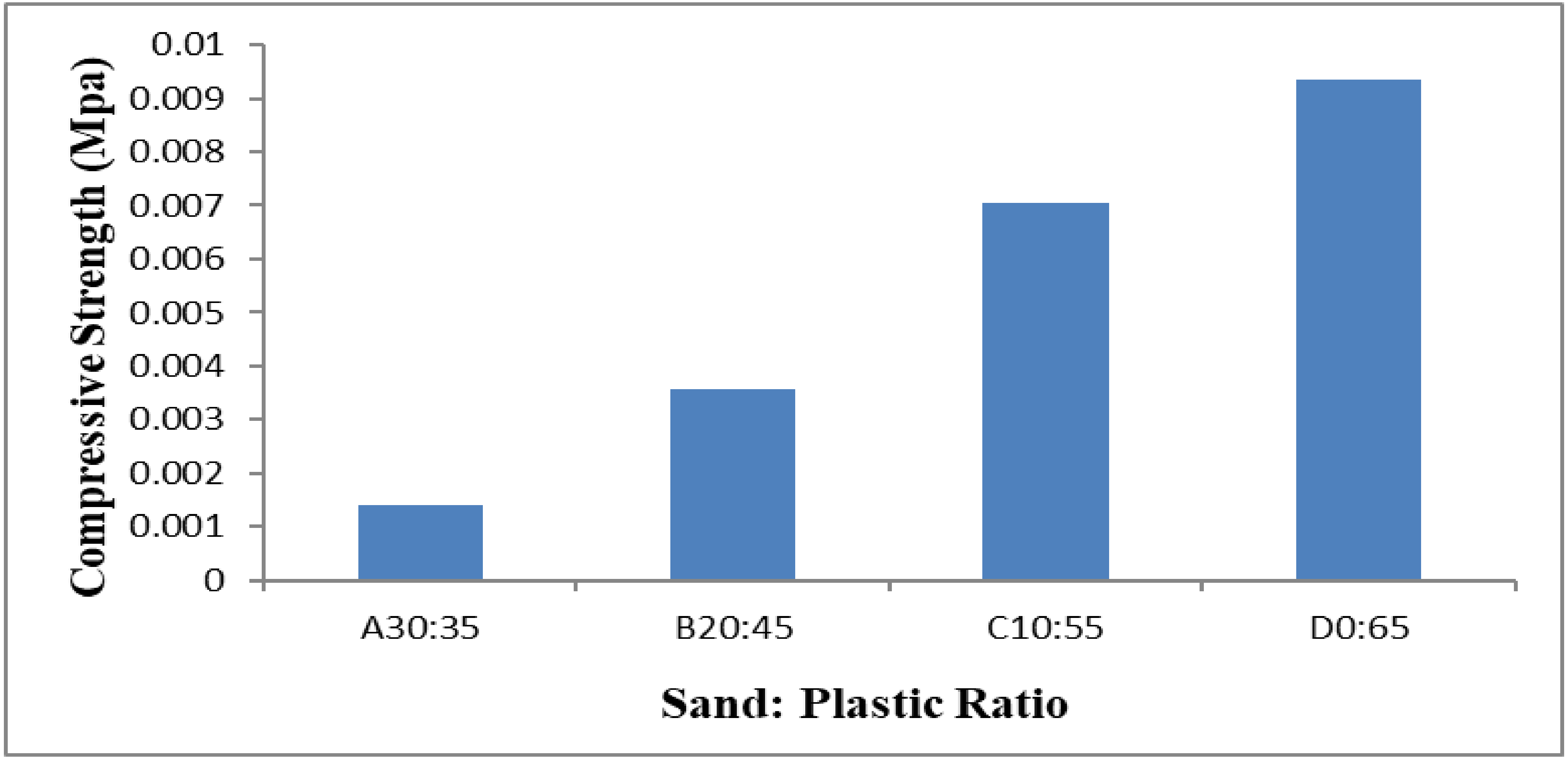
WATER SHRINKAGE



FLEXURAL STRENGTH



Compressive strength



Conclusions

In conclusion,

1. The higher water absorption implied that the tiles were porous, fragile and less durable. The mechanical tests showed that the flexural and compression tests data of 39.08 and 158.06 MPa respectively were highest recorded at sand:plastic ratio of 0:60 samples.

2. 2. A direct relationship existed between the quantity of plastic used and the strength of the tile produced, which means that, as the plastic content were increased, mechanical properties was increased.

3. 3. The unfired sample could not be subjected to mechanical tests as the bonds formed between the additives were weak.

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THANK YOU!