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Department of Mechanical Engineering

IMPACT OF VARYING LATERITE AND COWHORN ADDITIVES ON THE MECHANICAL PROPERTIES OF CEMENT MATRIX PLASTIC TILES

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PRESENTATION SUMMARY

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).

INTRODUCTION CONTD.

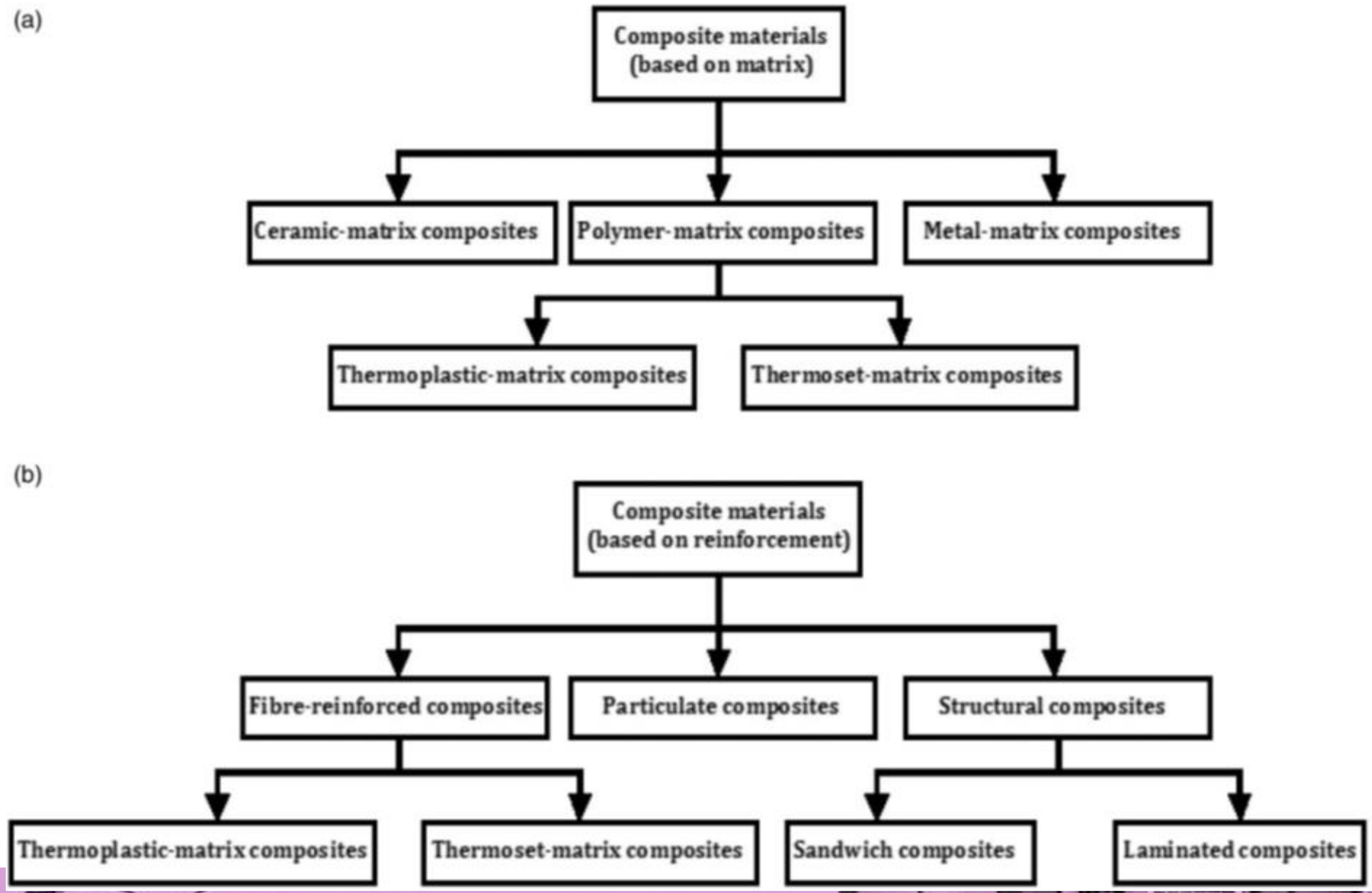
- Several materials (construction and agricultural wastes) have been used in the development and manufacturing of various types of tiles to meet certain characteristics and functions. It is beneficial to explore ways of utilizing plastics and animal wastes (cowhorn) as substitutes in the production of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



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

Cow horn

- Cow horns are bone structures with high carbon content.
- Cow horn are agricultural residues and are considered to be wastes
- They are rich in carbon fibres and posses good reinforcements characteristics

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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,

INTRODUCTION CONTD.

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

AIM OF THE STUDY

The aim of this work is to investigate the utilization of recycled plastic and cowhorn additives on cement matrix tiles production.

OBJECTIVEs OF THE STUDY

The objectives are:

- To remove recycled plastic and animal wastes by adding as substitutes to additives in tiles

- To conduct physical test on the additives used for the production of the Cement Matrix Tiles (CMT),

OBJECTIVEs OF THE STUDY CONTD

- To produce experimental tiles with various proportions of laterite, cement, pulverized cow horn and recycled plastics waste, under the heat treatment,

- To subject the manufactured tiles to physical and mechanical tests.

STATEMENT OF PROBLEM

- Increasing the bond between the wall tiles

- Can the current cost of producing tiles be reduced? If yes, can they be reduced by partially replacing cement which is the most expensive component of the cement matrix tiles with plastics and cow horn additives?

- Plastic waste pollutes marine environment and has killed many marine creatures.

- Cow horn has been used in certain applications shoe hills etc., expanding the use of cow horn so they can be easily deployed.

JUSTIFICATION OF THE STUDY

Recycled plastic waste is a global problem and has poisoned and led to the death of so many aquatic creatures. It also releases toxic subtances into the water thereby causing pollution and has been associated with cancer in humans. In the search of food and man's desire for satisfaction, numerous animals are being slaughtered everyday. Cow horn posses as wastes as they are diffucult to dispose.

This project aims at removing the plastic waste as well as agricultural waste (cowhorn) from the streets and water ways and turning it into a useful material that can create wealth, clean the environment and promote sustainability

SCOPE OF THE STUDY

The scope of the work is limited to producing wall tiles using varying quantities of laterite, silica sand, plastic and cow horn additives while keeping cement constant and subjecting the resulting material to physico-mechanical tests.

LIMITATIONS OF THE STUDY

- This study is limited to the use of laterite, silica sand, pulverized cow horn and plastics with cement hydrated with water as the bonding material to develop an experimental composite tiles.

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	GAP
• Ibrahim and Muhammad (2014)	Design Analysis and Optimization of Cow Horn – Plastic Composite Chair Seat	The material produced could withstand the maximum operating stress a chair need	The research was limited to chair production

LITERATURE REVIEW CONTD.

AUTHOR(S)	WORK	RESULT(S)	GAP(S)
• Ohijeagbon (2014)	Clay silica was retrofitted (added) with sawdust thus improving the mechanical properties	Wood waste can be used to stabilize the mechanical property of ceiling	The thermal and combustion properties have to be investigated just in the case of uncontainable fire outbreak.

LITERATURE REVIEW CONTD.

AUTHOR(S)	WORK	RESULT	GAP(S)
• Ajao, K. S *et al.* (2016)	Development of paving tiles compounded with pulverized Corncob charcoal	30% and 10% addition of pulverized corncob charcoal for 20% and 15% cement content respectively are suitable for acceptable strength paving tiles.	As % of pulverized corncob charcoal in the mixture aggregate increases, the flexural strength, compressive strength and bulk density of the tiles decreases

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 cow-horn (additive/reinforcement)
- Pulverized recycled plastic (additive)

Materials and methods: objective 1.

- Addictive samples (cow horn/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 laterite and cowhorn additives on cement matrix plastic tiles

Laterite:PCH	Laterite %	PCH %	Cement %	Silica %	Plastic %	Compaction Load (KN)
$A^{45:0}$	45	0	5	10	40	25
$B^{40:5}$	40	5	5	10	40	25
$C^{35:10}$	35	10	5	10	40	25
$D^{30:15}$	30	15	5	10	40	25

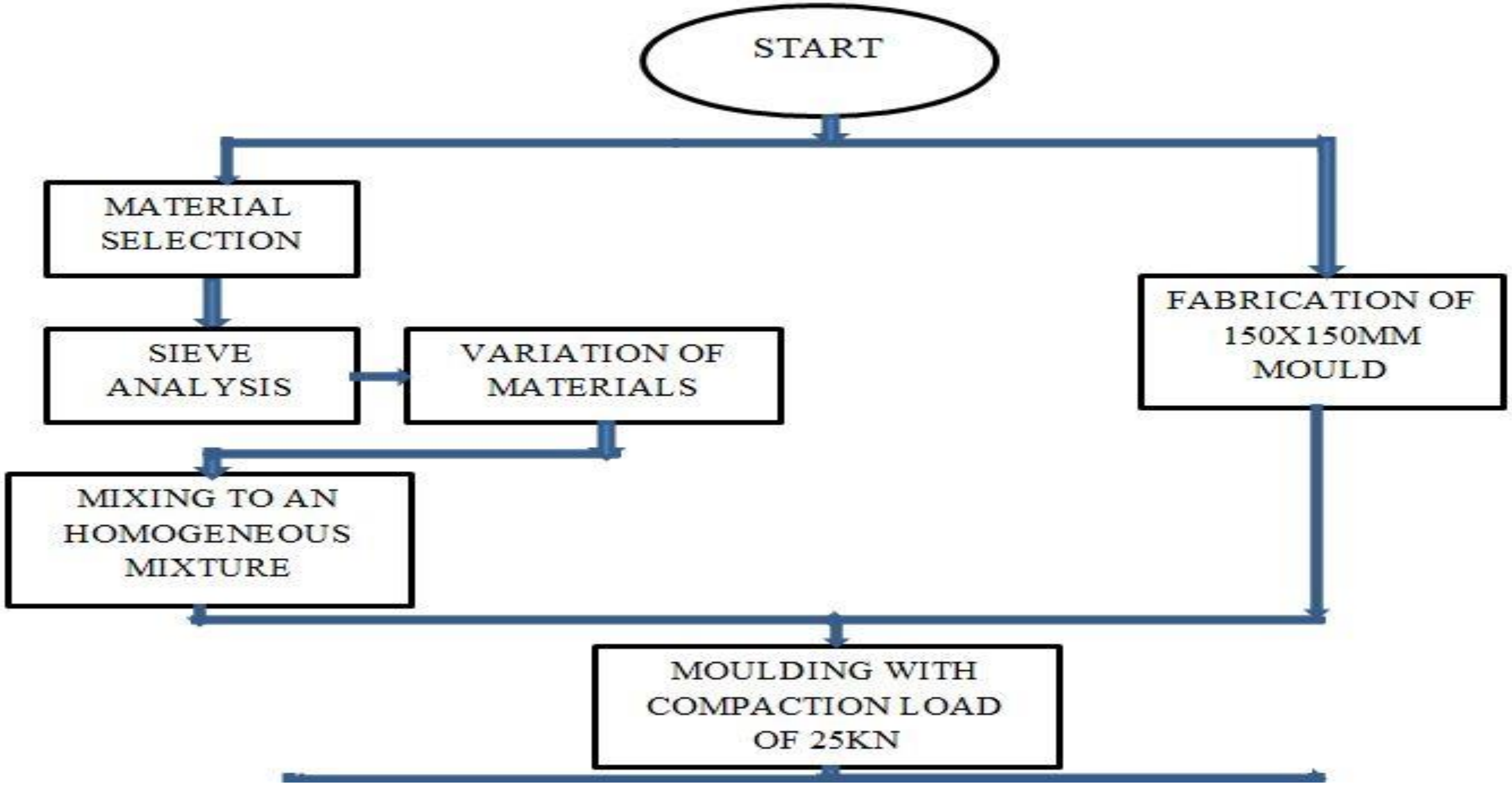
Mould

Moulding Plate

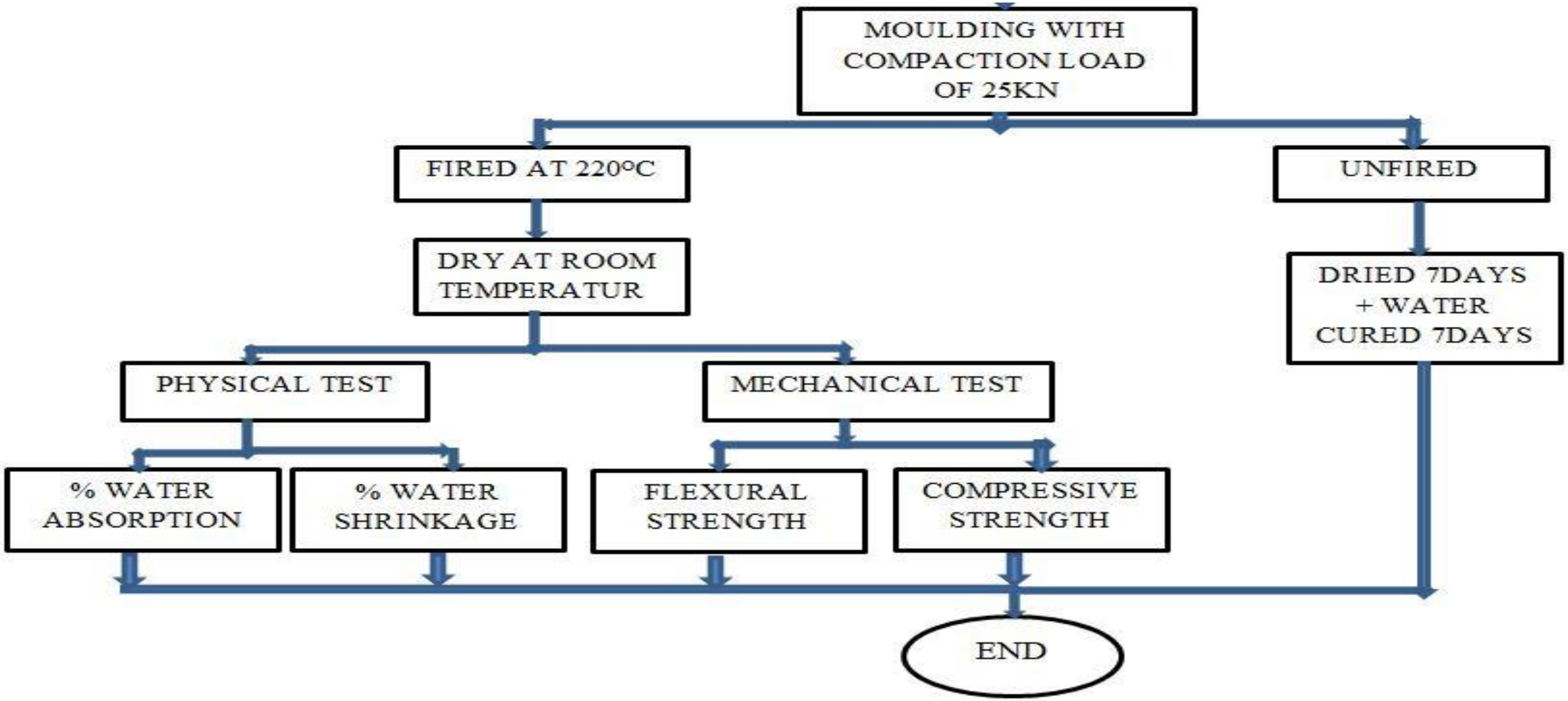
Moulding box

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

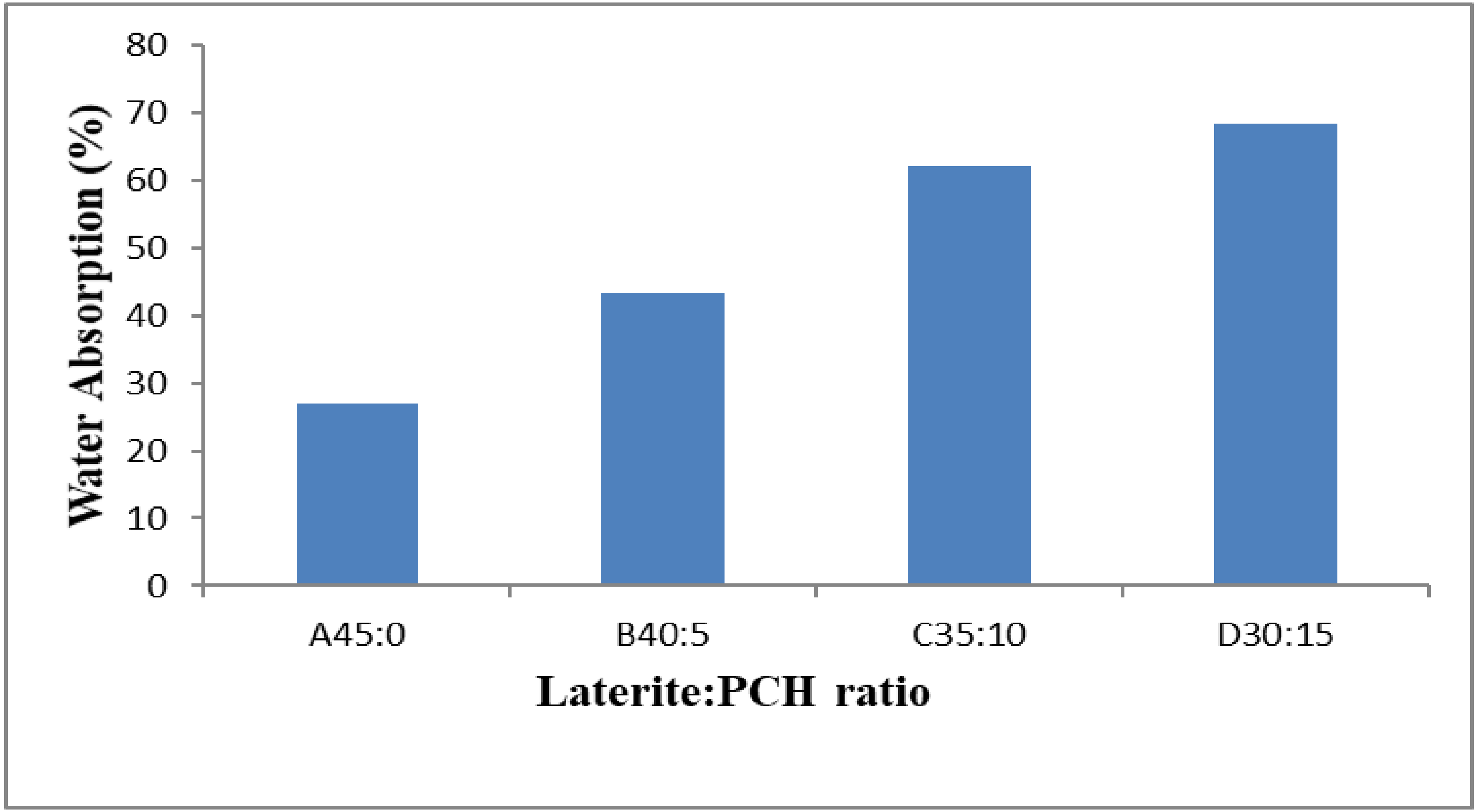
$$C_s = \frac{P_C}{A_C} \qquad (4)$$

Where, Cs = Compressive strength of the specimen, MPa

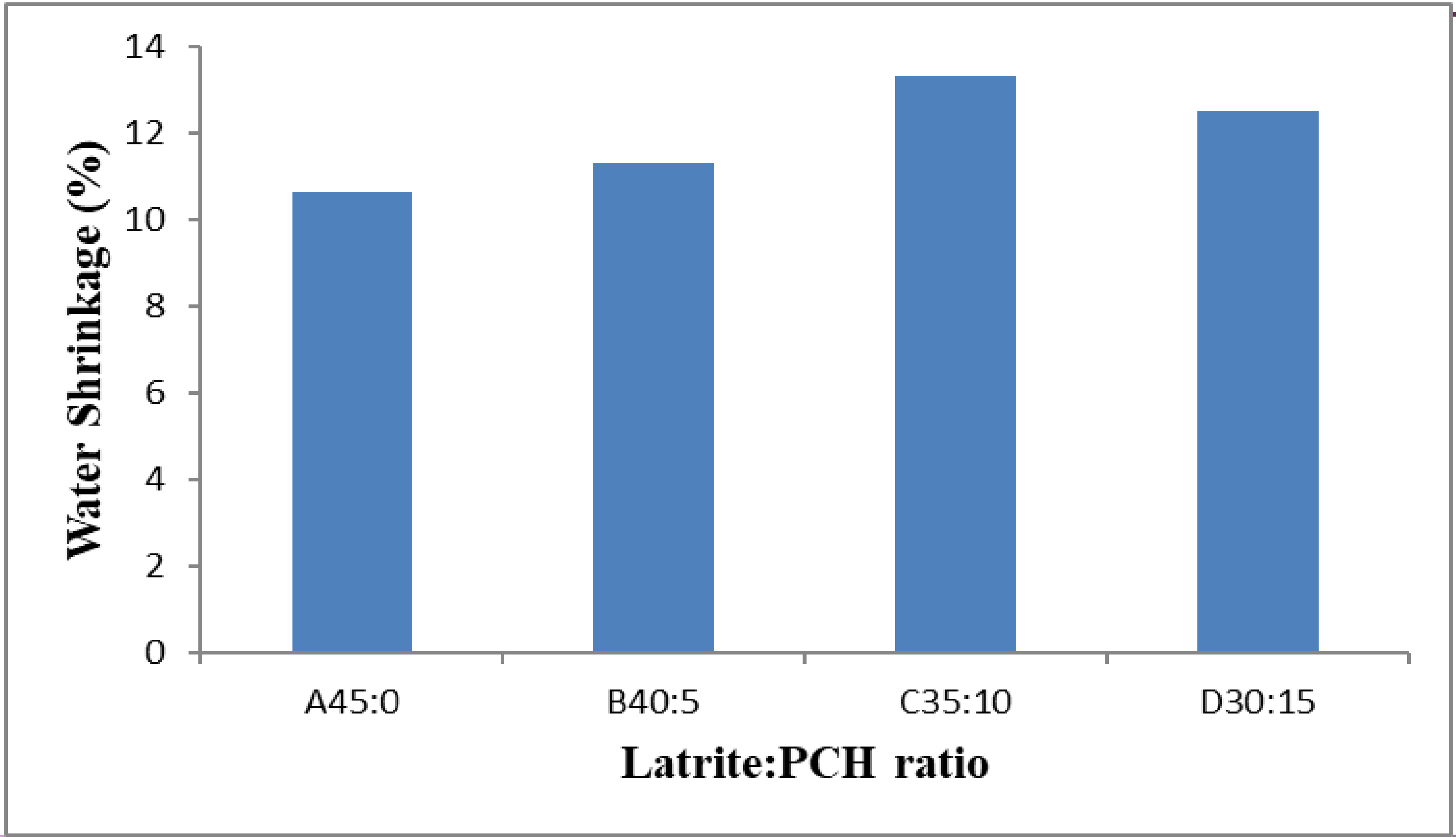
Pc = Average load on the specimen at failure, N

- Ac = Calculated area of the bearing surface on the test specimen, ⟦mm⟧^2

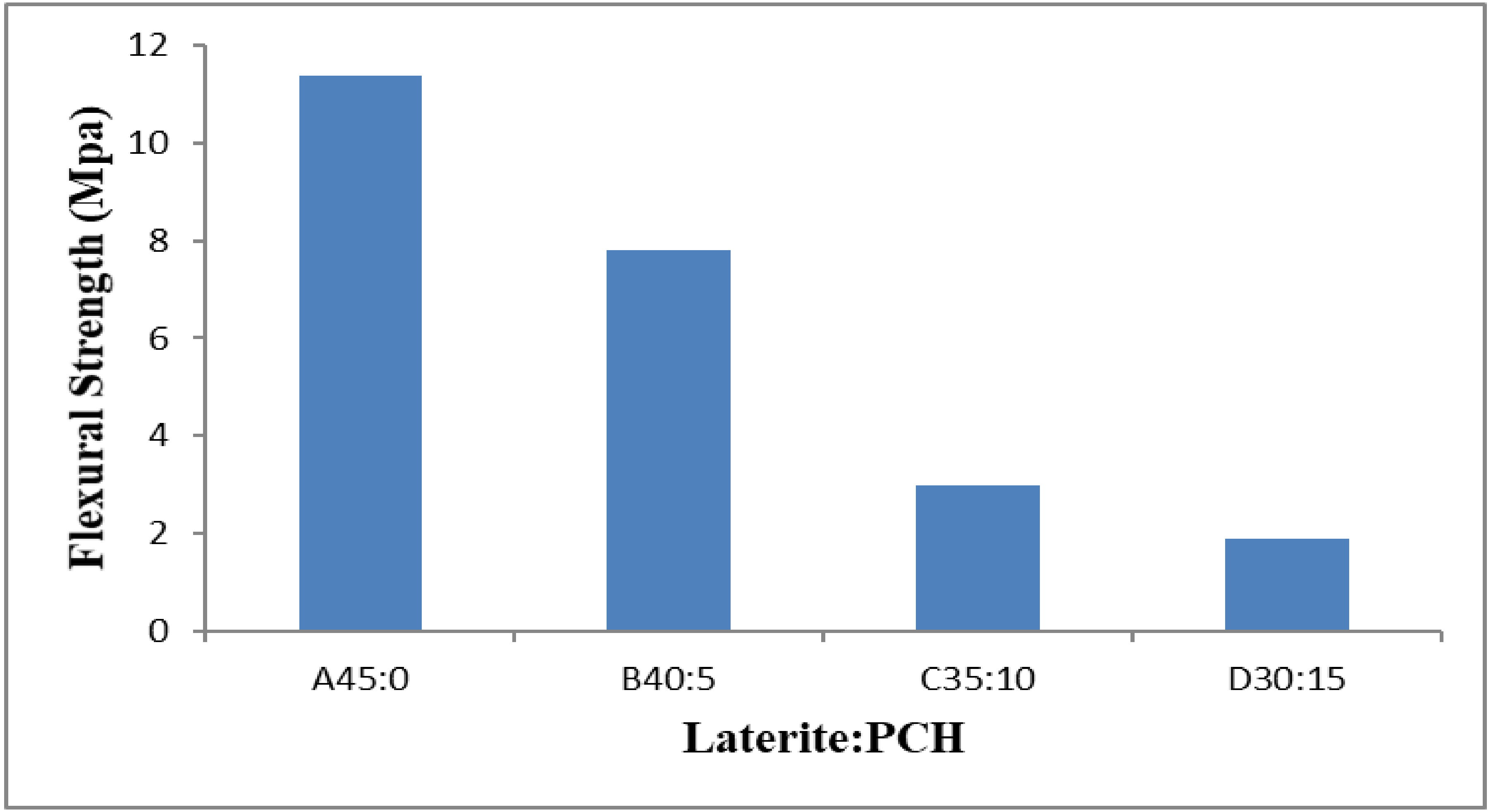
Result and discussion: water absorption



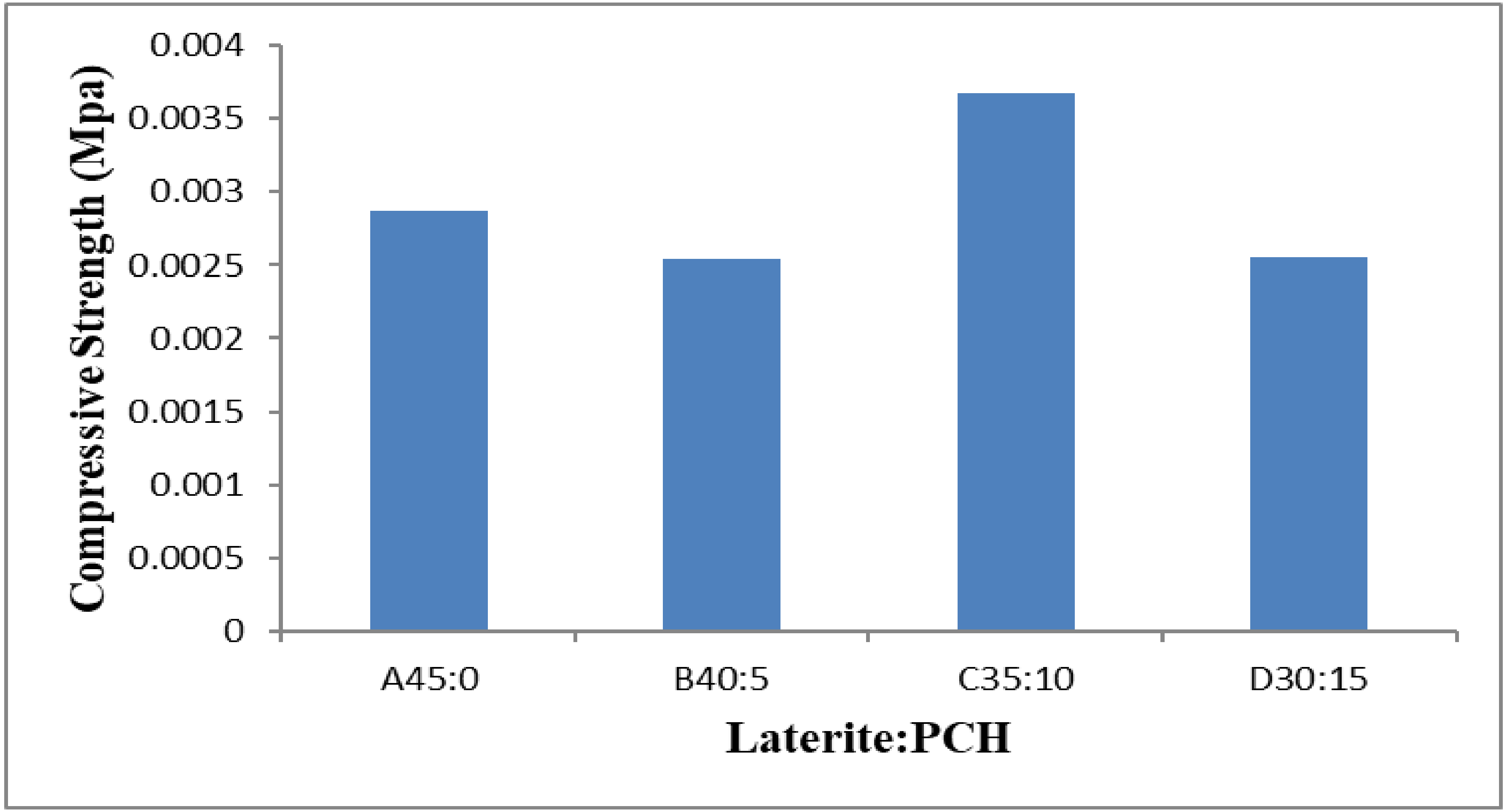
WATER SHRINKAGE



FLEXURAL STRENGTH



Compressive strength



Conclusions

In conclusion,

1. the unfired tiles were friable to undergo physico-mechanical test,

2. the water absorption and shrinkage test for the laterite:PCH samples with 30:15 percent was most porous. It was observed that increasing the PCH content had a direct relationship with the degree of porosity and vice versa,

3. it was also observed that the flexural strength of the samples containing 45% laterite and no PCH recorded the best values of 11.38mpa, thus a direct relationship between the PCH and vice versa.

4. the compressive strength of samples were best recorded at 0.0037Mp and did not follow particular trend for the compressive strength.

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THANK YOU!