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Thermal and Some Physical Properties of Cement Bricks with sawdust as Aggregate Replacement

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ABSTRACT—Experimental investigation of heat transfer for cement bricks with sawdust as replacements for aggregates as a means of improving energy consumption in building without compromising the strength of the blocks and building. The samples were tested based on their crushing strength and heat flow resistance. The result shows a Percentage reduction in heat conduction of between 0 and 30% for volumetric sawdust replacement 0, 5, 10, 15, and 20%.

KEYWORDS*:* Cement bricks, Compressive strength, Experimental, Heat transfer, Sawdust

I. INTRODUCTION

A great portion of the current energy consumption is due to construction and building maintenance for housing purposes [1]. This general energy consumption requirement of buildings can greatly be reduced if the resistance to conduction heat transfer ability of the building blocks used in its construction is improved on. One of the major ways by which this can be achieved is by replacing certain percentages of its aggregates with insulating materials.

Saw dust is a major waste material generated in saw mills and as the demand for wood and its product increases, the volume of the sawdust generated increases and this causes a great environmental problem in our urban cities. More production equals more waste, more waste creates environmental concerns of toxic threat. An economical viable solution to this problem should include utilization of waste materials for new products which in turn minimize the heavy burden on the nation's landfills [6]

Using sawdust, a very good heat conduction resistance material as aggregate replacement in cement bricks stands to serve two purposes. It will increase the conduction resistance of the cement bricks and also aid the management of the saw mill waste.

II. PREPARATION OF SPECIMEN

Cement bricks of size (150x150x150)mm Fig. 1, made using plane river sand with maximum size 4.75mm and specific gravity of 2.6 homogenously mixed with ordinary Portland cement of 43 grade confining to NIS 087: 2000 [5]. Four sets of each replicate with 0%, 5%, 10%, 15% and 20% sawdust replacement by volume were produced for experimental purposes.

Heat transfer, compressive strength and other physical properties analysis were carried out after a full curing period of 28days.

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Fig. 1: Samples of the specimen

III. DENSITY

Variations were observed in density and weight between the samples with the same percentage replacement. Sawdust has lower density than sand and since replacement by sawdust is done by volume, the density of mortar decrease as the percentage of sawdust increases. The relationship between density of the specimens and sawdust content is as shown in Fig. 2

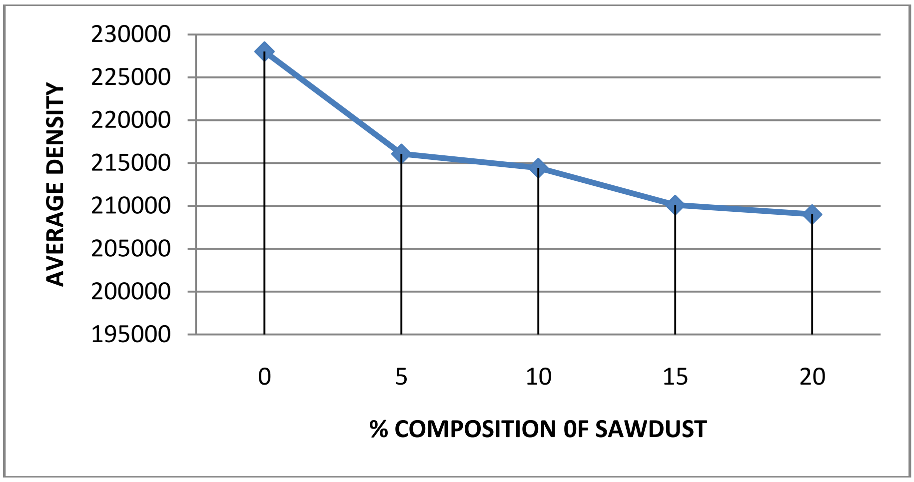

Fig. 2: Relationship between density of the specimens and sawdust content

IV. COMPRESSIVE STRENGTH ANALYSIS

A Universal compression Testing Machine as shown in Fig. 3 was used to test all the samples after a curing process of 28days. The correlation between compressive strength of the specimens and sawdust content is as shown in Fig. 4

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Fig. 3: Universal compression Testing Machine

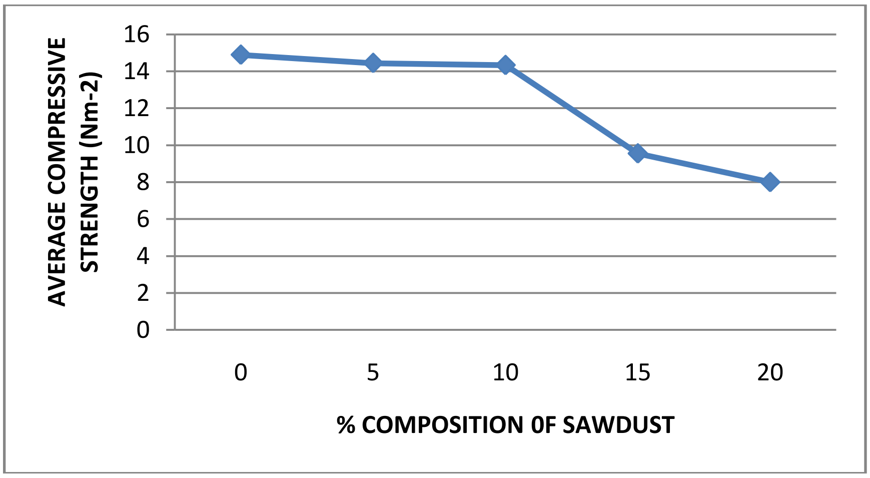

Fig. 4: Relationship between compressive strength of the specimens and sawdust content

V. CONDUCTION HEAT TRANSFER

The thermal conductivity for each of the samples was determined using the steady-state (absolute or comparative) method by measuring the temperature difference (ΔT) across the samples in response to an applied amount of heating power. This is essentially a measure of the heat flow through the sample [4], [2]. Given by the equation below

$$K = \frac{Q(dx)}{A(\Delta T)}$$

Where, Q is the heat transfer rate through the brick, dx is the thickness of the brick, A is the heat transfer area of the brick and ΔT is the temperature diff erence across the brick surfaces. The relationship between density of the specimens and sawdust content is as shown in Fig. 5

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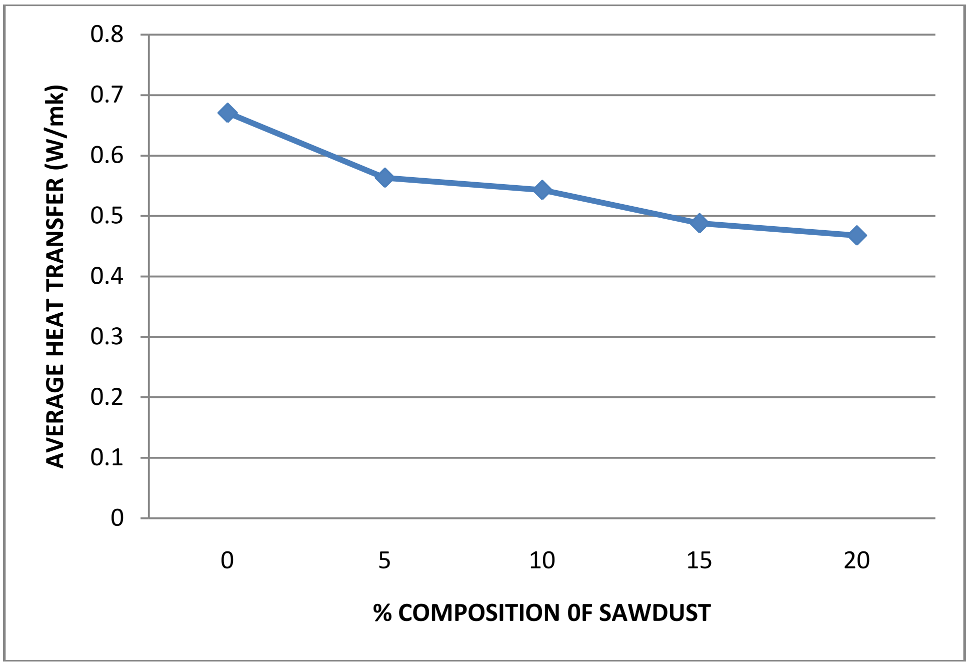

Fig. 5: Average heat transfer of the specimens

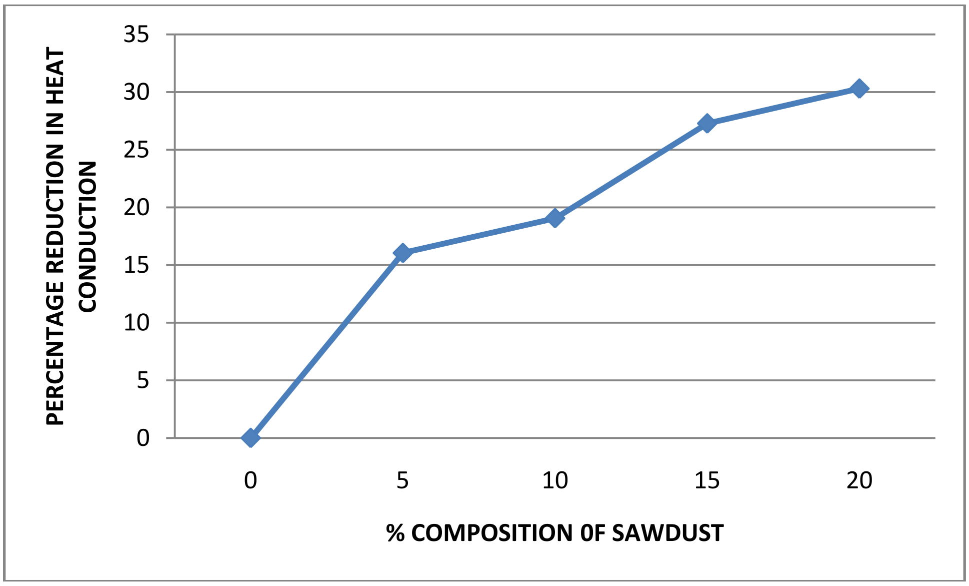

Fig. 6: Percentage reduction in heat conduction

VI. DISCUSSION AND CONCLUSION

Thermal and some physical properties of cement bricks with different volumetric percentages of sawdust as aggregate replacement was experimentally considered as a means of improving the thermal insulating properties. It is observed

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that as the volumetric percentage of sawdust increases, the compressive strength reduces while the resistance to heat conduction increases. The percentage reduction in heat transfer in the specimen ranges between 0% and 30%. As expected, since sawdust has a lower density than sand aggregates, the density of the specimens reduces with increase with percentage replacement.

NOMENCLATURE

ΔT	*Temperature difference (K)*
K	*Thermal conductivities ($Wm^{-1}k^{-1}$)*
Q	*Heat transfer (wm^{-2})*
dx	*Sample thickness (m)*
A	*Sample cross sectional area (m^2)*

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