was obtained from taps in concrete laboratory of Department of Building, University of Jos.

In this study, 225mm x 450mm hollow blocks were produced at the concrete laboratory of the Department of building University of Jos. Mix ratio 1:6 (cement: sand) was used in this study for sandcrete block production. Cement was partially replaced with MHA in varying percentages of 0, 10, 20 and 30% by weight. Water binder ratio of 0.5 was adopted for this research. For each replacement levels, 12 sandcrete block samples were cast. The blocks were molded and cured for 7, 14 and 28 days. The block samples were cured by constant sprinkling of water to keep the surfaces of the block samples moist. The compressive strengths of the blocks were determined at 7, 14 and 28 days by crushing using compressive strength testing machine in accordance with the standard procedure given by [1]. Water absorption test was also carried out on the block samples after 28 day curing in accordance with [1].

2. RESULTS AND DISCUSSION

2.1 Chemical and Physical Analysis Millet Husk Ash

The result of chemical analysis of MHA is presented in table 1. The result show that the sum, $SiO_2 + Al_2O_3 + Fe_2O_3$ is 70.1% which is slightly greater than the minimum of 70.0% specified in [4] for pozzolanas. The ash also satisfies the [1] requirement for the loss on ignition, which puts it at a maximum of 12. This result confirms that MHA can be used as pozzolana. The specific gravity of the MHA was found to be 2.3.

Table -1: . Chemical Composition of MHA

Constituent	Percentage Composition
SiO_2	63.7
Al_2O_3	3.80
Fe_2O_3	2.60
CaO	0.02
MgO	0.03
Na_2O	1.14
K_2O	20.1
P_2O_3	4.10
MnO	0.05
SO_3	2.06
TiO_3	0.16
Cl	2.15
Br	0.07
Loss on Ignition	11.20

2.2 Compressive Strength

The variations of compressive strength of the mix proportions with various percentage replacements of cement with MHA are presented in Figure 1. The results show that the compressive strength decreases with increase in MHA content for all ages of curing. For lower percentage replacements levels of 10 and 20%, the silica from the pozzolana is in required amount and contributes to the hydration process resulting to sandcrete blocks with high compressive strength. At 30% MHA and 40% MHA replacement levels, the quantity of the MHA is the mix is higher than the amount required for pozzolanic reaction with calcium hydroxide liberated as a result of hydration of cement. The excess silica contributes nothing to hydration of cement and consequently resulting to reduction in compressive strength [16]. The compressive strengths generally increased with age of curing. At 28 days, the compressive strength of mixes with 0, 10, 20, 30 and 40% replacements of cement with MHA were 4.50, 4.00, 3.15, 2.00, and 1.15N/mm^2 respectively. The compressive strengths of sandcrete blocks made with 10 and 20% replacements of cement with MHA met the minimum requirements for sandcrete blocks specified in NIS 87 (2004) which is between 2.5N/mm^2 to 3.45N/mm^2. At 30 and 40% replacement levels, the compressive strengths fall below the minimum requirement. This implies the 20% is the optimum replacement of cement with MHA.

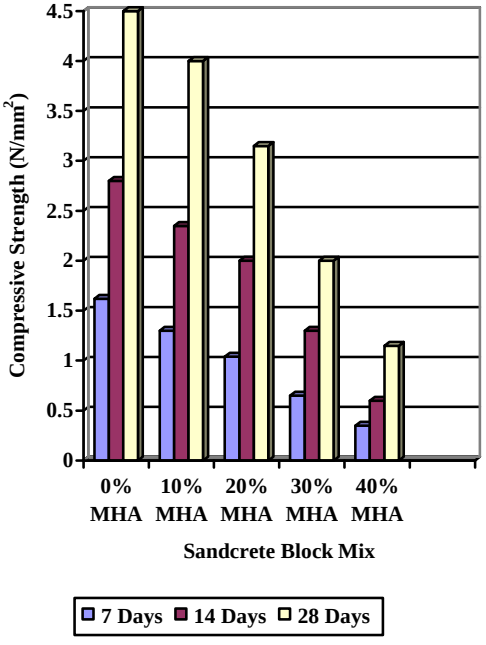

Figure -1: Compressive Strength of Sandcrete blocks

2.3 Water Absorption

The results of water absorption of the sandcrete block samples were presented in Table 2. The results show that the sample with 10% replacement of cement with MHA recorded the lowest water absorption of 5.00%. This could be as a result of densification of the sample due to pozzolanic reaction of OPC with MHA. At 20, 30 and 40% replacements of cement with MHA, the water absorption is higher than that of the control. However, the water absorption of all the specimens does not exceed the maximum allowed water absorption of 12% as specified by NIS 87 (2004).

Table 2. Water Absorption Test Result

Percentage Replacement	Water Absorption (%)
0% MHA, 100% OPC	5.25
10% MHA, 90% OPC	5.00
20% MHA, 80% OPC	5.85
30% MHA, 70% OPC	6.75
40% MHA, 60% OPC	8.25

3. CONCLUSIONS

Based on the findings of this research work, the following conclusions were drawn:

1. The millet husk ash sourced from Shendam, Plateau State, Nigeria is pozzolanic and could be used as partial replacement of cement in sandcrete blocks production.
2. The compressive strength of the sandcrete blocks for mixes increase with increase in curing age and decrease with increase in percentage replacement of cement with millet husk ash. 10 and 20% replacement of cement with Millet husk ash resulted to sandcrete blocks with acceptable compressive strengths.
3. The water absorptions of all the mixes were within the acceptable limits.

3. RECOMMENDATION

Partial replacement of cement with 20% millet husk ash is recommended for adoption in sandcrete block production.

REFERENCES

[1] NIS 87, (2004). Nigerian Industrial Standard Standard for sandcrete blocks. Nigerian Industrial Standard approved by The Standard Organisation of Nigeria (SON).

[2] Uche, O.A.U., Adamu, M. & Bahuddeen, M.A. (2012). Influence of millet husk (ash) on the properties of plain concrete. Epistemics in Science, Engineering and Technology, 2(2), 68-73.

[3] Oyekan, G.L. & Kamiyo, O.M. (2011). A study on the engineering properties of sandcrete blocks produced with rice husk ash as blended cement. Journal of Engineering and Technology Research, 3(3), 88-98.

[4] American Society for Testing and Materials (2000). Specifications for Pozzolanas. ASTM International, USA, ASTM C618.

[5] Gibbons, P. (1997). Pozzolanas for lime mortars. The Conservation and Repair of Ecclesiatical Buildings. Retrieved from http://www.buildingconservation.com/articles/pozzo/pozzo.htm.

[6] Ghassan, K.A., Alkadi, M. & Asteris, P.G. (2013). Natural pozzolana as a partial substitute for cement in concrete. The open Construction and Building Technology Journal, 7, 33-43.

[7] Apata, A.O. & Alhassan, A.Y. (2012). Evaluating locally available materials as partial replacement of cement. Journal of emerging Trends in Engineering and Applied Sciences, 3(4), 725-728.

[8] Marthong, C. (2012). Saw dust ash as partial replacement of cement. International Journal of Modern Engineering Research, 3(3), 1366-1371.

[9] Ettu, L.O., Nwachukwu, K.C., Arimanwa, J.I., Anyanwu, T.U. & Okpara, S.O. (2013). Strength of blended cement sancrete and soilcrete blocks containing Afikpo rice husk ash and corn cob ash. International Journal of Modern Engineering Research, 3(3), 1366-1371.

[10] Tyagher, S.T., Utsev, J.T. and Adagba, T. (2011). Suitability of saw dust ash lime mixture for production of sandcrete hollow blocks. Nigerian Journal of Technology, 30 (1), 79-84.

[11] Tsado, T.Y., Yewa, M., Yaman, S. and Yewa, F. (2014). Comparative analysis of properties of some artificial pozzolana in concrete production. International Journal of Engineering and Technology, 4(5), 251-255.

[12] Jimoh, R.A., Banuso, O. R. & Oyeleke, F.M. (2013). Exploratory assessment of strength characteristics of millet husk ash (MHA) blended cement laterized

concrete. Advances in Applied Science Research, 4(1), 452-457.

[13] British Standards Institution (1991). Specification for Portland Cements. London, BS 12.

[14] British Standards Institution (1992). Specification for Aggregates from Natural Sources for Concrete. London, BS 882.

[15] British Standards Institution (1980). Methods of Tests for Water for Making Concrete. London, BS 3148.

[16] Oyetola, E.B. & Abdullahi, M. (2005). Strength characteristics of rice husk ash /ordinary Portland cement blocks. Nigerian Journal of Construction Technology and Management, 6(1), 50-55.