INTERNATIONAL RESEARCH JOURNAL OF MULTIDISCIPLINARY TECHNOVATION (IRJMT)

MAPLE TREE PUBLISHING HOUSE

http://www.mapletreejournals.com/index.php/IRJMT
Received 10 September 2019 ISSN 2582-1040
Accepted 19 October 2019 2019; 1(6); 279-287
Published online 02 November 2019

Experimental Study on Sand and Cement Replacement by Termite Mound Soil

R.Harish[1*], S. Ramesh[2], A.Tharani[3], P. Mageshkumar[2]

[1] *Department of Civil Engineering, Sri Subramanya College of Engineering and Technology, Palani, India.*
[2] *Department of Civil Engineering, K.S.Rangasamy College of Technology, Tiruchengode, India.*
[3] *Department of Civil Engineering, Karpagam College of Engineering, Coimbatore, India.*

**Corresponding author E-Mail ID: harish.ramadas@gmail.com*

Doi: https://doi.org/10.34256/irjmtcon38

ABSTRACT

This paper presents the results of an experimental investigation of the compressive strength of concrete cubes containing termite mound soil. The specimens were cast using M20 grade of concrete. Two mix ratios for replacement of sand and cement are of 1:1.7:2.7 and 1:1.5:2.5 (cement: sand: aggregate) with water- cement ratio of 0.45 and varying combination of termite mound soil in equal amount ranging from 30% and 40% replacing fine aggregate (sand) and cement from 10%,15%,20% were used. A total of 27 cubes, 18 cylinders and 6 beams were cast by replacing fine aggregate, specimens were cured in water for 7,14 and 28 days. The test results showed that the compressive strength of the concrete cubes increases with age and decreases with increasing percentage replacement of cement and increases with increasing the replacement of sand with termite mound soil cured in water. The study concluded that termite mound cement concrete is adequate to use for construction purposes in natural environment.

Keywords: Termite, Water cement ratio, Mix ratio, Compressive strength, Split tensile strength, Flexural strength.

1. INTRODUCTION

Building materials account for between 40-60% of the total construction cost and this is attributed to the fact that basic conventional building materials like cement and aggregates are becoming increasingly expensive due to high cost incurred in their processes, production and transportation. The utilization of locally available materials that can either reduce or replace the conventional ones are being investigated. For example, the used of rice husk ash, corncob ash, shell ash, and termite mound soil have been ascertain suitable as replacement of sand.

Termite mounds are available all over the world. However, the availability and distribution depend on soil and vegetation, climatic features and presence of water. In India, the most dominant species of mound building termites are the wood - feeding, the fungus growing and the grass-harvesting germinates. However, constitute the dominant species and has a wider distribution of mounds in the southern zone of India.

The mound is usually made of finer soil whose plasticity has further been improved by the secretion from the termites while being used in building the mounds. It is therefore a better material than ordinary

clay in terms of utilization for moulding, and in dam construction .Heat treated termite mound soil has been reported to have resistance to wear, abrasion and penetration by liquids, and has cementations properties which makes it a good sand supplement, it equally has low thermal conductivity which could make it possible to reduce solar heat flow into building enclosure and regulate temperature fluctuations within the storage environment. The use of termite mound soil in the production of concrete is scarce in literature hence the study to investigate the influence of curing media on the compressive strength of termite mound blended concrete.

Concrete is a building constitute material which can be made with mixing Portland cement fine aggregate (sand) and coarse aggregate. The constituents are usually mixed together with water. It is used in building construction for structural member construction such as columns, beams and slabs. It can also be used for foundations, pavements and flooring purposes.

MATERIALS

Cement

Ordinary Portland Cement of 53 Grade was locally available is used in this investigation. The Cement is tested for various properties as per the IS: 4031-1988 and confirming to various specifications of IS: 12269- 1987 having specific gravity 3.15.

Table 1 Properties of cement

S. No	Name of the test	Value
1	Consistency	36 %
2	Initial Setting Time	32 minutes
3	Fineness modulus	1.75
4	Specific gravity	3.15

Fine aggregate

Locally available natural river sand having fineness modulus of 2.85 and specific gravity of 2.74 and conforming IS: 383 -1970.

Table 2. Properties of fine aggregate

S. No	Name of the test	Value
1	Specific Gravity	2.74
2	Fineness modulus	2.85
3	Water absorption	2.5 %
4	Bulk Density	1587.6

Coarse aggregate

Crushed angular aggregate of size 20 mm nominal size from the local source with specific gravity of 2.74 was used as coarse aggregate and conforming IS: 383- 1970.

Table 3. Properties of coarse aggregate

S. No	Name of the test	Value
1	Specific Gravity	2.74
2	Water absorption	0.65%
3	Bulk density	1652.89 kg/m^3

4	Crushing strength	22.12%
5	Impact strength	19.18%
6	Flakiness index	99.85%
7	Elongation index	99.65%

Water

Locally available potable water confirming to standard specified in IS: 456-2000 is used.

Termite

Termites are a group of social insects usually classified at the taxonomic rank of Order Isopteran. Termites mostly feed on dead plant material, generally in the form of wood, leaf litter, soil, or animal dung, and about 10% of the estimated 4,000 species are economically significant as pests that can cause serious structural damage to buildings, crops, or plantation forests.

The below results are given in Tamil Nadu Agricultural University, Department of Environmental Sciences, Coimbatore.

Table 4. Properties of termite

Parameters	Termite
pH	7.50
EC(Ds m^{-1})	0.25
Moisture (%)	44
Organic Carbon(%)	31.42
Calcium (mg/l)	22.87
Copper (ppm)	8.1
Manganese (ppm)	5.24
Zinc (ppm)	6.59
Iron (ppm)	39.4

Mix deign

The Mix properties for the normal mix concrete are designed using IS: 10262-2009 to design for M20 grade of concrete.

Table 5 Mix design for sand replacement

Water	Cement	Fine aggregate	Coarse aggregate
197 kg/m^3	420 kg/m^3	716 kg/m^3	1120 kg/m^3

Table 6.Mix design for cement replacement

Water	Cement	Fine	Coarse

		aggregate	aggregate
197 kg/m3	434 kg/m3	685 kg/m3	1071 kg/m3

EXPERIMENTAL RESULTS

Compressive Strength

The compressive strength test was carried out on 150mm x150mmx150mm cubes as specified by IS 516-1959(1989). The results of the compressive strength of conventional and termite mound blended concrete at 7 days, 14 days and 28 days for M20 grade concrete are tabulated.

Table 7. Compressive strength of cubes in replacing percentage of sand by TMS

Percentage of replacement	Specimen	Curing period (days)	Load (KN)	Compressive strength (N/mm2)
Normal concrete	Cube 1	7	293	13
	Cube 2	14	383	17
	Cube 3	28	458	20.4
30% sand replacement by TMS	Cube 1	7	300	13.3
	Cube 2	14	360	16
	Cube 3	28	445	19.3
40% sand replacement by TMS	Cube 1	7	360	16
	Cube 2	14	460	20.45
	Cube 3	28	575	23.5

Table 8 Compressive strength of cubes in replacing percentage of cement by TMS

Percentage of replacement	Specimen	Curing period (days)	Load (KN)	Compressive strength (N/mm^2)
Normal concrete	Cube 1	28	458	20.4
10% cement replacement by TMS	Cube 2	28	498	22.3
15% cement replacement by TMS	Cube 3	28	540	23.6
20% cement replacement by TMS	Cube 4	28	610	24.8

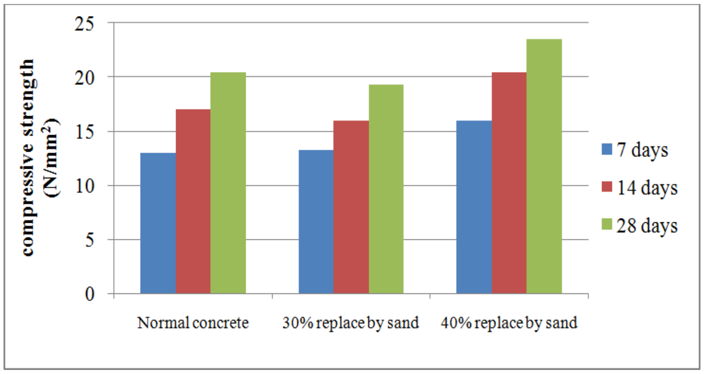

Figure 1Graphical comparison of compressive strength of concrete in replacing percentage of sand by TMS

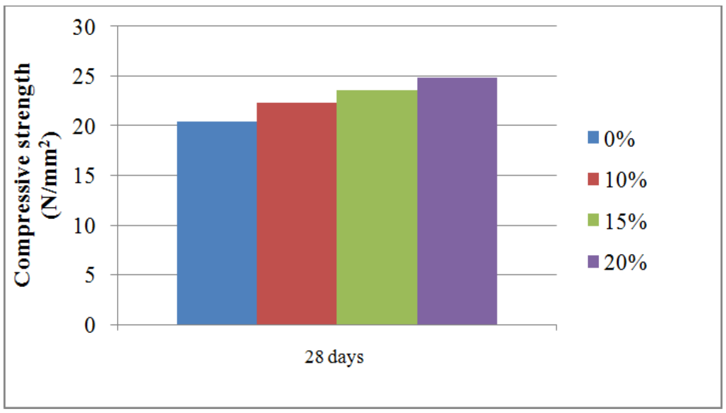

Figure 2.Compressive Strength of Concrete in replacing percentage of cement by TMS

Split Tensile Strength of Concrete

The split tensile strength test was carried out on cylindrical specimens of 150mm diameter And 300 mm length. The results of the split tensile strength of conventional and termite mound blended concrete at 7 days, 14 days and 28 days for M20 grade concrete are tabulated.

Table 9.Split tensile strength of cylindrical specimens in replacing percentage of sand by TMS

Percentage of replacement	Specimen	Curing period (days)	Load (KN)	Split tensile strength (N/mm^2)
Normal concrete	Cylinder 1	7	90	1.27
	Cylinder 2	14	120	1.7
	Cylinder 3	28	150	2.32
30% sand replacement by TMS	Cylinder 1	7	140	1.98
	Cylinder 2	14	150	2.12
	Cylinder 3	28	160	2.39
40% sand replacement by TMS	Cylinder 1	7	170	2.4
	Cylinder 2	14	160	2.3
	Cylinder 3	28	155	2.22

Table 10.Split tensile strength of cylindrical specimens in replacing percentage of cement by TMS

Percentage of replacement	Specimen	Curing period (days)	Load (KN)	Split tensile strength (N/mm^2)
Normal concrete	Cylinder1	28	150	2.32
10% cement replacement by TMS	Cylinder 2	28	195	2.65
15% cement replacement by TMS	Cylinder 3	28	210	3.1
20% cement replacement by TMS	Cylinder 4	28	250	3.45

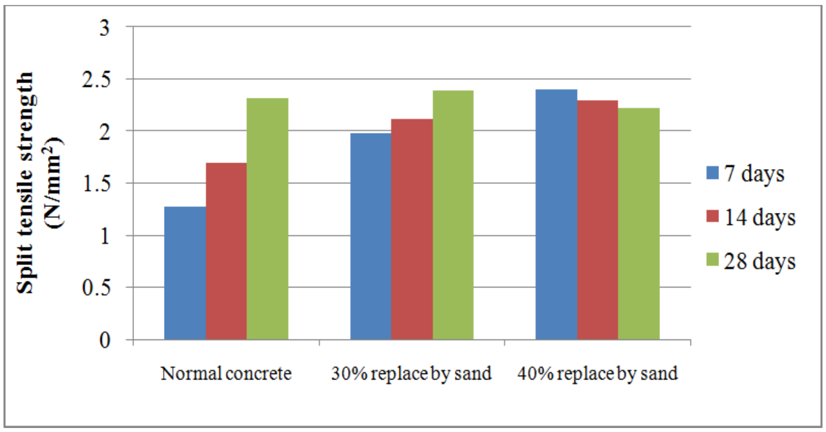

Figure 3 Graphical Comparison of Split tensile Strength of Concrete replacing percentage of sand by TMS

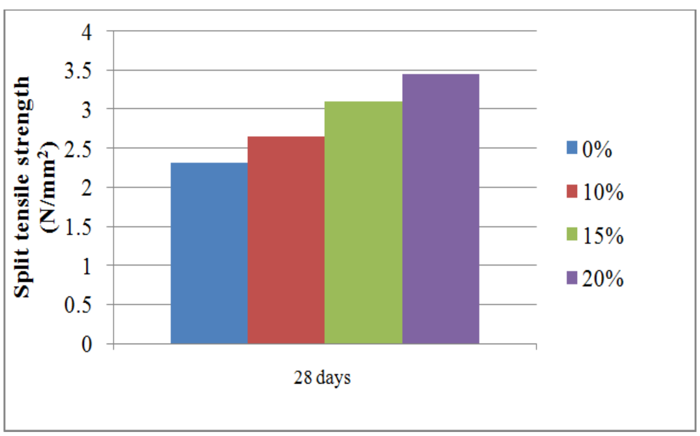

Figure 4. Split tensile Strength of Concrete in replacing percentage of cement by TMS

Flexural Strength Test on Concrete

The flexural strength test was carried out on prisms of cross section 150mm x 150mm x 700mm. The results flexural strength of conventional and termite mound blended concrete at 28 days for M20 grade concrete is tabulated.

Table 11. Flexural strength of prisms in replacing percentage of sand by TMS

Percentage of replacement	Specimen	Curing period (days)	Load (KN)	Compressive strength (N/mm^2)
Normal concrete	Prism 1	7	16	3.4
	Prism 2	14	21	4.6
	Prism 3	28	25	5.25
30% sand replacement by TMS	Prism 1	7	17	3.5
	Prism 2	14	23	4.8
	Prism 3	28	25	5.12
40% sand replacement by TMS	Prism 1	7	21	4.72
	Prism 2	14	22	5.19
	Prism 3	28	24	5.3

Table 12.Flexural strength of prisms in replacing percentage of cement by TMS

Percentage of replacement	Specimen	Curing period (days)	Load (KN)	Flexural strength (N/mm^2)
Normal concrete	Prism 1	28	25	5.25
10% cement replacement by TMS	Prism 2	28	27	5.7
15% cement replacement by TMS	Prism 3	28	29	6.2
20% cement replacement by TMS	Prism 4	28	32	6.8

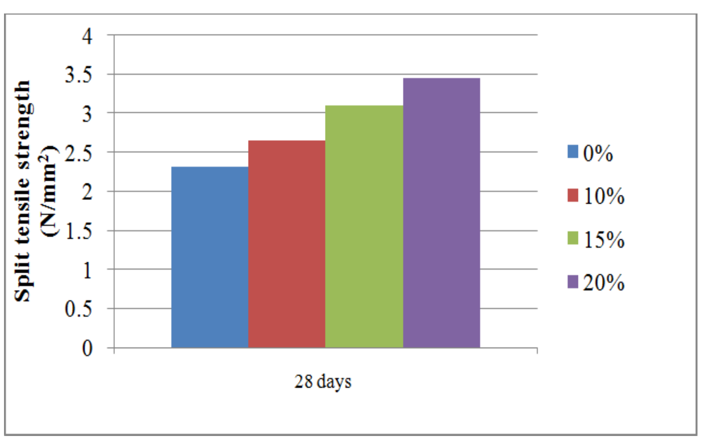

Figure 5.Graphical Comparison of Flexural Strength of Concrete in replacing percentage of sand by TMS

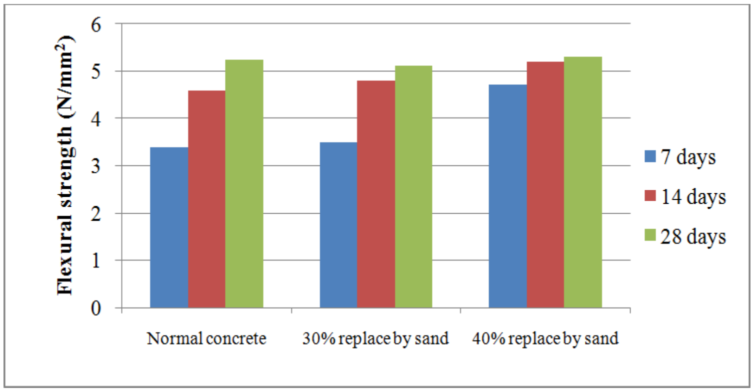

Figure 6. Flexural Strength of Concrete in replacing percentage of cement by TMS

CONCLUSION

Physical analysis and mechanical analysis were conducted on termite mound soil. The results showed that the termite mound soil was well graded and contained more of the finer sand particles than the sand sample.

The compressive strength of the resulting that concrete which had its fine aggregate 40% replaced with termite mound soil was more than 35% of the compressive strength of concrete prepared in using only coarse sand as fine aggregates.

The flexural strength of the resulting that concrete which had its cement 10 % replaced with termite mound soil was more than 52% of the compressive strength of normal conventional concrete.

The purpose of the project was to establish whether termite mound soil could be used as fine aggregate and cement in the preparation of concrete without tedious or expensive processing. Sand replacement by termite mound soil is more economical.

REFERENCE

1. Adegunloye.F.O (2007) Utilization and Evaluation of Treated Termite Mound Clay Bricks for Grain Silos Construction. Ph.D.Thesis, Agricultural Engineering Dept, University of Ibadan.
2. Adesanya.D.A and Raheem.A.A. (2009) A study of the workability and compressive strength characteristics of corn cob ash blended cement concrete, Construction and Building Materials, 23 (1): 311-317.
3. Ayangade.J.A, Olusola.K.O, Ikpo.I.J, and Ata.O (2004) Effect of Granite Dust on the Performance Characteristics of Kernelrazzo Floor Finish, Building and Environment, 39 (10): 1207-1212.
4. ASTM C 270 (2006) Standard Specification for Mortar for Unit Masonry. West Conshohocken, PA: ASTM International.
5. ASTM C618 (2008) Standard Specification for Coal fly ash and raw or Calcined Natural Pozzolan for use in concrete (ASTMC618-08), west Conshohocken, PA: ASTM International, 3pp.
6. Bassel.H, Nasim.S and Hassan.K(2012) Improving Durability of Concrete to Phosphoric Acid Attack, Jordan Journal of Civil Engineering, 6(1): 68-82.

7. Elfgreen.L and Ronin.V (2005) Mechanism for Performance of Energetically Modified Cement versus Corresponding Blended Cement and Concrete Research, 35: 315 - 323.

8. Murthy.V.N.S (2007)-Soil mechanics and foundation engineering- geotechnical engineering series, New Delhi, India. CBS Publishers and distributors PVt. Ltd., 1038 pp. Neville,

9. A.M. (2000) Properties of Concrete, 5th ed. New York: Pitman, 849 pp. Nigerian Industrial Standards NIS 444: 1 (2003) Composition, Specification and Conformity criteria for common cements, Lagos, Standard Organization of Nigeria (SON).

10. Odumodu.R.C. (1991),"Clay Block Industry in Nigeria, Problems and Prospects", Engineering Focus, NSE Publication, National Engineering Centre, Victoria Island, Lagos, 6: 37-40.

11. Olanipekun.E.A, Olusola.K.O and Ata.O (2006) Comparative Study of Concrete Properties of Palm Kernel Shell as Fine and Coarse Aggregates, Building and Environment, 41 (3): 297-301.

12. Olaniyi.A and Umoh.A.A (2013) Compressive Strength of Calcined Pulverised Termite Mound Blended Cement Concrete, Journal of Environmental Design, 8 (1&2): 34-42.

13. Olusola.K.O and Umoh.A.A (2012) Strength Characteristics of Periwinkle Shell Ash Blended Cement Concrete, international Journal of Architecture, Engineering and Construction, 1 (4): 213-220.

14. Olusola.K.O and Joshua.O (2012) Effect of Nitric Acid Concentration on the Compressive Strength of Laterized Concrete, Civil and Environmental Research, 2 (10): 48-57.

15. Parker,P.S (1998), "Structural Design", Concise - Encyclopedia of Science and Technology, 4th edition, New York: McGraw Hill Company.

Conflict of Interest

None of the authors have any conflicts of interest to declare.

About the License