SSRG International Journal of Civil Engineering
ISSN: 2348 – 8352 /doi:10.14445/23488352/IJCE-V7I6P110

Volume 7 Issue 6, 80-87, June 2020
©2020 Seventh Sense Research Group®

Triple Blending of Concrete By Partial Replacement of Cement With Perlite And Rice Husk Ash

Jayaseela Jonnalagadda [#1], Jayavani Jonnalagadda [*2], Venkata Sivaraju Sarikonda [#3]

[#1]Assistant professor,department of civil engineering,Narasaraopet Institute of technology,Narasaraopet.
[#2,3]Assistant professor, department of civil engineering, P.N.C&Vijai Institute of engineering and technology, Phirangipuram.

Received Date: 24 May 2020
Revised Date: 27 June 2020
Accepted Date: 01 July 2020

Abstract:
Concrete is the most versatile building material being utilized all around the world for construction material. Concrete material is highly susceptible to high temperatures due to a fire accident or when it is nearest to reactors or furnaces. The physical structure and chemical composition of the materials transforms considerably when raising to the highest temperature. The characteristics properties such as modulus of elasticity, volume deformation, structural integrity, the strength of structural elements are notably during exposures. The main aim is to increase the thermal insulating property but the concrete is having a low thermal insulating property. By the replacement of perlite powder in certain percentages(2.5%,5%,7.5%and 10%) to increase the thermal insulation of concrete.

Keywords — *compressive strength test, split tensile strength test, slump test, water absorption test, SEM analysis, XRD analysis, EDS analysis*.

INTRODUCTION

When compared to the normal concrete the blended concrete is very economical and possesses more strength. Perlite is an amorphous volcanic glass material and it is having a high water content and thermal insulating property. For the initial strength, a constant replacement of 10% Rice Husk Ash (RHA) is used. Perlite gives more strength when the curing period increases. The chemical composition of perlite and Rice Husk Ash (RHA) is as follows:

Perlite is a widely applicable and versatile mineral used in a variety of industrial processes and products, it expands nearly 15-17 times the original size. By adding admixtures to concrete the construction works are also getting developed and the durability of structures is being increased considerably. Concrete is having a low thermal insulating property. This lagging property can be enhanced by the replacement of perlite.

I) Triple blended concrete: Triple blended concrete incorporate three diverse cementitious materials. The utilization of suitably proportioned triple mixes permits the impacts of one supplementary cementitious material to adjust for the inborn weaknesses of another. Such types of cement have been found to display fabulous crisp and mechanical properties of the concrete. This emerges from the decrease in pore measure and the refinement of the pore structure of the concrete glue and also from changes in the properties of the interfacial zone between the bond glue and the total surface. In past years, the concrete containing natural pozzolans which are in the form of calcined or in the raw condition such as RHA, PERLITE, zeolite, diatomite, and mixtures are used largely in the world. These are highly required in places like nuclear and power structures, fire-prone structures like chimneys, heaters, and skyscrapers, etc., are the important places where high-performance concrete applications are needed. Furthermore, natural pozzolans make more benefits i.e., suppression of heat leak, its cost reduction, low permeability, and porosity and decrease the penetration of chemicals through the materials are all due to the bonding, integrity, and densification of the microstructure of the concrete materials when it is used as a cement replacement.

Rice husk ash:
Rice Husk Ash (RHA) which is an agriculture by-product has been reported to be a good pozzolana by numerous researchers. Mehta and pirth (2000) investigated the use of RHA to reduce the temperature in high strength mass concrete and got result showing that RHA is very effective in reducing the temperature of mass concrete compared to OPC concrete

perlite powder:
Perlite, a hydrated volcanic glass, commonly has a pearly, vitreous luster characterized by concentric

onion skin fractures. A relatively high- water content of 2% to 5% distinguishes perlite from other hydrous volcanic glasses, such as obsidian, hydrated volcanic ash, and pumicite. Upon rapid heating, perlite transforms into a cellular material of low bulk-density. As the chemical water held within the perlite boils, generally at temperatures in the range of 900–1100°C, the resultant steam forms bubbles within the softened rock to produce a frothy-like structure. The formation of these bubbles allows perlite to expand up to 15–20 times its original volume. This new material is referred to as expanded perlite (commercially, the term perlite can denote either natural or expanded perlite). Because of its favorable physical and chemical characteristics, expanded perlite finds diverse utilization in various applications: for use as a lightweight aggregate in the construction industry; as a rooting medium and soil conditioner in horticulture; as a bleaching agent in the textile industry; as an adsorbent in the chemical industry; and as a filter aid and as filler in miscellaneous processes. Nearly 65% of the perlite produced today is consumed by the construction industry. Its lightness, thermal, and acoustic insulation properties make expanded perlite an excellent candidate to be used as lightweight aggregate in concrete production. For insulation purposes, expanded perlite powder (EPP) is utilized as filler material in hollow bricks or as an additive in plasters. Studies to date have generally focused on the lightness and insulation properties of expanded perlite.

CEMENT:

PROPERTIES	VALUE
Specific gravity	3.15
Initial Setting time	39min
Final Setting time	200 min
Consistency	32%

Chemical composition of Cement:

CHEMICAL COMPOSITION	VALUE (%)
Silicon dioxide	21.1
Calcium oxide	62.4
Ferric oxide	2.49
Aluminum oxide	4.50
Loss on ignition	2.40

AGGREGATES:

PROPERTIES	VALUES
Specific gravity	2.77
Water absorption	0.55%
Fineness modulus	4.475
Size of fine aggregate	Passing through 2.36mm

Properties of RHA:

PROPERTIES	RESULT
Physical state	Solid-Non- hazards
Appearance	Very fine powder
Color	Grey
Particle size	25 microns-mean
Specific gravity	2.3

Chemical composition of RHA:

Chemical composition	Value
Silica (SiO_2)	93.80%
Alumina (Al_2O_3)	0.74%
Ferric oxide (Fe_2O_3)	0.30%
Titanium oxide (TiO_2)	0.10%
Sodium oxide (Na_2O_3)	0.28%
Calcium oxide (CaO)	0.89%
Loss of ignition (Loi)	3.37%

RICE HUSK ASH (RHA):

PERLITE POWDER

properties	
Color	white
Bulk density	40-50kg/m³
Ph	Neutral
Thermal conductivity	0.40 w/m k @ 0°
Moisture content	0.5% max.
Organic content	0.1% max.
Specific gravity	2.2-2.7

PERLITE POWDER

Testing of Materials:

Test values of cement:

Specific gravity	3.15
Consistency	32 %
Initial setting time	39 min
Final setting time	200 min

Aggregates test:

Properties	Fine aggregate	Coarse aggregate
Specific gravity	2.77	2.78
Fineness modulus	4.475	5.78
Water absorption	0.55 %	1 %

Mix proportions for w/c ratio 0.4:

Cement	448.09 kg/m^3
Fine aggregate	804.4 kg/m^3
Coarse aggregate	1011.92 kg/m^3
Water	186 kg/m^3

Mix proportion ratio for M30 grade of concrete is

1:1.79:2.25

Slump value and Compressive strength of the concrete:

Trial mix	w/c ratio	Slump value (m	Compressive ys (MPa)
1	0.44	16	17.7
2	0.4	0	24.8

Mix Proportions of concrete:

%'S OF PERLITE+RHA	CEMENT (kg/m^3)	WATER (kg/m^3)	F.A (kg/m^3)	C.A (kg/m^3)	RHA (kg/m^3)	PERLITE (kg/m^3)
0%+0%	448.09	186	804.4	1011.92	-	-
2.5%+10%	448.09	186	804.4	1011.92	44.809	11.20
5%+10%	448.09	186	804.4	1011.92	44.809	22.40
7.5%+10%	448.09	186	804.4	1011.92	44.809	33.60
10%+10%	448.09	186	804.4	1011.92	44.809	44.809

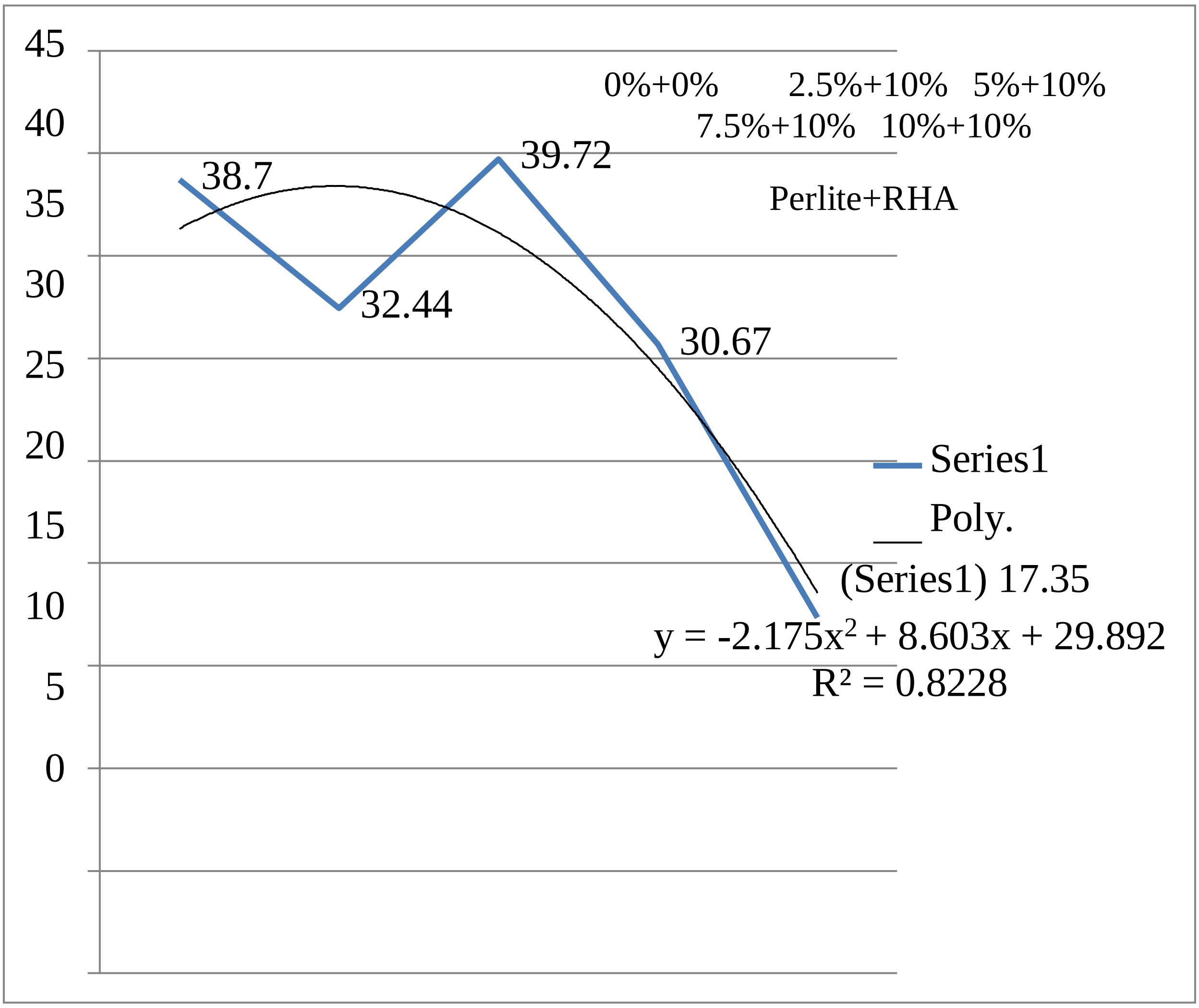
SEM ANALYSIS:

XRD ANALYSIS:

RESULTS AND DISCUSSION:

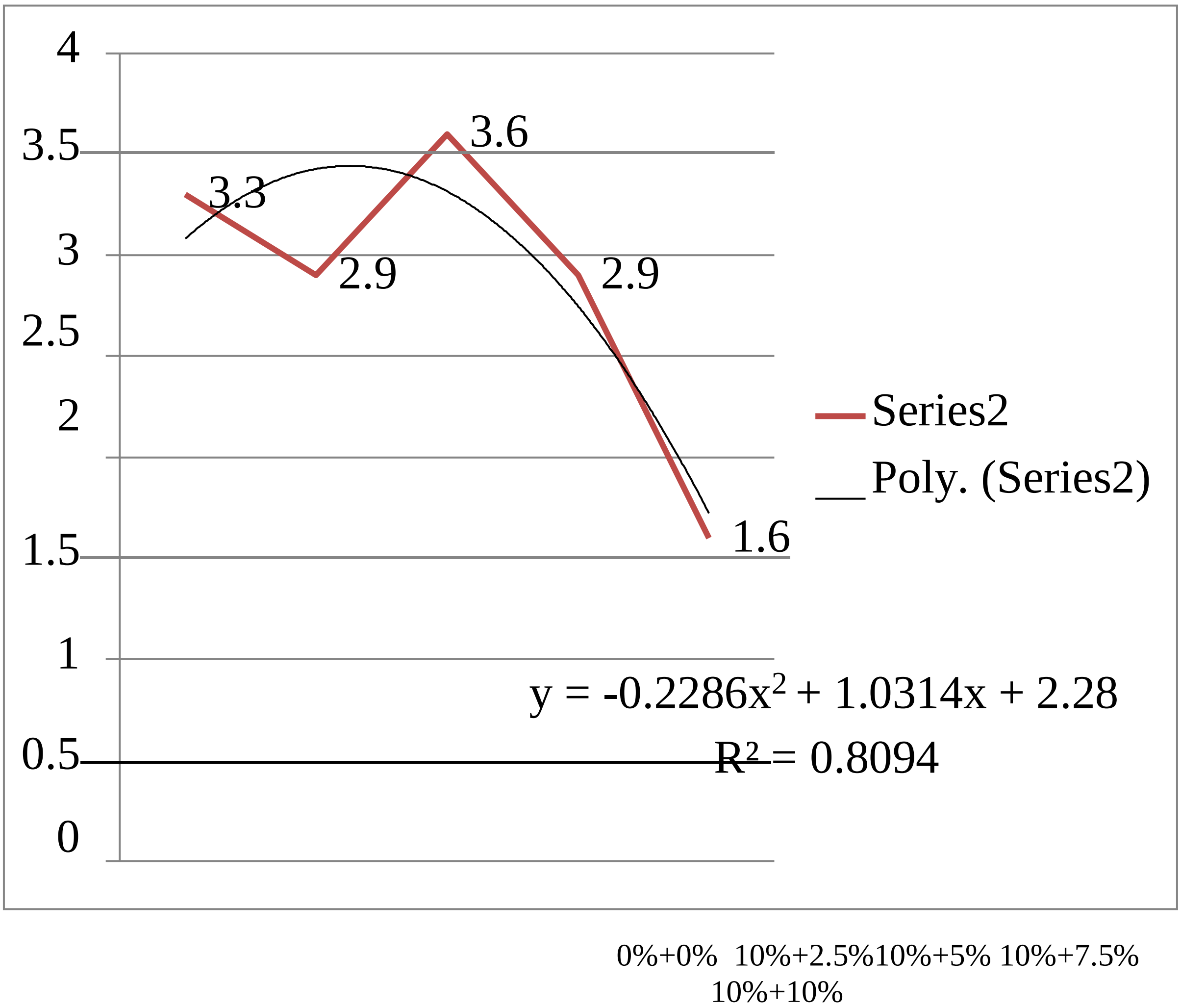
28 days Compressive stress of the concrete (MPa)

% Replacement(perlite+RHA)	Compressive stress(Mpa)
0%+0%	38.7
2.5%+10%	32.44
5% +10%	39.72
7.5%+10%	30.67
10%+10%	17.35



28 days spilled tensile stress of concrete (Mpa):

% replacement of perlite+RHA	Split tensile stress(MPa)
0%+0%	3.3
2.5+10%	2.9
5%+10%	3.6
7.5%+10%	2.9
10%+10%	1.6

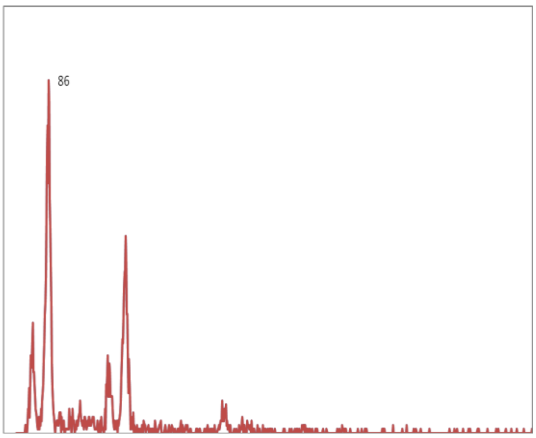


WATER ABSORPTION TEST:

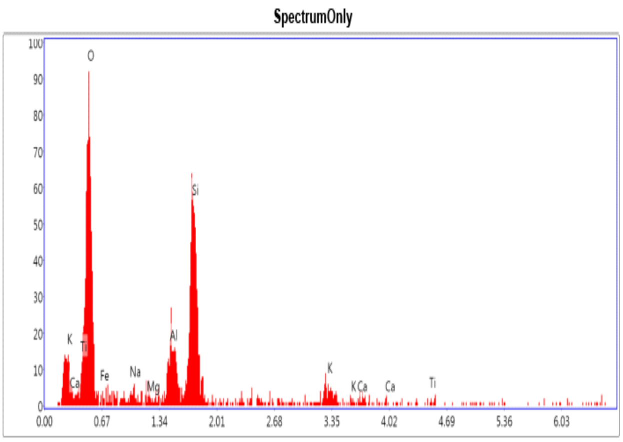
28 days of water absorption test.

% replacement of perlite+RHA	Water absorption(%)
0%+0 %	3.1
2.5%+10%	2.06
5%+10%	1.9
7.5%+10%	3.3
10%+10%	3.7

XRD ANALYSIS



EDS analysis:



CONCLUSIONS

- On 28thday, the specimen has maximum compressive strength obtained for the mix containing 5% PP and 10% RHA shows 39.72 MPa respectively.
- Similarly, the tensile strength obtained for the mix containing 5% PP and 10% RHA shows 3.6 MPa respectively.
- As the percentage of perlite powder increases (@5%), both the compressive strength and tensile strength values increased by 2.6% and 8.33% respectively, because the voids in between the cement particle and the micropores in the concrete are occupied by perlite and RHA which are very fine particles.
- The water absorption of concrete mix with (5% perlite +10% RHA) is low because the prepared concrete is having the most densification at that combination.

REFERENCES

[1] Yu, L-H., H. Ou& Lee, L. L. Investigation on pozzolanic effect of PP in concrete. Cement and Concrete Research 33(1)(2003).

[2] Deepa G. Nair, K.S Jagadish, Alex Fraaij, Reactive Pozzo;oans from Rice Husk Ash: An alternative to cement for rural housing, Cement and Concrete Research 36(2006) 1062- 1071.

[3] Johari, M. A. M. et al.,Influence of supplementary cementitious materials on engineering properties of high strength concrete, Construction and Building Materials. (2011).

[4] Vosoughi, Vandad, Seyed Mahmoud MotahariCrin, &SoroushEisapour.. Evaluation of PP-Performance in Concrete to Replace Part of the Cement. Cumhuriyet Science Journal 36(4)(2015).

[5] Somya Madvariya, Dr. S. K. Jaiswal Evaluation Of Low-Cost Pumpable Concrete Using Waste Foundry Sand International Journal of Engineering Trends and Technology 67(7)(2019) 97-100.

[6] Narender Reddy. A & Meena, T.. An experimental investigation on the mechanical behavior of eco-friendly concrete, IOP Conference Series: Materials Science and Engineering, 263(3)(2017).

[7] Narender Reddy. A &Meena, T. Behaviour of triple blended concrete under compression, International Journal of Civil Engineering and Technology, 8(4) (2017).

[8] Chai Jaturapitakkul and Boonmark Roongreung, Cementing Material from Calcium Carbide Residue-Rice Husk Ash, Journal of Materials in Civil Engineering ASCE, September-October (2003) 470-475.

[9] Hossain et al. found that addition of rice husk ash in cement increases its normal consistency and setting times. It has also been found that addition of rice husk ash in brick does not affect its shape and size. (2011)

[10] Vuriti Pavan, T. Lai Chandu, Dr.M. Srinivasa rao, A.Lakshumu Naidu Study and Characterisation of Various Industrial Fly Ash International Journal of Engineering Trends and Technology 62(1)(2018) 34-41.