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RESEARCH ARTICLE

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INTERNAL CURING OF HIGH PERFORMANCE CONCRETE

SURYA M C[1],ARYA KRISHNA[2],BINCY PAUL[3]

[1,3]PG Student, Department of Civil Engineering, Indira Gandhi Institute of Engineering and Technology , Kerala, India,

[2]Assistant Professor, Department of Civil Engineering, Indira Gandhi Institute of Engineering and Technology, Kerala, India


SURYA M C


ARYA KRISHNA


BINCY PAUL

ABSTRACT

Proper curing of concrete structures is important to ensure that they meet their intended performance and durability requirements.. Traditional external curing could not achieve a desired effect due to the very low permeability of high-performance concrete, so some researchers shifted their attention to internal curing. In this paper experimental investigation is done to study the mechanical properties for M40 grade HPC by replacement of cement with bentonite clay and super absorbent polymer as an additive at varying percentage respectively, bentonite clay at 2.5%,5%,7.5%,10% and super absorbent polymer at 0.25%,0.3%,0.35%,0.4%.It is found the mechanical properties like compressive, flexural and tensile strength increases upto an optimum value and decrease.

Keywords: Internal curing, Bentonite clay, Super absorbent polymer

I. INTRODUCTION

Now a day's HPC has become an object of intense research due to its growing use in the construction practice. High-performance concrete (HPC) exceeds the properties and constructability of normal concrete. Special mixing, placing, and curing practices may be needed to produce and handle high-performance concrete. High-performance concretes are made with carefully selected high-quality ingredients and optimized mixture designs.

The study deals with internal curing of HPC. Internal curing refers to the process by which the hydration of cement occurs because of the availability of additional internal water that is not part of the mixing water 'internal curing' is, curing 'from the inside to outside' through the internal reservoirs. 'Internal curing' is often also referred as 'Self–curing.'In this study replacement of cement with bentonite clay at varying percentage, and at the optimum percentage super absorbent polymer is added as additive.

II. EXPERIMENTAL INVESTIGATION

Concrete is a composite building material formed by the combination of cement, fine aggregate, coarse aggregate and water in a particular way that is designed to meet the job on hand with regard to desired workability, strength, durability and economy. Materials used for the study are cement, fine aggregate, coarse aggregate, bentonite clay, super absorbent polymer and admixture used is Arromix.

Materials used and their properties are tested according to IS Specifications. M30 grade concrete mix is the prepared according to IS 10262:2009

Compressive strength, flexural strength and split tensile strength of M40 grade concrete and concrete containing 2.5%, 5%, 7.5%, 10% of bentonite clay replaces cement are experimentally investigated. Compression test is the most common test conducted on hardened concrete. The compressive test is carried out on specimens cubical in shape having a size of 150x150x150mm. The compression tests were conducted after 7 days, 28 days. The test was conducted according to IS specifications.

Fig 1. Test setup for compressive strength and split tensile strength respectively.

A standard test cylinder of concrete specimen of size 300mm x 150mm is used to determine the split tensile strength. The test is done using compression testing machine. Test setup for compressive strength and split tensile strength respectively shown in fig1.

Fig 2. Test setup for flexural strength

Flexural strength is a measure of an unreinforced concrete beam or slab to resist failure in bending. It is measured by loading 100 x 100 mm x 500mm concrete beams with a span length of at least three times the depth. Fig 2. Shows the test setup for flexural strength of concrete.

Compressive strength split tensile strength and flexural strength of the concrete containing 7.5% of bentonite clay which replaces cement and then addition of super absorbent polymer at various % to the optimum mix (7.5%) are experimentally investigated.

III. RESULTS AND DISCUSIONS

The study undergo with the comparison of control mix with external curing and the replacement and addition is carried out by internal curingFrom the experiments, the result obtained shows that the compressive strength was increasing as the replacement of cement with bentonite clay increase up to 7.5%. The increase in strength is shown in table I and its graphical representation in fig 3. The strength was 38.42 N/m^2 on 7 day test and 48.23N/mm^2 on 28 day test. Further replacement shows the decrease in the compressive strength.

Table I. Compressive strength of concrete at various % of cement replacement (N/mm^2)

Cube designation	Compressive strength (N/mm^2)	
	7 day	28 day
M40	35.67	44.5
2.5%	36.15	45.16
5%	38.42	47.5
7.5%	41.95	48.23
10%	39.6	45.79

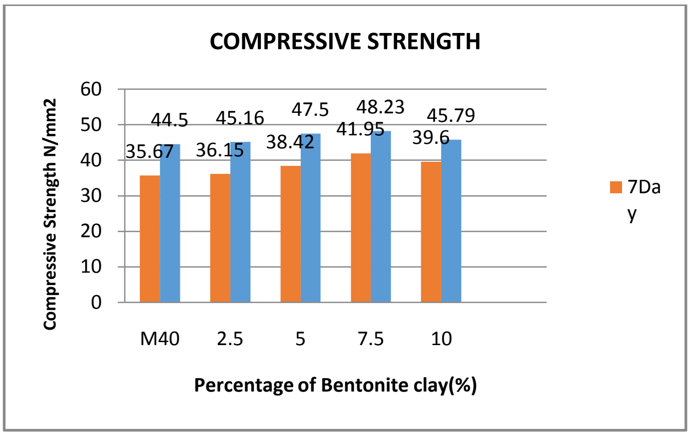

Fig 3. Graphical representation of compressive strength at 7day and 28 day.

Similarly for the split tensile strength, the increase in strength is shown in table II and its graphical representation in fig 4.

Table II. Split tensile strength of concrete at various % of coarse aggregate replacement. (N/mm^2)

Cylinder designation	Split tensile strength (N/mm^2)	
	7 day	28 day
M40	1.91	2.85
2.5%	2.1	2.99
5%	2.26	3.16
7.5%	2.36	3.32
10%	2.24	3.25

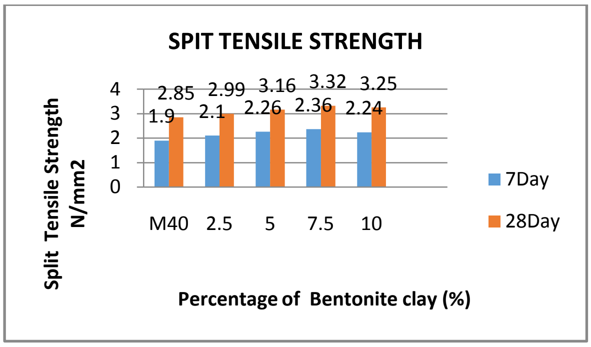

Fig 4. Graphical representation of split tensile strength at 7day and 28day.

Table III. Flexural strength of concrete at various % of cement replacement. (N/mm^2)

Beam designation	Flexural strength (N/mm^2)	
	7 day	28 day
M40	3.6	5.8
2.5%	3.68	5.91
5%	3.95	6.05
7.5%	4.24	6.3
10%	4.03	6.19

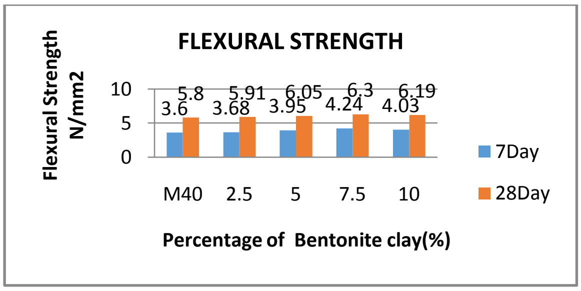

Fig 5. Graphical representation of flexural strength at 7day and 28day

By the addition of super absorbent to the optimum % replacement of cement (7.5%), compressive strength, split tensile strength and flexural strength increases. The variation in compressive strength and split tensile strength is shown in table IV and table V respectively. The respective graphs are figure 6 and figure 7.

Table IV. Compressive strength of concrete by addition of super absorbent to optimum % replacement of cement. (N/mm^2)

Cube designation	Compressive strength (N/mm^2)	
	7 day	28 day
0.25%	42.08	48.23
0.3%	43.76	49.1
0.35%	45.5	52.32
0.4%	41.9	50.06

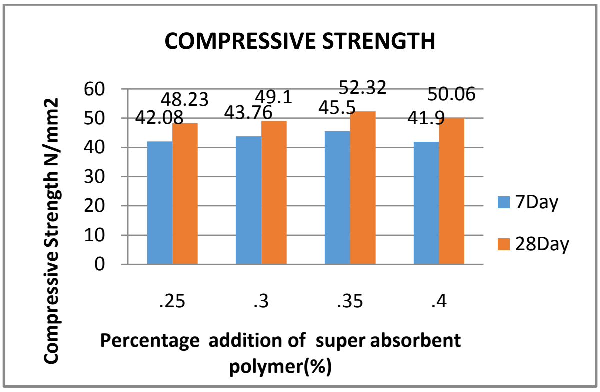

Fig 6. Graphical representation of compressive strength at 7day and 28day by addition of super absorbent.

Table IV. Split tensile strength of concrete at various % of coarse aggregate replacement. (N/mm^2)

Cylinder designation	Split tensile strength (N/mm^2)	
	7 day	28 day
0.25%	2.36	3.32
0.3%	2.39	3.45
0.35%	3.22	3.61
0.4%	3.15	3.5

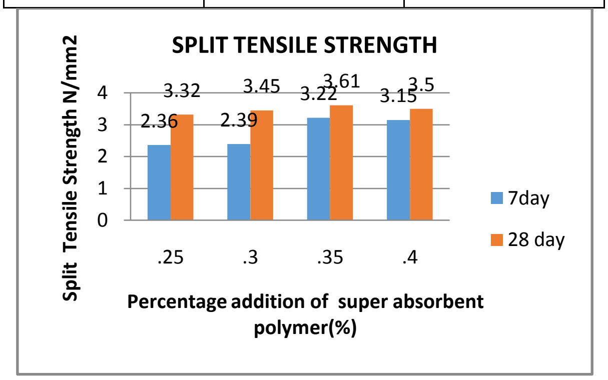

Fig 7. Graphical representation of split tensile strength at 7day and 28day by addition of glass fiber.

The flexural strength variation in concrete is tabulated in Table VI and fig 8 shows the strength variation.

Table VI. Flexural strength of concrete by addition of super absorbent polymer to optimum % replacement of cement. (N/mm^2)

Beam designation	Flexural strength (N/mm^2)	
	7 day	28 day
0.25%	4.24	6.3
0.3%	4.5	6.39
0.35%	4.73	6.67
0.4%	4.61	6.54

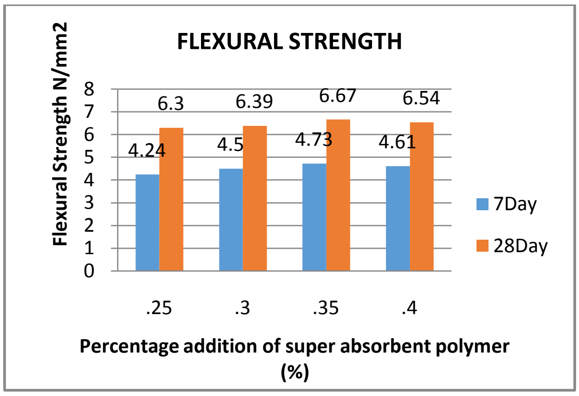

Fig 8. Graphical representation of flexural strength at 7day and 28day by addition of super absorbent polymer.

IV. CONCLUSION

High-performance concrete (HPC) exceeds the properties and constructability of normal concrete. High-performance concrete almost always has a higher strength than normal concrete. Experimental investigation on compressive strength and split tensile strength is conducted to find out the optimum strength of concrete by partially replacing cement by bentonite clay, additive super absorbent polymer is added to concrete improves the strength.

From the results obtained from the study it is clear that the mechanical properties will be improved by the partial replacement of cement with bentonite clay up to 7.5%. The result also showed that addition of super absorbent polymer into concrete had little influence in the mechanical properties of concrete.

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REFERENCES

[1] Chenhui Jiang, Yang Yang, Yang Wang, Yuenian Zhou, Cheng Chang ,' *The influence of light weight aggregate on internal curing and its impact on autogenous shrinkage of high performance concrete'.* Construction and building materials, 5 april (2014).

[2] P. Gomathi, A. Sivakumar, *'Accelerated curing effects on the mechanical performance of cold bonded and sintered fly ash aggregate concrete* on,'building and construction materials', 12 january 2015.

[3] Vivek Hareendran, '*Experimental investigation on strength aspects of Internal curing concrete using super absorbent polymer*',on International Journal Of Advanced Structures And Geotechnical Engineering ',vol 03 no.2 April 2014

[4] Sudegh Ghourchian, Mateusz Wyrzykowski, Pietro Lura Mohammad Shekarchi, Babak Ahmadi,' *An investigation on the use of zeolite aggregates for internal curing of concrete*',building and construction materials',5 December 2012.

[5] Salman Afzal, Khan Shahzada, Muhammad Fahad, Salman Saeed, Muhammad Ashraf,*Assessment of early-age autogenously shrinkage strains in concrete using bentonite clay as internal curing technique*', Construction and Building Materials', 18 may 2014.

[6] Yudong Han, Jun Zhang, Yiming Luosun, Tingyu Hao, *'Effect of internal curing of internal relative humidity and shrinkage of high strength concrete slabs* ', Construction and Building Materials,17 feburary2014, 41-49.

[7] H.K. Kim, J.G. Jang, Y.C. Choi, H.K. Lee, *'Improved chloride resistance of high-strength concrete amended with coal bottom ash for internal curing. Work studies a chloride resistance of high-strength concrete incorporating bottom ash aggregates for internal curing*', Construction

and Building Materials,24 august2014,71, 334-343.

[8] Xiao Sun, Bin Zhang, Qingli Dai, Xiong Yu,' *Investigation of internal curing effects on microstructure and permeability of interface transition zones in cement mortar with SEM imaging, transport simulation and hydration modelling techniques* ', building and construction material', 21 july 2014 ,76 366 -379.

[9] Viet-Thien-An Van,*Rice husk ash as both pozzolanic admixture and internal curing agent in ultra-high performance concrete*,',Cement & Concrete Composites, 2014, 53,270-278.

[10] Dayalan J, Buellah. M, *'Internal Curing Using Prewetted Light Weight Aggregate*', International Journal Of Innovative Research, In Science Engineering And Technology , march 2014 vol 3. Issue 3.