Experimental Study on Properties of Concrete USNG Humic Acid

K. Sathya Prabha[1] , Thajudeen. A.K[2]

[1]Assistant Professor, Department of civil Engineering, M.I.E.T Engineering College, Tiruchirappalli, Tamilnadu, India, 620
[2]PG Student, Department of Structural Engineering, M.I.E.T Engineering college, Tiruchirappalli, Tamilnadu, India, 620 007

Abstract- In this paper presents the test results of fresh and hardened properties of M25 grade concrete incorporating humic acid was added in 0.5%, 1.0%, 1.5% by weight based on the percentage of cement added. In split tensile strength of the cylinder and flexural strength of beam the maximum tensile strength is achieved in 0.5% of humic acid then the normal conventional concrete. Flexural strength was compared by testing of beams of size 1.0 x 0.15 x 0.2 m under two point loading. Results showed that there was no degradation of strength for beams with humic acid as replacement for the cement.

Index Terms- Humic Acid, flexure, Stiffness, Ultimate load.

I. INTRODUCTION

High Consumption of natural sources, high amount production of industrial wastes and environmental pollution are some of the factors which are responsible for obtaining solutions for a sustainable development. A

Sustainable development can be achieved only if the resources efficiency increases. The resource efficiency increment is possible by the reduction in use of energy and materials.

The solution is utilizatison industrial by-products or soil wastes such as the humic substances (HS) are the natural products which consist most important pool of transient refractory organic carbon in the geo sphere. They are present ubiquitously in soil, sediments and aquatic environment. They are composed of carbon, hydrogen, oxygen, nitrogen and sulphur. Humic substances (HS) is known to be of high molecular mass polyhydroxycarboxylate which contain poly-aromatic and aliphatic sub units**.**

Earlier research work in the usage of Humic Acid as replacement for cement shows to improve the strength of reinforced concrete., it is found that permeability of concrete depends upon the content of alumina in mineral admixtures, i.e. higher the alumina content, lesser the permeability which results higher resistance to sulfate and chloride ion penetration. It is well known that changes and deterioration in concrete limit service life of the concrete structures. Addition of mineral admixtures to concrete not only reduces the cement content thereby reducing heat of hydration, but also inhibits deterioration of concrete making it durable and better quality concrete by reducing pore size or permeability and improving resistance against sulfate attack.

II. EXPERIMENTAL INVESTIGATION

The objectives of this study are to investigate the effect of use of Humic Acid (HA) as partial replacement of cement in various percentages (0 – 1.5 %) on concrete properties (M25grade) such as mechanical characteristics of the concrete .

2.1 Material and Mix Proportions

A. Cement (C)

Portland Pozzolana Cement (53MPa) confirming to IS: 12269-1987 and the specific gravity of cement were found to be 3.15. The physical properties of cement given in Table 2.1.

Table 2.1 PROPERTIES OF CEMENT (OPC 53 Grade)

Sl. No.	Properties of Cement	Values as per **(IS: 12269-1987)**
1.	Fineness	225 m^2/kg
2.	Initial setting time	30 min
3.	Final setting time	600 min
4.	Compressive Strength	37 **N/mm^2** in 7 days 53 **N/mm^2** in 28 days
5.	Soundness, expansion	10 mm

B. Fine Aggregate (FA)

Locally available River sand having bulk density 1890 kg/m^3 was used and the specific gravity is 2.63. The Fineness modulus of river sand is 3.03.

C. Coarse Aggregate (CA)

Crushed angular aggregate with maximum grain size of 12.5mm and downgraded was used and having bulk density 1650kg/m^3. The specific gravity is 2.89 and fineness modulus was found to be 6.74 respectively.

D. Water (W)

Fresh potable water, which is free from acid and organic substance, was used for mixing the concrete.

E. Humic Acid (HA)

Humic substances (HS) are organic matter formed during the physical, chemical and microbiological transformation process of dead tissue or animal and plant. Its present everywhere in soil, sediments and aquatic environment. HS contain carbon, hydrogen, oxygen and nitrogen with small amount of sulfur. These elements are always present regardless of their origin and country. The macromolecular structures of HS are highly sensitive to different chemical conditions of solution. Their reactivity in an environment depends on the functional groups, macromolecular structure and concentration. The HS is replaced for Cement starting from 0 % 0.5%, 1%, 1.5 % in M25 grade concrete. Specific gravity of HS is 1.0

III. MIX DESIGN

The concrete mix is designed as per IS 10262 – 1982 and IS 456-2000 for the conventional concrete and HS added at the range of 0.5%, 1%, and 1.5% by the weight of cement. The mix proportions of M25 concrete are given in the table 3.1.

Table 3.1 MIX DESIGN
Mix Proportions for One m^3 of Concrete

Cement	Sand	C A	Water	HS	W/C
425.8	**535.43**	**1166**	**191.56**	**1.6**	**0.45**
1.00	1.26	2.74			

A. Test Specimens and Test Procedure

For this experimental work cubes, cylinders and beams were casted in the laboratory. Cubes and cylinders were casted using concrete mixes with along with 0.5%, 1.0%, and 1.5% of HS by weight of cement.

Compressive strength test on cubes as per IS: 516-1959, the cube specimen of the size 150 x 150 x 150 mm were tested after curing for period of 7 and 28 days for different combinations and results were compared with control specimens.

Split tensile strength on cylinders as per IS: 516-1959, the test was carried out for 7 and 28 days on cylindrical specimens 150mm diameter (D) and 300mm (L) placed horizontally between the loading surfaces of a compression testing machine and the load is applied until failure of the cylinder, along the vertical diameter. The optimum replacement percentage was chosen as 0.5% of HS by weight of cement.

A1. Beam Reinforcement Details

Two beam specimens of size – 1.5m x 0.15m x 0.25m were casted. One was used as control beam and another one was casted with mix. Two numbers of 12mm diameter bars at bottom and top were used as main reinforcement. Shear reinforcement consists of 8mm diameter 2-legged stirrups @ 180mm c/c throughout the length of the beam.

A2. Testing of beams

Flexural test on beams were carried out in universal testing machine of capacity 1000kN. Deflectometers were fixed to measure the deflection at salient points.

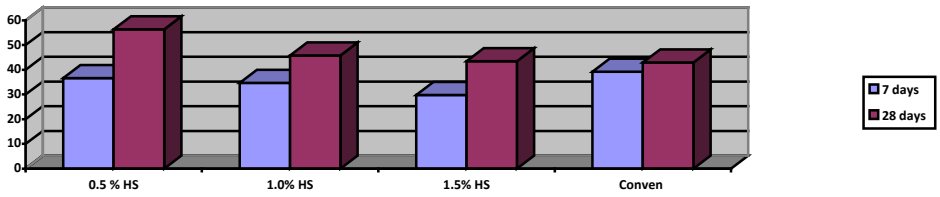
IV. RESULTS AND DISCUSSIONS

4.1 Cube Compressive Strength

The Compressive strength test results of specimens are shown in table 4.1. with addition of 0.5 % of HS has attain the higher compressive strength. The cube compressive strength for different proportional at period of 7 and 28 days are given as below.

Table 4.1 Compressive Strength of Cubes N/mm^2

HUMIC SUBSTANCES	7days	28days
0.5%ppf	36.61	56.44
1.0%ppf	34.67	45.77
1.5%ppf	29.75	43.45
Conventional	39.19	42.97

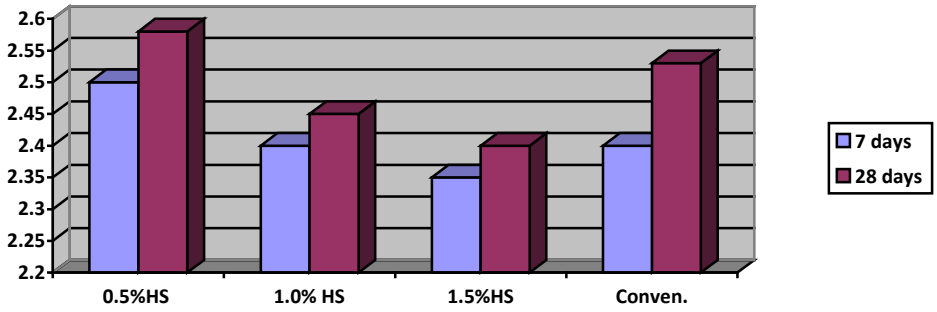


4.2 Cylinder Split Tensile Strength

The split tensile strength of specimens also showed that the optimum mix with 0.5% of HS. The split tensile strength for different mixes at period of 7 and 28 days are shown in table 4.2 below.

Table 4.2 Split Tensile Strength of Cylinders

HS	7days	28days
0.5%	2.50	2.58
1.0 %	2.4	2.45
1.5%	2.35	2.40
Conventional	2.4	2.53



4.3 Flexural strength

Loading of control beams were carried & Comparisons of various test results are given in Table.4.3. The loads versus midspan deflection for both the beams were recorded, and their mean values were observed for beam

Data	Peak Load (KN)	Flexural strength N/mm²	Young's modulus N/mm²	Max Bending Moment (KN-M)	Maximum displacement (mm)
Control beam	68.60	18.00	20180	11.43	12.4
BGC3	72.25	18.96	20480	12.04	13.6

V. CONCLUDING REMARKS

The study was conducted to evaluate the strength characteristics of concrete. The concrete mix design was done for M_{25} grade concrete. The following points were concluded from this study.

• The 7 days cube compressive strength results shows reduced strength of concrete due to HS action.

• The strength of concrete cubes at 28 days with 0.5% replacement of along with HS shows an increase of 31% in compressive strength..

• BSC3 showed high flexural strength and high modulus of elasticity compared to control specimen.

• Experimental result shows that BSC3 retained the stiffness similar to that of control beam.

• HS in BSC3 checked the development of cracks and thereby had many flexural cracks of reduced width.

• Result showed that BSC3 had similar moment curvature relationship as control beam with enhanced moment carrying capacity.

• In this study, HS is a hazardous material used as a replacement for Cement to bring down the pollution.

REFERENCES

[1] Aiken,G.R.(ed). "Humic substances in soils, sediments and water; geochemistry,isolation and charactericts", j.Wiley and Sons, New York(1985).

[2] Arno Kaschl,Volker Rombeld, and Yona Chen. "Cadmium binding by fractions of Dissolved organic Matter and humic substances from Municipal Solid waste ."

[3] A.quatmane,M.Hafidi, M.EI Gharous, J.C.Revel. "Complexation of calcium ions by humic and fulvic acids."Analusis 27(5) (1999).

[4] B.Debska,A. Maciejewska,J.Kwiatkowsta. "The Effect of fertilization with brown coal on Haplic Luvisol humic acids." Rostlinna Vyroba 48(1)(2002), 33-39

[5] Campabell, P.G.C., Tessier, A. In mwtals speciation,separation and recovery. Patterson, J.W,Passino,R.,Lewis Publishers,Michigan, 1987,pp.1-201.

[6] Charles W. Cater,Irwin H. Suffet. Binding DDT to dissolved humic materials.Environ. Sci..16(11)(1982)735,

[7] Anwar Khitab*, Muhammad Tausif Arshad, Faisal Mushtaq Awan, Imran Khan- DEVELOPMENT OF AN ACID RESISTANT CONCRETE: A REVIEW

[8] A. Iglesias, R. L!opez, S. Fiol, J.M. Antelo, F. Arce- Analysis of copper and calcium–fulvic acid complexation and competition effects

[9] Tehmina Ayub, Nasir Shafiq, Sadaqat Ullah Khan- Durability of Concrete with Different Mineral Admixtures: A Review

[10] IS 383-1970 Specification for coarse and fine aggregates from natural sources for concrete, New Delhi, India: Bureau of Indian Standard.

[11] IS 9103-1999 Concrete Admixtures Specifications New Delhi, India: Bureau of Indian Standard.

[12] IS:10262-1982 recommended guild lines for concrete mix design, India: Bureau of Indian Standard.

[13] IS:1199-1959 method of sampling and analysis of concrete, New Delhi, India: Bureau of Indian Standard.

[14] IS:516-1959 method of test for strength of concrete, New Delhi, India: Bureau of Indian Standard.

[15] IS:456-2000 plain and reinforced concrete code of practice, New Delhi, India: Bureau of Indian Standard.

AUTHORS

First Author – K. Sathya Prabha, Assistant Professor, Department of civil Engineering, M.I.E.T Engineering College, Tiruchirappalli, Tamilnadu, India, 620, 007.sathya.asw@gmail.com

Second Author – Thajudeen. A.K, PG Student, Department of Structural Engineering, M.I.E.T Engineering college, Tiruchirappalli, Tamilnadu, India, 620 007, tajuddin@gmail.com