ANALYSIS ON INFLUENCE OF NITRIC ACID ON M60 SELF COMPACTING CONCRETE'S DURABILITY CHARACTERISTICS

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ABSTRACT

Innovative self-compacting concrete (SCC) can be placed and compacted without the use of vibration. Even in the midst of crowded reinforcement, it can flow under its own weight, completely filling forms and attaining full compaction. Due to its significance and capacity to address the issues with concrete mix, the properties of SCC have been the subject of numerous studies. To determine the characteristic compressive strength and split tensile strength of M60 grade concrete mix, rice husk ash (RHA) and sugarcane bagasse ash (SCBA) are used to replace cement in stepped percentages of 0%, 5%, 10%, 15%, and 20%. The concrete is then cured with normal water and nitric acid solution (HNO3) for various lengths of time (7 days, 28 days, and 60 days). Nitric acid used for the curing in the concentration of 1%, 3%, 5%. Trial mixes with the varying water cement ratio, replacement percentage, quantity of super plasticizer and viscosity modifying agent, is to be prepared and tested. This research is to investigate the degradation of self compacting concrete due to attack of nitric acid based on measurement of compressive strength loss. The test results need to be must acceptance the characteristics of self-compacting concrete such as slump flow, V-funnel, U-box and L-Box are presented.

INTRODUCTION

High-performance self-consolidating concrete (SCC) is made to flow into formwork under its own weight. Compared to traditional Portland cement concrete, SCC is easier to pour and requires no mechanical consolidation or vibration. In 1986, self-compacting concrete (SCC), a brand-new type of high performance concrete (HPC) with exceptional deformability and segregation resistance, was created in Japan. Designing a suitable mix fraction and assessing the qualities of the resulting concrete are the main tasks involved in producing SCC. Designing a suitable mix fraction and assessing the qualities of the resulting concrete are the main tasks involved in producing SCC. RHA increases the viscosity of concrete, which boosts its ability to self-consolidate.

Concrete is the most basic element for any kind of construction work. No matter what type of building structure itis, the concrete used should be study and well compacted.

Ensuring the above points not only provide additional strength to the structure but also good finish and appearance to the final product. The compacting of any conventional concrete is done through external force using mechanical device.

The fluidity and segregation resistance of SCC ensures a high level of homo genetic, minimal concrete voids and uniform concrete strength, providing the potential for a superior level of finish and durability to the structure. SCC is often produced with low water-cement ratio providing the potential for high early strength, earlier remolding and faster use of elements and structures. The elimination of vibrating equipment improves the environment on and near construction and precast sites where concrete is being placed, reducing the exposure of workers to noise and vibration. For SCC, it is generally necessary to use super plasticizers in order to obtain high mobility. Adding a large volume of powdered material or viscosity modifying admixture can eliminate segregation. The powdered materials that can be added are Rice husk ash (RHA),Sugarcane bagasse ash(SCBA).

LITERATURE REVIEW

IJCSE-International Journal of Civil & Structural Engineering Research Piyushkumar ,Anil pratapsingh(2015): They studied on " Effect of use of Bagasse Ash on Strength of Concrete",with increasing demand and consumption of cement researchers and scientist are in search of developing alternate binders that are eco friendly and contributes towards waste management .In these paper SCBA has been chemically and physically characterized and partially replaced in the ratio of 0%,5%,10%,15%&20% by weight of cement in concrete The properties for fresh concrete are tested like slump cone test and for hardened concrete compressive strength at the age of 7&28 days by using grade M30.The test result indicate that the strength of concrete increase up to 10% SCBA replaced with cement.

IJSLE-International for Service Learning In Engineering R Shrinivasan and K. Sathiya (2010): They studied on "Experimental Study on Bagasse Ash in Concrete". The utilization of industrial and agricultural waste produced by industrial processes has been the focus of waste reduction research for economic, environmental, and technical reasons. Sugar-cane bagasse is a fibrous waste product of the sugar refining industry, along with ethanol vapor. This waste product (Sugar-cane Bagasse ash) is already causing serious environmental pollution, which calls for urgent ways ofhandling the waste. Bagasse ash mainly contains aluminum ion and silica. In this paper, Bagasse ash has been chemically and physically characterized, and partially replaced in the ratio of 0%, 5%, 15% and 25% by weight of cement in concrete. Fresh concrete tests like compaction factor test and slump cone test were undertaken was well as hardened concrete tests like compressive strength, split tensile strength, flexural strength andmodulus of elasticity at the age of seven and 28 days wasobtained. The test result indicate that the strength of concrete increase up to 15% SCBA replacement with cement.

SiriratJanjaturaphan and SupapornWansom (2010):They studied on, "The Pozzolonic Activities of Industrial Sugar Cane Bagasse Ash". They find out the chemical composition of the Sugarcane Bagasse Ash and compared them with the other pozzolonic material that is, rice husk ash and concluded that theSCBA is suitable for the partial replacement of cement.

D. Mukharjee (2011):Has Study made on "Utilization of SCBA". They described the various uses of SCBA in agriculture, construction, use of bagasse as fertilizers; in Horti culture etc. their chemical and other fertilizing propertiesetc. also gave various options for utilizing bagasse ash in various fields. Ashes obtained after control burning of SCB at 600oC/5hour were reasonably reactive given by the fact that little crystallization of minerals occurred. Morphological, XRD and TGA/DTA study of the blended pastes confirmedthe hydration reaction of SCBA within the cement gel. Compressive and flexural strength tests confirmed the actual behavior of SCBA blended mortars and it suggested that up to 15% substitution of OPC with SCBA can be made with better strength results than that with pure cement.

Sagar W. Dhengare, Dr.S.P.Raut, N.V.Bandwal, AnandKhangan(2015):They Studied on, "Investigation into Utilization of Sugarcane Bagasse Ash as Supplementary Cementations Material in Concrete". This paper presents the use of sugarcane bagasse ash (SCBA) as a pozzolanic material for producing high-strength concrete. The utilization ofindustrial and agricultural waste produced by industrialprocesses has been the focus on waste reduction. Ordinary Portland cement (OPC) is partially replaced with finely sugarcane bagasse ash. The concrete mixtures, in part, arereplaced with 0%, 10%, 15%, 20%, 25% and 30% of SCBA respectively. In addition, the compressive strength, the flexuralstrength, the split tensile tests were determined. The bagasse ash was sieved through No. 600 sieve. The mix design used for making the concrete specimens was based on previous research work from literature. The water –cement ratios varied from 0.44 to 0.63. The tests were performed at 7, 28, 56 and90 days of age in order to evaluate the effects of the addition SCBA on the concrete. The test result indicate that the strengthof concrete increase up to 15% SCBA replacement with cement.

Jayminkumar A. Patel, Dr. D. B. Raijiwala(2015): They studied on, "Experimental Study on Use of Sugar Cane Bagasse Ash in Concrete by Partially Replacement with Cement". In this paper sugar cane bagasse ash which is taken from one of the sugar mill of south Gujarat (INDIA) used in M25 grade of concrete by replacing cement 5% by weight and compare with normal M25 grade of concrete to check thefeasibility of sugar cane bagasse ash in concrete.

K Meeravali, K V G D Balaji, T. Santhosh Kumar (2014):They studied on, "Partial Replacement of Cement in Concrete with Sugar Cane Bagasse Ash-Behaviour in Hcl Solution". In this paper concrete cubes are casted with different percentages of Sugarcane Bagasse ash replaced with cement by weight (i.e. 0%, 5%, 10%, 15%, 20%, and 25%), and this cubes are exposed to 5% HCL environment. Compressive strength of cubes for 7days, 28 days and 60days are observed. Having gone through above literatures, it has been found that several researchers studied the effect of SCBA with their thermal and mechanical properties on concrete. Higher grade of concrete was considered as a base sample for above all research. So an attempt has been made to find out the % of SCBA to be added to M20 grade concrete in order to increase its strength and make it competition with higher gradeconcrete with maintaining the economy of work.

Bertil et al (2001):Carried out an experimental and numerical study on mechanical properties such as strength, elastic modulus, creep and shrinkage of SCC and the corresponding properties of normal compacting concrete. The study includes eight mix proportions of sealed or air-cured specimens with water binder ratio (w/b) varying between 0.24 and 0.80. Fifty percent of mixes were self compacting concrete and rest were normal cement concrete. The result indicates that elastic modulus, creep and shrinkage of SCC did not differ significantly from the corresponding properties of normal cement concrete.

MATERIALS USED

CEMENT

Ordinary Portland cement of 53 grade was used. RHA and SCBA admixtures used in the replacement of cement in the percentages of 0%, 5%, 10%, 15%, and 20%.The initial setting time OPC is 30 minutes (minimum) and final setting time is 600minutes (maximum)..The specific gravity of cement is 3.15

FINE AGGREGATE

The river sand, passing through 4.75 mm sieve and retained on 600 μm sieve, conforming to Zone II as per IS 383-1970 isusing as fine aggregate in the present study. All normal concrete fine aggregates including crushed or rounded can be used in SCC. The moisture content of the used fine aggregates should be closely monitored and must be taken into account in order to produce SCC of constant quality.

The sand is free from clay, silt and organic impurities. The aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity and bulk modulus

.Heavy weight particles made of metallic components are sometimes used to produce heavy weight concrete for nuclear shielding purposes.

COARSE AGGREGATE

Throughout the investigations, crushed coarse aggregates of 10mm or 12mm procured from the local crushing plants were used. The aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity and bulk density etc.

Coarse aggregate has an important role when studying the fresh properties. Blocking occurs easily if the size of the aggregate is large compared with the reinforcement spacing.

The optimum coarse aggregate content depends on the following parameters:

- The lower the maximum aggregate size, the higher is theproportion of coarse aggregate.
- For rounded aggregates, a higher content can be used than for crushed aggregates

WATER

Fresh portable water free from organic matter and oil is used in mixing the concrete. Water in required quantities were measured by graduated jar and added to the concrete. The rest of the material for preparation of the concrete mix was taken by weigh batching. The pH value should not be less than 7.

Water decreases both the yield stress and the plastic viscosity. Concrete is much more prone to segregation if only water is added to increase the filling ability. Because of this, SCC could not have been developed until suitable superplasticisers were produced.

RICE HUSK ASH (RHA)

Rice husk ash is produced by incinerating the husks of rice paddy. Rice husk is a by-product of rice milling industry. Controlled incineration of rice husks between 500 and 800 degree centi grades produces non-crystalline amorphous RHA. RHA is whitish or gray in color. The particles of RHA occur in cellular structure with a very high surface fineness. It is used for the replacement of cement. Rice husk is an agricultural residue which accounts for 20% of the 649.7 million tons of rice produced annually worldwide. The produced partially burnt husk from the milling plants when used as a fuel also contributes to pollution and efforts are being made to overcome this environmental issue by utilizing this material as a supplementary cementing material2. The chemical composition of rice husk is found to vary from one sample to another due to the differences in the type of paddy, crop year, climate and geographical conditions.

SUGAR CANE BAGASSE ASH (SCBA)

he physical effect (or the so-called filler effect) is concerned with the packing characteristics of the mixture, which in turn depends on the size, shape, and texture of the SCBA particles.It is used for the replacement of cement because of it is gain the strength. Utilization of different cementitious materials along with SCBA for the production of SCBA blended cement confers to get sustainable concrete. Quantities of SCBA are obtained as by-product from combustion in sugar industries; Therefore, SCBA is suitable supplementary cementitious material for use in concrete.

NITRIC ACID (HNO3):

Nitric acid usually occurs in chemical plants producing explosives, artificial manure and other similar products. Nitric acid can be formed from the compounds and radicals of nitrates in the presence of water

Though HNO3 is not as strong as H2SO4, its effect on concrete at brief exposure is more destructive since it transforms CH into highly soluble calcium nitrate salt and low soluble calcium nitro- aluminate hydrate

SUPER PLASTICIZER

Calcium lingo sulphonate in liquid form with 65% free water is used. These admixtures when they disperse in cement agglomerates significantly decrease a viscosity of the paste by forming a thin film around the cement particles. High range water reducing admixture called as super plasticizers are used for improving the flow or workability for decreased water- cement ratio without sacrifice for compressive strength and split tensile strength

RESULTS AND DISCUSSIONSTABLE-1

MIX PROPORATIONS OF M_{60} GRADE SCC:

Type of concrete	cement (kg/m3)	Fine aggregate (kg/m3)	Coarse aggregate (kg/m3)	Water (kg/m3)	
SCC	480	836.04	771.84	192	0.2%
	1	1.74	1.60	0.40	0.2%

TABLE-2

FRESH CONCRETE PROPERTIES OF M_{60} GRADESCC:

	Slump flow (mm)	T50 (sec)	V-funnel (sec)	T5 minutes (sec)	L-Box
Test results	695	3	8.5	9	0.8

Table-3

Compressive strength results for cubes cured in water after7days:

Sample Designation	Combined % of RHA & SCBA	Load (KN)			Area (mm^2)	Average load (KN)	Compressive Strength (N/mm^2)
		T1	T2	T3			
W1	0%	825	815	820	22500	820	36.44
W2	5%	650	655.5	645	22500	650.16	28.89

W3	10 %	625	615	635	22500	625	27.77
W4	15 %	610.5	605	615	22500	610.16	27.11
W5	20 %	595.5	585	600	22500	593.5	26.37

Table-4

Compressive strength results for cubes cured in water after

28 days:

Sample Designation	Combined % of RHA & SCBA	Load (KN)			Area (mm^2)	Average load (KN)	Compressive Strength (N/mm^2)
		T1	T2	T3			
W1	0 %	1358	1345	1350	22500	1351	60.04
W2	5 %	1020	1025.5	1015.3	22500	1020.26	45.34
W3	10 %	985	975	965	22500	975	43.33
W4	15 %	965.5	963	966	22500	964.83	42.88

W5	20 %	935.75	925.5	945	22500	935.41	41.57

Table-5

Split tensile strength results for cylinders cured in waterafter 28days:

Sample Designation	Combined % of RHA & SCBA	pressive Strength (N/mm²)
W1	0%	57.21
W2	5%	43.19
W3	10%	41.85
W4	15%	39.49
W5	20%	37.66

CONCLUSION

For the advancement of the building industry and material science, rice husk ash and sugarcane bagasse ash are used. It is a potential alternate method for the secure disposal of bagasse and rice husk ash from sugarcane. Compared to conventional concrete, RHA and SCBA are more cost-effective without sacrificing the strength of the concrete. A self-compacting concrete of the M60 grade that satisfies all the SCC features, including flow ability, passing ability, and segregation resistance, has been finally obtained after a number of trial tests. The major constituent proportions are used to construct a self-compacting concrete mix design tool. For the self-compacting concrete mix design, this tool is highly straightforward and user-friendly. From results M60 grade RHA and SCBA concrete for HNO3 solution exposure in 28 days, the various replacement showed better compressive strengths. At various replacements of RHA and SCBA gives maximum strengths and shows good resistance to nitric acid attack.

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