Performance Evaluation of Ternary Blended Sugarcane Bagasse Ash Concrete using RCP Test

T.Santhosh Kumar, KVGD Balaji, Chitti Babu Kapuganti, S Eswar Rao

Abstract*— Durability performance of concrete has been done from past several decades by several researchers using different pozzolanic materials. To develop the eco friendly durable concrete, utilization of agriculture waste such as sugarcane bagasse too hot garbage (SCBA) which is a result in sugar endeavors is utilized as one of the pozzolanic material close to silica rage. In the present examination ternary sugarcane bagasse slag silica smoke concrete (TBASF) were mulled over for Rapid chloride weakness test at different ages made with fragmentary abrogating of bond with SCBA in different degrees for example 5%, 10%, 15%, 20%, 25% and evident 10% of Silica rage. The outcomes demonstrates that with the general displacing of security in security with SCBA and Silica smoke evidently was relentlessly ensured against chloride particle weakness at ages of 28 days and 56 days.

***Keywords*— Bagasse Ash, Silica fume, Ternary blended concrete, rapid chloride permeability**

INTRODUCTION

Helplessness is a fundamental property of with respect to the healthiness of cement. The advancement of water or different liquids in bond also pass on exceptional contaminants. They makes different sorts of solidarity issues for solid development in sureness penetrability shows rate at which relentless specialists, for example, gases (co2,so3, and so forth.) fluids (ocean water, hazardous downpour, and so on.) attack into the solid. This prompts different sorts of blend responses. Usage duplicity to a reinforced bond could happen if chloride salts enter the solid spread and achieve the upheld steel. This kind of issue a basic bit of the time happens in interstates stopping structures, assistant decks and structures in marine condition. Low penetrability cement is depended on to shield such solid structures from section of convincing made mixes into bond. Beginning late there has been a vital improvement in noteworthiness for the estimation of the weakness of bond by uprightness of effect of the powerlessness on the nature of solid structures.

Making survey:

Ozkan Sengul [1] drove the tests to discover Compression Strength and Rapid Chloride Permeability of Concretes with Ground Fly Ash and Slag. At last, "the test outcomes show the ground fly too hot remains and ground granulated impact radiator slag surprisingly decay the enthusiastic chloride absence of insurance of cement. The producer foreseen that that ought to lessen the chloride feebleness of solid, thought of pozzolans are more larger than diminishing the water/strong degree".

Ali Reza Bagheri [2] reviewed about the impact of silica seethe in improving rate of solidarity progression and quality traits of formed security containing a less responsive slag.Concrete blends were assessed for electrical obstruction, compressive quality, chloride deficiency and chloride improvement at two or three ages as long as 180 days. The outcomes of those tests demonstrates that synchronous utilization of silica smoke has less impact on development of solidarity properties and moderate rate of getting in nature of parallel blends containing less reactivity slag.However it is ordinary that by utilizing off base mix of less reactivity slag and silica fume, it is conceivable to affirm ternary blends with multi day quality like the control blend and enlarges quality especially in the entire approach.

Banti A. Gedam [3] isolated on the "Impact of Supplementary Cementitious Materials on Shrinkage, Creep, and Durability of High-Performance. In this way, a starter examination has been done in drying conditions to consider the introduction utilizing three contrasting SCMs FA, SF, and GGBS. Four apparent HPC blends of M50 assessment utilizing grouped SCMs, explicitly fly powder (FA), silica rage (SF), and ground granulated impact radiator slag (GGBS) near standard port land bond (OPC) have been set up to review the cut back scale partner and micromechanical solid properties. From the outcomes it is seen that the usage of GGBS for halfway substitution of OPC strong gives best performing outcomes for coefficient of weakness, shrinkage, and creep".

Corina-Maria Aldea [4] studied the relation between concrete permeabilityandcracking. The effect of material composition and crack-width on water and chloride permeability were examined. From the results un-cracked high strength concretehas less water permeability than normal high strength concrete. Only exciting concretewith low water-to-bond degree was delicate to weakness of chloride concerning part. From the test outcomes producer amassed that the penetrability of water is all around have high affectability than the shortcoming ofchlorides concerning the split widths.

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M. Sharfuddin Ahmed [5] "Assessment of Binary and Ternary Blended cement with silica rage, fly affecting remains and BFS materials utilizing the Rapid Chloride Permeability Test. The outcomes demonstrated that securities with BFS mixes show lower charge passed and higher compressive quality than close mixes utilizing fly genuinely hot trash. The producer reasons that a high volume BFS-silica rage ternary mix is incomprehensibly helpful from persuading, normal and quality viewpoints."

Noor ul Amin [6] researched on "usage of bagasse slag as fragmentary substitution of bond in cement. Tests drove on compressive quality, part resolute nature, chloride spread, and security from chloride particle ambush. The outcomes demonstrate that bagasse too hot remains is a productive mineral admixture and pozzolan with the ideal substitution level of 20% security, which diminished the chloride spread by over half with no hostile repercussions for different properties of the set security".

I.B.Muhit [7]conducted tests on water weakness, split malleable strength,compressive quality and flexural nature of top tier bond (HPC) by utilizing fly ashand silica seethe. From the outcomes "10% silica smoke and 20% fly truly hot junk showed the least water entrance criticalness of 11mm and 15mm self-rulingly. 7.5 % silica smoke and 10% fly too much hot remains evidently was ideal for most too compressive quality, most huge split endurance correspondingly as most excellent flexural adaptability".

Research objective: The fundamental purpose of union of this examination is to explore chloride weakness on the ternary cement made with halfway abrogating of security with BA (5%, 10%, 15%, 20%, 25%) and 10% of Silica rage..

EXPERMENTAL METHODOLOGY

Material Properties:

The properties of material are referenced underneath.

Ordinary Portland cement:

Standard Portland commitment of 43 Grade from a particular get-together was utilized for the whole work and care has been taken to store it in impermeable holders to shield it from being impacted by the regular and rainstorm soaked quality and sogginess. The security was searched for after for physical necessities as shown by May be: 12269-1987.

Table 1: Chemical properties of Cement

SI.NO	Component	Symbol	Percent
1.	Calcium Oxide	CaO	63.6
2.	Silica	SiO_2	20.7
3.	Alumina	Al_2O_3	6.0
4.	Ferric Oxide	Fe_2O_3	2.4
5.	Sulfur trioxide	SO_3	1.4
6.	Magnesium Oxide	MgO	2.4
7.	Sodium Oxide	Na_2O	0.1
8.	Potassium Oxide	K_2O	0.7
9.	Loss on Ignition	LOI	1.2
10.	Insoluble residue		0.3
11.	Free Calcium Oxide	CaO	1.1

Sugarcane Bagasse Ash (BA): BA is collected from NCS sugar limited, Bobbili, Vizianagaram district, AP,India, was used as one of the mineral admixture. The Plant was designed to operate with boiler of travelling gate type with outlet steam parameters of 87kg/cm^2 at 515ºc using bagasse as a main fuel. The ash was grinded in ball mill in order to make it as fine as the cement fineness.

Table 2: Physical properties of Sugarcane Bagasse Ash

S.No	Property	Value
1	Density	575Kg/m^3
2	Specific gravity	2.20
3	Mean size particle	0.1-0.2µm
4	mean specific area	2500m^2/kg
5	particle shape	Spherical

Table 3: Chemical properties of BA

Sl. No.	Component	Symbol	Percent
1	Silica	SiO_2	63.00
2	Alumina	Al_2O_3	31.50
3	Ferric Oxide	Fe_2O_3	1.79
4	Manganese Oxide	MnO	0.004
5	Calcium Oxide	CaO	0.48
6	Magnesium Oxide	MgO	0.39
7	Loss on Ignition	LOI	0.71

Table 4: Chemical properties of Silica fume

Sl. No.	Component	Symbol	Percent
1.	Silica	SiO_2	90-96
2.	F1erric Oxide	Fe_2O_3	0.2-0.8
3.	Alumina	Al_2O_3	0.5-0.8
4.	Calcium	CaO	0.1-0.5
5.	Magnesium Oxide	MgO	0.5-1.5
6.	Sulfur trioxide	SO_3	0.1-0.4
7.	Carbon	C	0.5-1.4
8.	Potassium Oxide	K_2O	0.4-1
9.	Sodium Oxide	Na_2O	0.2-0.7

FINE AGGREGATE

The course sand encountering 4.75 mm strainer and held tight 600 µm sifter, changing as indicated by Zone II as appeared by IS 383-1970 was utilized as fine total in the present examination..

COARSE AGGREGATE:

All through the examinations, a 20 mm size coarse complete got from the close to pulverizing plant was utilized. The firm was looked for after for a territory of its physical properties such asFineness Modulus, Gradation,Bulk thickness and Specific Gravityetc. as appeared by Seems to be: 23-86-1963 and IS: 383-1970..

Super plasticizer:

Compound admixture (Conplast SP430A2) changing with IS: 9103 and BS: 5075 and ASTM-C-494 Type 'G' was used for obtaining a workable mix.

EXPERIMENTAL PROCEDURE

In the present study cement was replaced with BA and SF in various proportions.

Mix proportion:

A normal mix design of M60 as per IS: 10262-2009 was prepared. The w/c ratio for the concrete maintained at 0.35. The mix design of concrete as shown below

Table5: Mix proportion of M60 concrete

Sl. No.	Fine aggregate	Coarse aggregate	W/C Ratio	Super Plasticizer
1	1.55	2.35	0.35	0.01

Table6: Mix series of ternary blended concrete

Series	BA replacement for OPC	SF replacement for OPC
TBASF0	Pure Cement Concrete (0%)	
TBASF5	5%	10%
TBASF10	10%	10%
TBASF15	15%	10%
TBASF20	20%	10%
TBASF25	25%	10%

Testing procedure:

Rapid Chloride Permeability Test: This test theory picks electrical conductance of cling to offer a brisk trace of its attestation from the portion of chloride particles as appeared by ASTM C1202. The RCPT framework is the snappiest procedure and is generally utilized for express request and quality control purposes. The LED presentation shows the accessible voltage over the solid model. The dispersal cell have of 2 chambers. 2.4M NaCl system is filled in one chamber and in another chamber 0.3M NaOH technique is taken. The chloride particles were obliged to experience normally set vacuum sprinkled solid model under a shocked DC voltage of 60 volts. Cling to chloride atom entry has no tendency in light of the way where that the estimation of this limitation can be depicted as is ordinarily said. The methodology figure the outcomes dependent on thepassage ofelectrical travel through a solid model during a six hour introduction period.Electrical conductance of the solid is offered subject to clearly the electric stimulate suitably wrapped the major.

Results and Discussions:

Compressive Strength: In this test work a totally number of 72 3D conditions of test sizes of 150mmx150mmx150mm for M60 grade ternary cement are casted with halfway dislodging of security with TBASF as 5%, 10%, 15%, 20% and 25% by weight of the strong and the compressive quality tests are done at 7, 28, 56 and 90 days energetically. The test outcomes are plotted in the unfathomable structure and in graph as appeared in figure 1.

Table7: Compressive Strength of BASF Ternary Concrete

Series	Compressive Strength in MPa			
	7 days	28 days	56 days	90 days
TBASF 0	47.11	67.56	70.22	73.33
TBASF 5	49.78	68.44	72	74.22
TBASF 10	51.11	69.33	73.78	76.44
TBASF 15	54.67	75.11	76.89	80.89
TBASF 20	44.44	64.44	67.11	68.89
TBASF 25	43.56	62.67	65.33	67.56

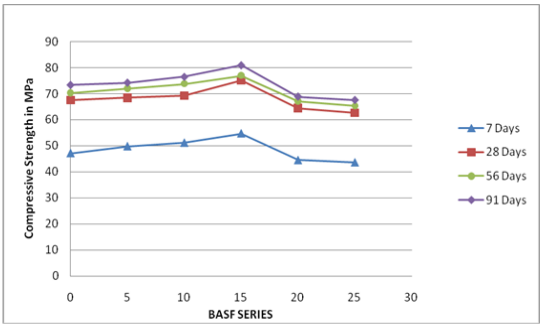

Fig 1 Compressive Strength of TBASF Ternary Concrete

From the test results it is seen that at 7 days quieting the compressive quality for TBASF 5, TBASF 10 and TBASF 15 was connected by 5.66%, 8.5%, and 16% when isolated and the strong without SCBA and silica rage, while the TBASF 20 and TBASF 25 was diminished by 5.6% and 7.51% straightforwardly.

At 28 days reestablishing the compressive quality for TBASF 5, TBASF 10 and TBASF 15 was related by 1.3%, 2.6%, and 11.17% when disconnected and the strong without SCBA and silica seethe, while the TBASF 20 and TBASF 25 was diminished by 4.62% and 7.34% self-governingly.

At 56 days enabling the compressive quality for TBASF 5, TBASF 10 and TBASF 15 was related by 2.53%, 5.06%, and 9.5% when isolates and the strong without SCBA and silica rage, notwithstanding the TBASF 20 and TBASF 25 was reduced by 4.43% and 7% self-governingly.

At 91 days engaging the compressive quality for TBASF 5, TBASF 10 and TBASF 15 was related by 1.21%, 4.24%, and 10.31% when restricted and the strong without SCBA and silica fume, while the TBASF 20 and TBASF 25 was diminished by 6.05% and 7.84% freely.

RAPID CHLORIDE PERMEABILITY TEST & RESULTS

The Rapid Chloride Permeability Tests were away for SIGMA Test and Research Center, Delhi for 28 days and 56 days. TBASF Concretes showed higher deterrent than

TBASF 0 at 28 days correspondingly as 56 days, and can be sorted out under "low" lack of protection layout as appeared by gauges. RCPT gives exceptional affirmation of update in the quality execution of TBASF solid when showed up contrastingly in association with TBASF 0.

Table 8: Results of Rapid Chloride Permeability Test at 28 Days

Series	Charge Passed in Coulombs	Chloride Permeability as per ASTM C 1202
TBASF 0	1359	Low
TBASF 5	984	Very Low
TBASF 10	716	Very Low
TBASF 15	470	Very Low
TBASF 20	452	Very Low
TBASF 25	416	Very Low

Table 9: Results of Rapid Chloride Permeability Test at 56 Days

Series	Charge Passed in Coulombs	Chloride Permeability as per ASTM C 1202
TBASF 0	1253	Low
TBASF 5	922	Very Low
TBASF 10	675	Very Low
TBASF 15	423	Very Low
TBASF 20	419	Very Low
TBASF 25	385	Very Low

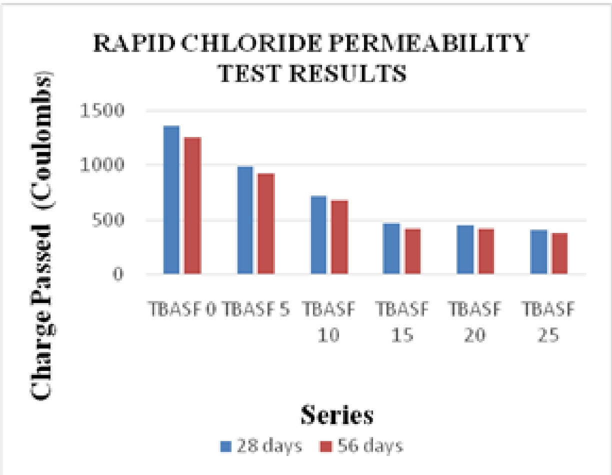

Fig. 2 Rapid Chloride Permeability Test Results

From the above results table it is observed that the average charge passed is decreased by 27.6% for TBASF 5 replacement, 47.31% at TBASF 10 replacement, 65.42% at TBASF 15 replacement, 66.74% at TBASF 20 replacement and 69.39% at TBASF 25 replacement compared to TBASF 0 at 28 days.

For 56 days average charge passed decreased by 26.42% at TBASF 5 replacement, 46.13% at TBASF 10 replacement, 66.24% at TBASF 15 replacement, 66.56% at TBASF 20 replacement, and 69.27% at TBASF 25 replacement compared to TBASF 0 at 56 days.

It is seen that the chloride molecule weakness diminished with improvement of bond annulling with TBASF in cement.

CONCLUSIONS:

1. With the far reaching supplanting of bond in cement with SCBA and Silica smoke obviously was reliably confirmed against chloride atom defenselessness at ages of 28 days and 56 days.
2. The chloride particle lack of protection was watched less at 56 days stood out from that of 28 days for all TBASF blends which results the criticalness of reasonable empowering and that chloride weakness can be all around diminished with solid age.
3. Durability execution of TBASF ternary cement had shown generously better control against chloride porousness.
4. The chloride delicacy for all TBASF models was "fantastically low", as appeared by ASTM C 1202 criteria

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