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Effect on Concrete Strength by Partial Replacement of Cement with Cotton Stalk Ash and Rice Husk Ash

Maninder Singh[1], Mr. Janardan Tiwari[2]

[1]M.Tech Scholar, Department of Civil Engineering in JCDM College of Engineering, Sirsa, Haryana, India
[2]Assistant Professor, Department of Civil Engineering in JCDM College of Engineering, Sirsa, Haryana, India

ABSTRACT

Huge quantity of Cotton stalk ash and rice husk ash are generating as a waste product in agriculture sector in India and many other developing countries every year. In lack of proper wakefulness and technology expansion, great portion of these by-products remain unutilized causing severe disposal and environmental troubles. The main goal of this thesis is to examine the performance of M40 grade concrete with a mix ratio as per M40 grade and a water/cement ratio of 0.425 Additionally, it aims to determine the compressive strength, flexural strength, and split tensile strength of concrete cement when cotton stalk ash and rice husk ash are used in place of cement. With various percentage like 10, 20, and 30 etc. of cotton stalk ash and rice husk ash well as with combined replacement of Cotton stalk ash and rice husk ash. and results that the workability of concrete was found to be reduced on enhance the Cotton stalk ash (CSA), rice husk ash (RHA) by difference percentages. The Maximum increase in 53.67 N/mm2 of compressive strength is obtained after the period 28 days with cotton stalk ash substituting 10% of the cement (CSA). The maximum increase in flexural strength over the period of 28 days was 5.98 N/mm2, with cotton stalk ash substituting 10% of the cement (CSA). When 10% of the cement is replaced with cotton stalk ash, the significant increase in split tensile strength for 28 days is 4.23N/mm2 (CSA) By substituting cotton stalk ash, rice husk ash for 20, 10% of the cement, the compressive strength as per this investigations for 28 days is observed 49.47 N/mm2 (CSA, RHA) is not achieved highest value but achieve the target mean strength. The greatest results are achieved when cotton stalk ash are utilized, although at different percentages.

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KEYWORDS: *Cotton stalk ash, Rice husk ash, Flexural Strength and Split Tensile Strength, Compressive Strength*

1. INTRODUCTION

Ordinary Portland Cement (OPC), the primary ingredient in making concrete, huge quantity of cement is utilized for various engineering projects, is becoming a costly and energy-intensive commodity. By the recent years, it is projected that the world's need for cement will have increased by three times, to around 3.5 billion tonnes. Despite the enormous demand, relatively few raw resources are needed to produce cement. In addition to being an expensive operation, making cement has worrying environmental effects due to CO2 emissions, which are a major contributor to global warming. According to Bhanumathidas and Mehta (2001), the production of one tonne of cement requires the use of almost 1.5 tonnes of earth minerals and emits one tonne of CO2 into the environment.

Since the vast of SCMs have pozzolanic properties, they aid in making concrete stronger and less porous over time. Because of this, mixing cement with SCMs has always had several benefits, including cost savings on cement, recycling of waste materials, enhanced physical characteristics, increased durability of concrete, and a smaller environmental effect due to the creation of fewer greenhouse gases. The primary materials that are authorised by European Standards are pozzolana, fly ash, GGBS, and limestone.

The objectives and scope of present study are

- To compare control concrete with (RHA+CSA) concrete's relative strength growth with age.
- Use of waste products in useful manner.
- Use of waste product partially replaced by cement results production of cement decreases.
- To decrease the production of cement.
- To make the concrete environment friendly.
- To utilized the waste products in economic manners.
- To study the various properties of cotton stalk ash and rice husk ash.
- To decrease the cost of storing of cotton stalk, rice husk.
- To resist the concrete from thermal cracking.
- To compare the strength of concrete using CSA and RHA with different percentages.

2. Literature Review's

2.1. Mohamed Amin Sherif (2021): as per future research there has been an increase in demand for cement's complimentary and partial replacement products in order to improve concrete's qualities and lessen the cement industry's environmental damage. The agricultural byproducts of burning cotton stalks and leaves of palm used as biomass include cotton stalk ash (CSA) and palm leaf ash (PLA). The objective of this research is to examine the results of employing CSA and PLA as cement replacements in high-performance concrete (HPC). In order to create the UHPC, 0%, 2.5%, 5, 7.5%, and 10% of NCSA and 10%, 20%, and 30% of PLA were used as partial replacements for cement.

2.2. Ibrahim saad agwa (2019): The characteristics in mechanics and microscopic structure of light-weight concrete (LWC), which incorporates ash of rice husk (RSA) and cotton stalk ash (CSA) as a partially replacement ratio by weight of cement, are presented in this work. As a control mix, seven LWSCC concrete combinations are created without RSA and CSA. In addition to the three mixes that contain 10%, 5%, and 20% RSA, there are 3 more mixes that contain 10%, 5%, and 20% CSA. With an 80 percent replacement ratio, lightweight coarse aggregate made of pumice is utilised in place of regular weight coarse aggregates. Fresh LWSCC's passage, filling, and segregation resistance abilities are assessed. Strength in splitting, tensile, flexural, and compression, micro structural analysis and density of harden state concrete are all assessed over a 28-day period.

2.3. Ovri et al. (2015): flexural strengths and compressive strengths of concrete constructed with cotton stalk ash and rice husk ash (RHA) substituted for cement are being studied. The following ratios of RHA were used to substitute cement: 0, 10, 20, 30 percentage. The specimens were allowed to cure for 7, 28 days, and it was discovered that while the control specimen with 0 % did, the ordinary Portland cement (OPC), RHA specimens did not. In terms of compressive and flexural strengths, the 10% RHA replacement showed the best value at 28 days (control: 23.1 N/mm2, 8.77 N/mm2, specimen of 22.32 N/mm2 and 6.59 N/mm2). With an increase in RHA content, it was discovered that the concrete's compressive and flexural strengths decreased.

2.4. Ramesh et al. (2015): reported on an experimental investigation that replaced all of the sand with m-sand and a portion of the cement with fly ash. He noticed that the natural sand resources were becoming depleted and that excellent quality sand could need to be carried across great distances, raising the expense of construction. Natural sand might not always be of high quality. As a result, it required to partially replacement of natural sand with an alternative materials in concrete without sacrificing the concrete's quality. One such substance is used in place of fine sand as a fine aggregate is quarry sand. The study sought to find out the compressive strength split tensile strength and flexural strength of the water as well as the use of quarry sand in place of natural sand as a fine aggregate.

2.5. Sivakumar et al. (2014): the detail of an investigation on the strength development of composite ash-containing specimen (flay ash-f & rice husk ash). In this thorough mechanical property investigation, the effect of replacing cement with Fly Ash of Rice Husk Ash (RHA) and class-F (FA) in aggregate proportions starting at 5% RHA and 5% FA mix both in concrete by replacing cement with the steady rise of FA & RHA was investigated. 20% RHA and 20% FA were taken as final percentage. Compressive experiments, flexural strength testing at various days, split tensile strength tests of cylinderical shape specimen, and flexural strength tests conducted.

3. Investigational Study

3.1. Utilized Material 3.1{a1} Cement In this experiment, regular Portland cement of grade 43 is employed. After examining the strength of cement for the period of 28 days in accordance with IS code 4031(1988), Ultratech cement in grade OPC 43 was employed. Specific gravity is 3.

3.1{a2} Aggregates Locally and easily available river sand that met grading zone I (IS 383-1970) and went through a 4.75mm IS sieve was classified as fine aggregate. It had fineness modulus of 3.503 and specific gravity of 2.68.

It has been used coarse aggregate from a nearby quarry regions. The specific gravity of the coarse aggregate of maximum size of 20 mm, is 2.79. Work with 20mm coarse gravel that has been crushed. The specific gravity and fineness modulus of coarse aggregate are 2.9 and 2.325 respectively.

3.1{a3} Cotton stalk ash Cotton stalk used was obtained from Near by field of Khaja Khaera Mor, Rania Road, Sirsa, India.

Fig: 3.2 COTTON STALK ASH

3.1{a4} Rice husk ash The rice mill at Sirsa provided the rice husk ash that was used. The ash made by burning rice husks (RH) with specific gravity of 2.01 and a bulk density is 106.1kg/m3 respecctively.

Fig: 3.3 RICE HUSK

3.1{b} Mix Design {as per IS 10262-2009} Mix Design of Concrete was Success by Utilization of Design Mix Ratio which was {1:1.53:.2.93}, and in same kind the Utilization of water/ Cement ratio are 0.425. mix proportions was Shows in Table no 1:

Sequential Number.	Rank of Concrete	Target Mean Power N/mm^2	Water/Cement ratio	Ratio of Mix Proportions
1.	M40	48.25	0.425	1:1.53:2.93

Table-1

MIX PROPORTION

M.D	System (Binary)	C	CSA	RHA	W	CA 10mm	CA 20mm	F
OPC	Control	11.502	0	0	5	13.48	20.22	17.589
OF10	OPC + 10% CSA	10.85	1.15	0	5	38.82	20.22	55.89
OF20	OPC + 20% CSA	9.2	2.30	0	5	38.82	20.22	55.89
OF30	OPC + 30% CSA	8.05	3.45	0	5	13.48	20.22	17.589
OR10	OPC+10% RHA	10.85	0	1.15	5	13.48	20.22	17.589
OR20	OPC+20% RHA	9.7	20	2.30	5	13.48	20.22	17.589
OR 30	OPC+30% RHA	8.05	30	3.45	5	13.48	20.22	17.589

M.D	System (Binary)	C	CSA	RHA	W	CA 10mm	CA 20mm	F
OCR10	OPC+10%CSA+10%RHA	9.20	1.15	1.15	5	13.48	20.22	17.589
OC20R10	OPC+20%CSA+10%RHA	8.05	2.30	1.15	5	13.48	20.22	17.589
OC10R20	OPC+10%CSA+20%RHA	8.05	1.15	2.30	5	13.48	20.22	17.589

Table-3

4. **Experiments Conducts for strength.** Mainly Number of 3 Experiments over and above test are Conducted on concrete, which is Sag test known Bearing power test both on 7^{th} and 28^{th} day, Tensile Power Test Conduct Both on 7^{th} and 28^{th} days and split power strength later on the processing of Water bath.

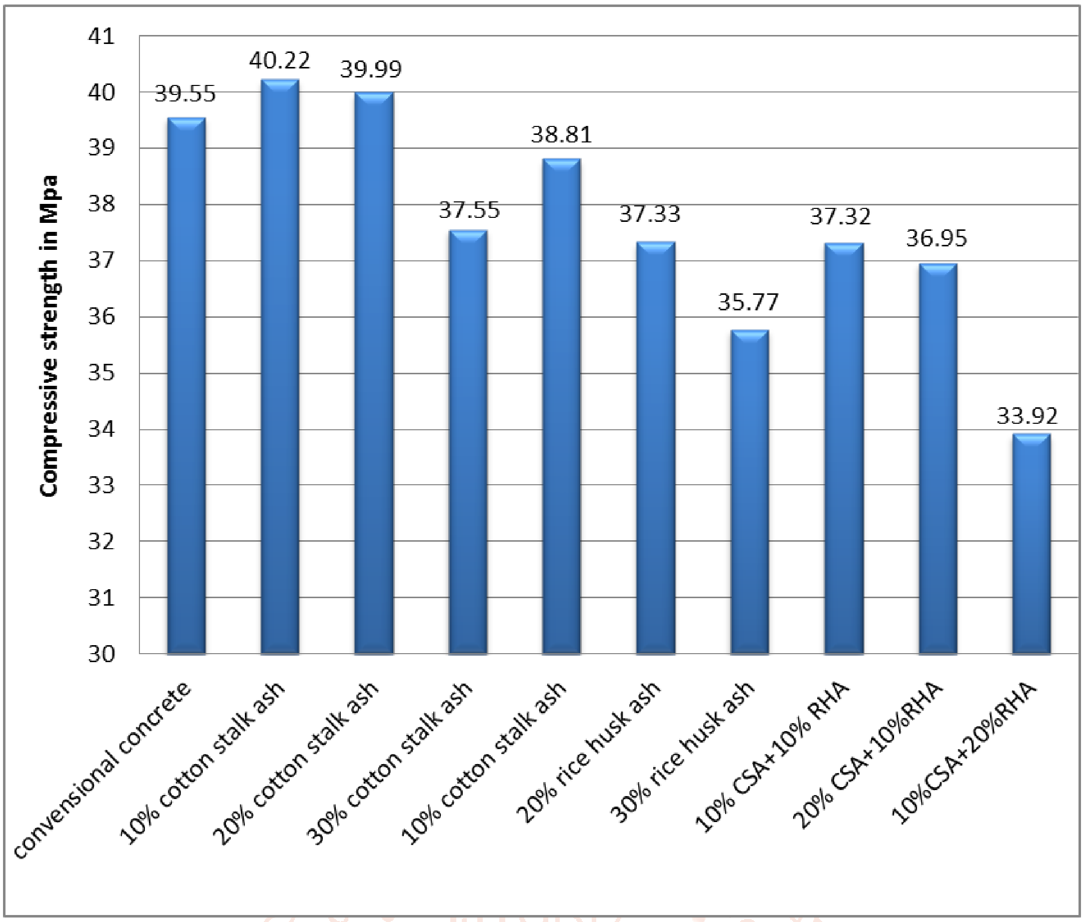
4.1 Slump Experiment or Workability Experiment 4.2 Bearing Power Experiment 4.3 Tensile Power Experiment 4.4 Split power Experiment

4.1 Slump Experiment Or Workability Experiment On ordinary concrete, cotton stalk ash concrete, rice husk ash mixed concrete, and combination of fly ash, rice husk mixed concrete, the slump test in accordance with 3.5 1199-1959 is conducted in order to determine workability. Workability increase when cotton stalk and rice husk ash percentages rise.

4.2 Compresssive strength Experiment As per IS 516-1959, the strength in compression was tested on a variety of specimens. Before being tested on a 1000 KN capacity compressive testing machine, the specimens were surface dried. In the given Tables no 4.1(a) and 4.1(b), which exhibit the compressive strength for period of 7 and 28 days respectively, illustrate the compressive strength of concrete with varied percentages of CSA, RHA, and content. After 28 days, This strength was measured as 53.67 MPa, 52.73 MPa, 50.36 MPa, 51.99 MPa, 48.22 MPa, 45.99 MPa, 50.73 MPa, 49.47 MPa, 51.33 MPa, 52.33 MPa, 53.10 MPa, 49.33 MPa, and 45.77 MPa, respectively, for 10%, 20%, and 30% CSA and RHA. When 10% Cotton stalk ash was substituted with cement, it was found that the maximum value of compressive strength was 40.22 MPa at period of 7 days and 53.67 MPa at period of 28 days. After conducting this study we examined that compressive strength is decrease by increase in the percentage cotton stalk ash. And same as with the increase in the amount of rice husk increased. When cotton stalk ash and rice husk ash (RHA) were employed at 10% and 20%, respectively, the minimum compressive strength at the period of 7 days and 28 days was 33.92 MPa and 45.77 MPa, respectively.

Table No- 4.1(a) COMPRESSIVE STRENGTH VALUES AT THE PERIOD OF 7 DAYS

Sr. No.	Sample No.	CSA used (%)	RHA used (%)	Compressive Load (KN)	Compressive strength of cube (N/mm2)	middling compressive strength of cube (N/mm2)
1	1	0	0	885	39.33	39.55
	2			890	39.55	
	3			895	39.77	
2	1	10%	0	910	40.44	40.22
	2			905	40.22	
	3			900	40.00	
3	1	20%	0	905	40.22	39.99
	2			900	40.00	
	3			895	39.77	
4	1	30%	0	860	38.22	37.55
	2			840	37.33	
	3			835	37.11	
5	1	0	10%	885	39.33	38.81
	2			870	38.66	
	3			865	38.44	
6	1	0	20%	845	37.55	37.33
	2			840	37.33	
	3			835	37.11	
7	1	0	30%	810	36.00	35.77
	2			805	35.77	
	3			800	35.55	
8	1	10%	10%	850	37.77	37.32
	2			840	37.33	
	3			830	36.88	
9	1	20%	10%	845	37.55	36.95
	2			830	36.88	
	3			820	36.44	
10	1	10%	20%	780	34.66	33.92
	2			760	33.77	
	3			750	33.33	

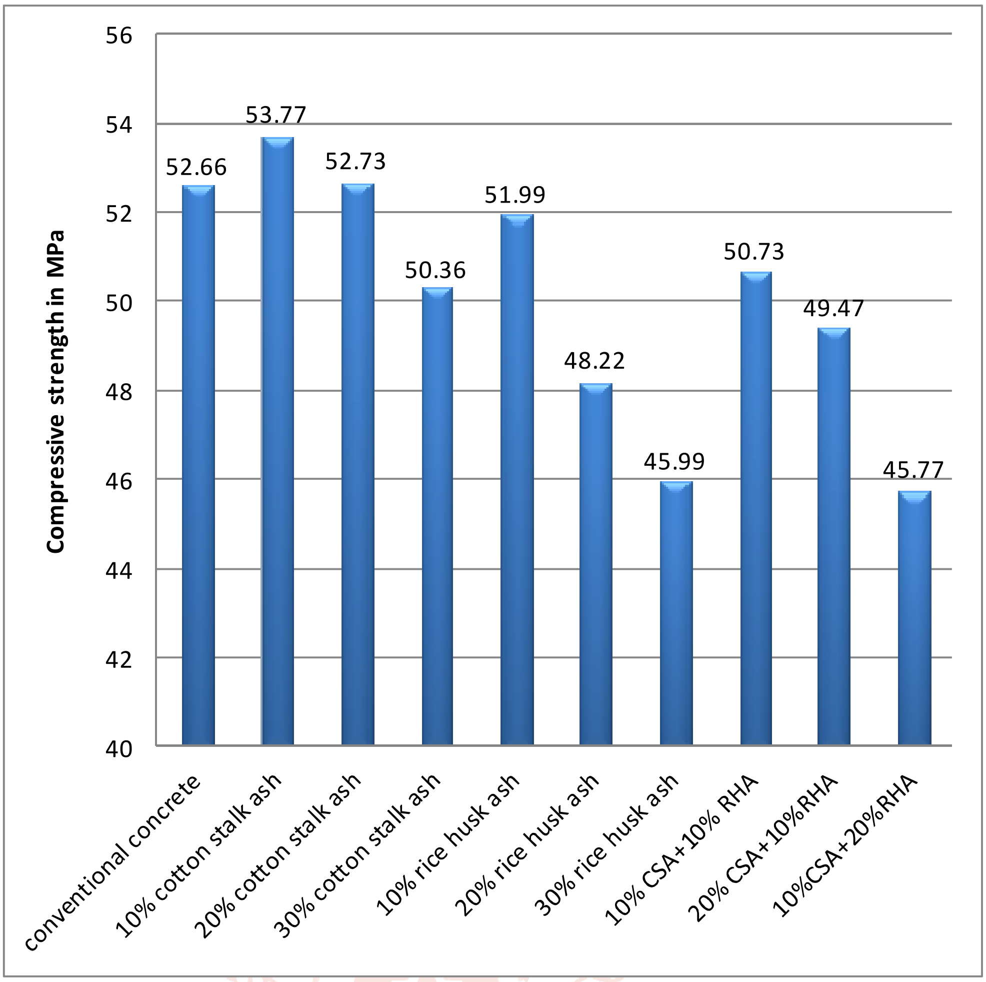


Graph 4.1(a) COMPRESSIVE STRENGTH FOR 7 DAYS

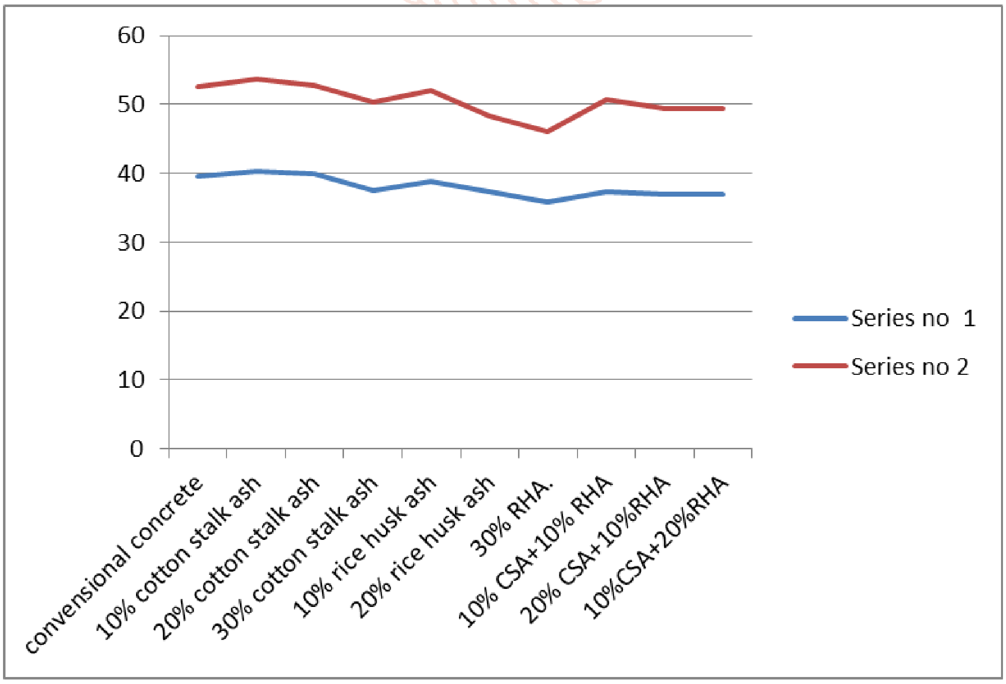
Table No.- 4.1(b) COMPRESSION STRENGTH DATA AT THE AGE OF 28 DAYS

Sr. No.	Sample No.	CSA used (%)	RHA used (%)	Compressive Load (KN)	Compressive strength of cube (N/mm2)	Average compressive strength of cube (N/mm2)
1	1	0	0	1195	53.11	52.66
	2			1190	52.88	
	3			1170	52.00	
2	1	10%	0	1220	54.22	53.77
	2			1210	53.77	
	3			1200	53.33	
3	1	20%	0	1200	53.33	52.73
	2			1190	52.88	
	3			1170	52.00	
4	1	30%	0	1145	50.88	50.36
	2			1135	50.44	
	3			1120	49.77	
5	1	0	10%	1175	52.22	51.99
	2			1170	52.00	
	3			1165	51.77	
6	1	0	20%	1090	48.44	48.22
	2			1085	48.22	
	3			1080	48.00	
7	1	0	30%	1040	46.22	45.99
	2			1035	46.00	
	3			1030	45.77	
8	1	10%	10%	1150	51.11	50.73
	2			1140	50.66	
	3			1135	50.44	

9	1	20%	10%	1120	49.77	49.47
	2			1115	49.55	
	3			1105	49.11	
10	1	10%	20%	1050	46.66	45.77
	2			1025	45.55	
	3			1015	45.11	



Graph 4.1(b) COMPRESSIVE STRENGTH VARIATIONS FOR 28 DAYS

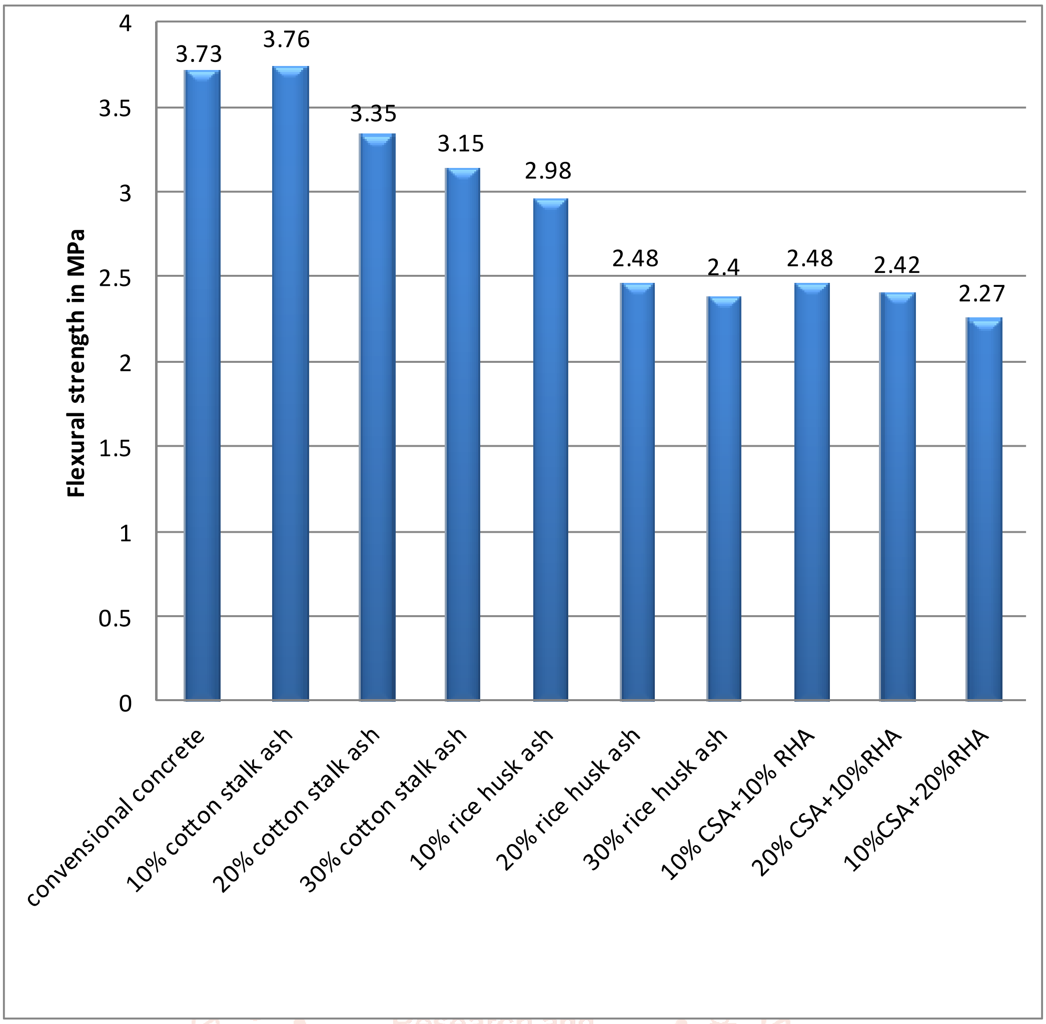


Graph 4.1(c) COMPRESSIVE STRENGTH VARIATIONS AT DIFFERENT AGES

4.3. Flexibility Power Due to short distance between the supports, the flexural strength of concrete with CSA and RHA percentages has been examined by testing breadth 150mm, depth 150mm, and length 700mm beams under twin point load. flexural strength in this. which display the 7 and 28 days flexural strength in table no 4.2(a) and 4.2(b) respectively, illustrate the strength in flexural of concrete with varying percentages of CSA, RHA. When cotton stalk ash was applied at 10%, it was shows that the increase in flexural strength and the highest value was 3.76 MPa after 7 days and 5.98 MPa after 28 days. The additional addition of rice husk and cotton stalk ash causes the beam's flexural strength to decline. When cotton stalk ash was used, the minimum strength in flaxure was 2.27 MPa for 7 days period and 3.39 MPa for 28 days period and ash of rice husk and cotton stalk ash (CSA) were used in proportions of 10% and 20%, respectively.

Table No.- 4.2(a) FLEXURAL STRENGTH AFTER 7 DAYS

Sr. No.	Sample No.	CSA used (%)	RHA used (%)	Flexural Load (KN)	Flexural strength of beam (N/mm2)	Average flexural strength of beam (N/mm2)
1	1	0	0	19.85	3.76	3.73
	2			19.75	3.74	
	3			19.60	3.71	
2	1	10%	0	19.90	3.77	3.76
	2			19.85	3.76	
	3			19.80	3.75	
3	1	20%	0	17.95	3.40	3.35
	2			17.70	3.35	
	3			17.55	3.32	
4	1	30%	0	16.90	3.20	3.15
	2			16.60	3.14	
	3			16.55	3.13	
5	1	0	10%	15.85	3.00	2.98
	2			15.80	2.99	
	3			15.70	2.97	
6	1	0	20%	13.30	2.52	2.48
	2			13.15	2.49	
	3			12.95	2.45	
7	1	0	30%	12.75	2.41	2.40
	2			12.70	2.40	
	3			12.65	2.39	
8	1	10%	10%	13.15	2.49	2.48
	2			13.10	2.48	
	3			13.05	2.47	
9	1	20%	10%	12.95	2.45	2.42
	2			12.80	2.42	
	3			12.75	2.41	
10	1	10%	20%	12.10	2.29	2.27
	2			12.05	2.28	
	3			11.90	2.25	



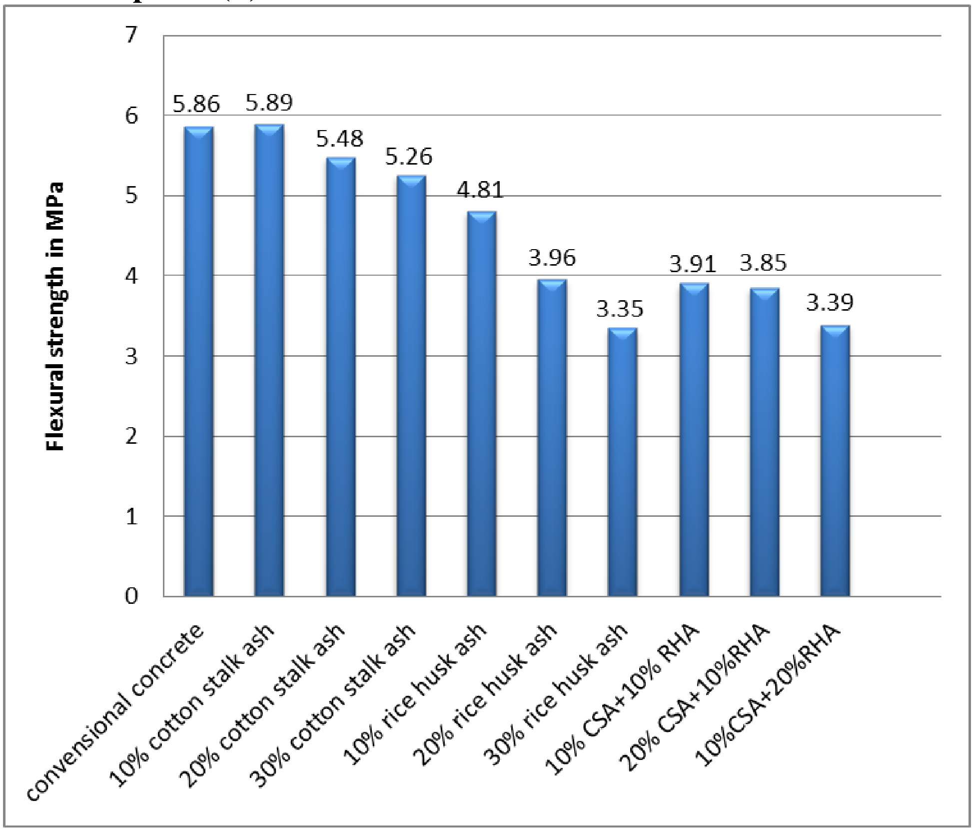
Graph 4.2(a) FLEXURAL STRENGTH FOR 7 DAYS

Table No.- 4.2(b) FLEXURAL STRENGTH FOR THE PERIOD 28 DAYS

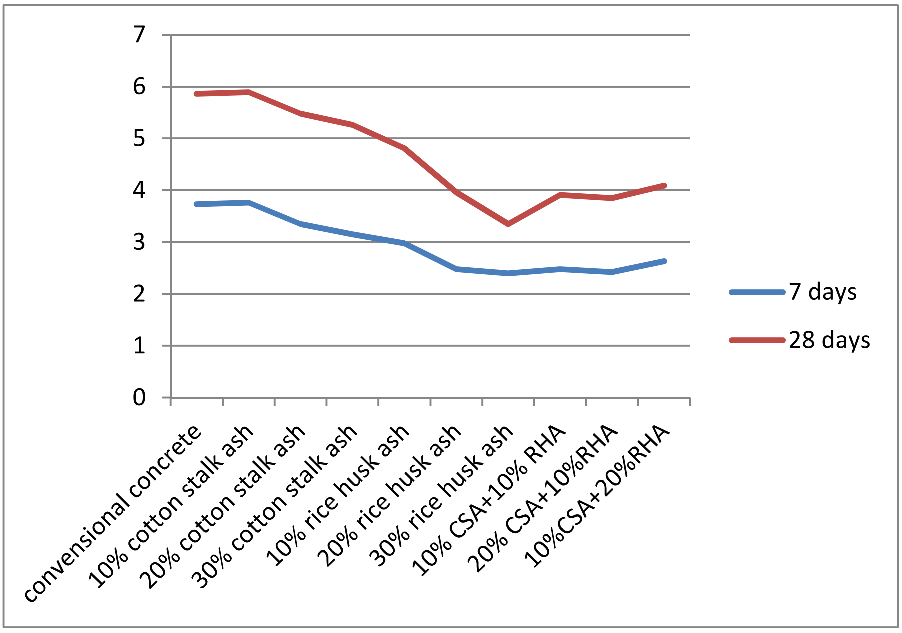
Sr. No.	Sample No.	CSA used (%)	RHA used (%)	Flexural Load (KN)	Flexural strength of beam (N/mm2)	Average flexural strength of beam (N/mm2)
1	1	0	0	31.10	5.90	5.86
	2			30.90	5.85	
	3			30.80	5.84	
2	1	10%	0	31.5	5.97	5.98
	2			30.90	5.85	
	3			30.95	5.86	
3	1	20%	0	29.05	5.50	5.48
	2			28.95	5.48	
	3			28.80	5.46	
4	1	30%	0	27.90	5.29	5.26
	2			27.75	5.26	
	3			27.70	5.25	
5	1	0	10%	25.50	4.83	4.81
	2			25.45	4.82	
	3			25.35	4.80	
6	1	0	20%	20.95	3.97	3.96
	2			20.90	3.96	
	3			20.85	3.95	

7	1	0	30%	17.80	3.37	3.35
	2			17.75	3.36	
	3			17.60	3.33	
8	1	10%	10%	20.75	3.93	3.91
	2			20.70	3.92	
	3			20.60	3.90	
9	1	20%	10%	20.45	3.87	3.85
	2			20.35	3.85	
	3			20.20	3.83	
10	1	10%	20%	18.05	3.42	3.39
	2			17.95	3.40	
	3			17.75	3.36	

Graph 4.2(b) FLEXURAL STRENGTH AFTER 28 DAYS



Graph 4.2 © FLEXRUAL STRENGTH VARIATION AT DIFFERENT AGES

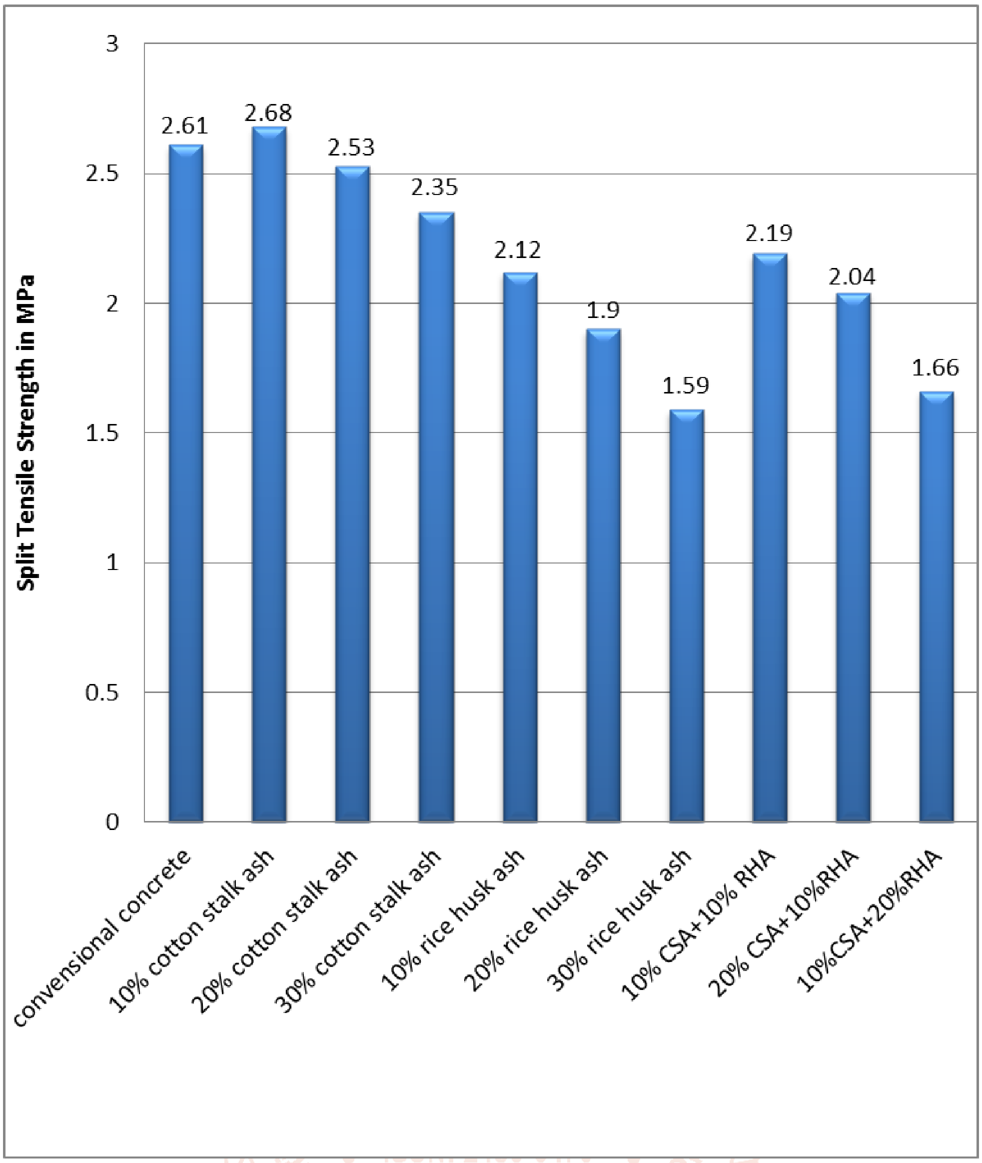


4.2.3 SPLIT TENSILE STRENGTH TEST

The split tensile strength of concrete of with different percentages of CSA, RHA has been shown in Table 4.5 and 4.6 which gives the split tensile strength after period of 7 and 28 days in table no 4.3(a) and 4.3(b) respectively. It was pragmatic that maximum split tensile strength observed was 2.68MPa at 7 days and 4.23MPa at 28 days when cotton stalk ash used at 10% respectively. cotton stalk and rice husk ash were mixed together more, which reduced the cubes' flexural strength. Minimum split tensile strength was 1.66MPa at 7 days and 2.35MPa at 28 days when cotton stalk ash(CSA) and rice husk ash (RHA) were used at 10 and 20% respectively.

Table No.-4.3(a) SPLIT TENSILE STRENGTH AFTER PERIOD OF 7 DAYS

Sr. No.	Sample No.	CSA used (%)	RHA used (%)	Split tensile Load in (KN)	Split tensile strength of specimen (N/mm2)	Average Split tensile strength of specimen (N/mm2)
1	1	0	0	190	2.67	2.61
	2			185	2.61	
	3			180	2.56	
2	1	10%	0	200	2.82	2.68
	2			195	2.75	
	3			175	2.47	
3	1	20%	0	183	2.58	2.53
	2			180	2.54	
	3			176	2.48	
4	1	30%	0	175	2.47	2.35
	2			165	2.33	
	3			160	2.26	
5	1	0	10%	155	2.19	2.12
	2			150	2.12	
	3			145	2.05	
6	1	0	20%	140	1.98	1.90
	2			135	1.90	
	3			130	1.83	
7	1	0	30%	120	1.69	1.59
	2			115	1.62	
	3			105	1.48	
8	1	10%	10%	160	2.26	2.19
	2			155	2.19	
	3			150	2.12	
9	1	20%	10%	147	2.07	2.04
	2			145	2.05	
	3			143	2.02	
10	1	10%	20%	125	1.76	1.66
	2			120	1.69	
	3			110	1.56	

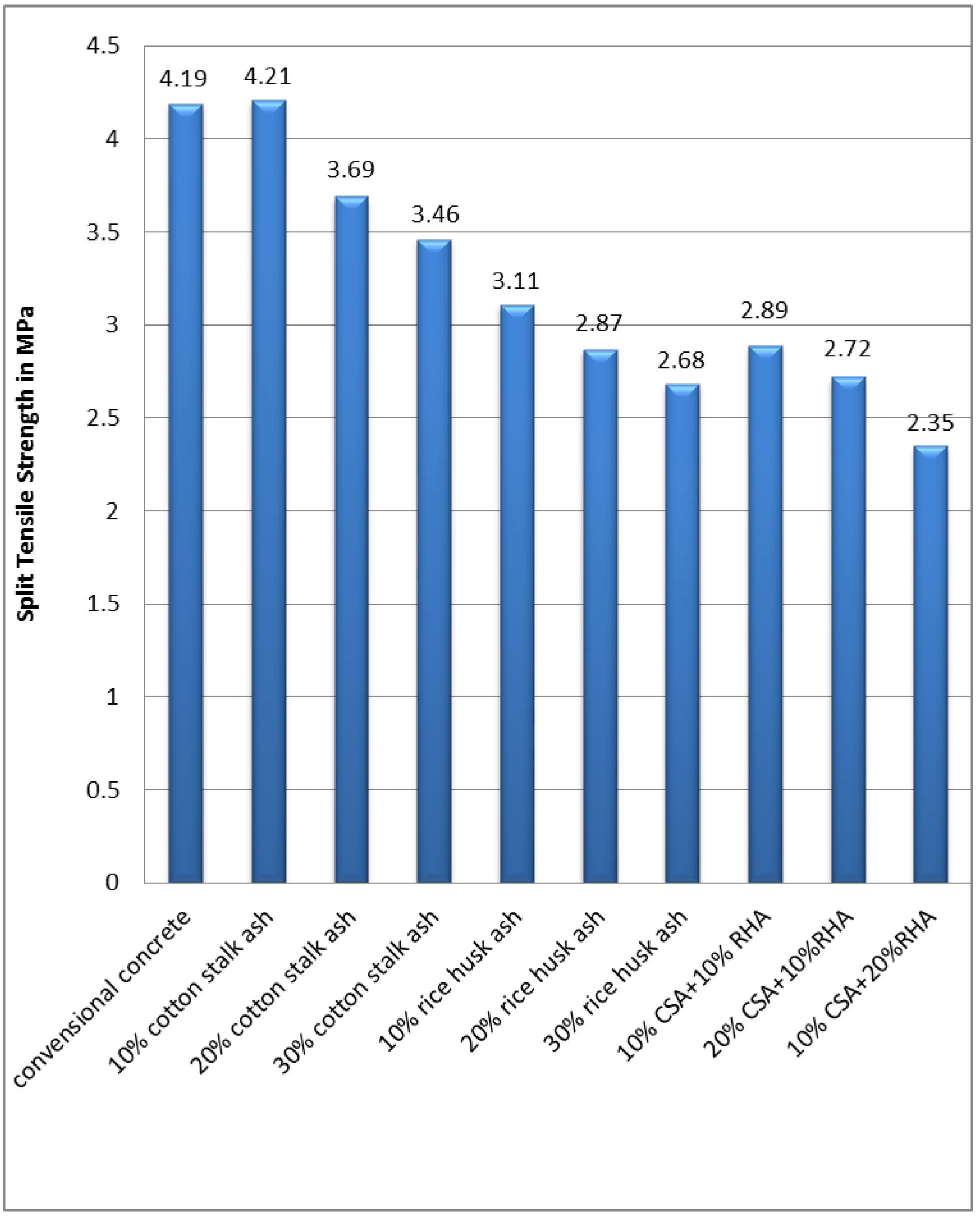


Graph 4.3(a) SPLIT TENSILE STRENGTH VARIATIONS AFTER 7 DAYS

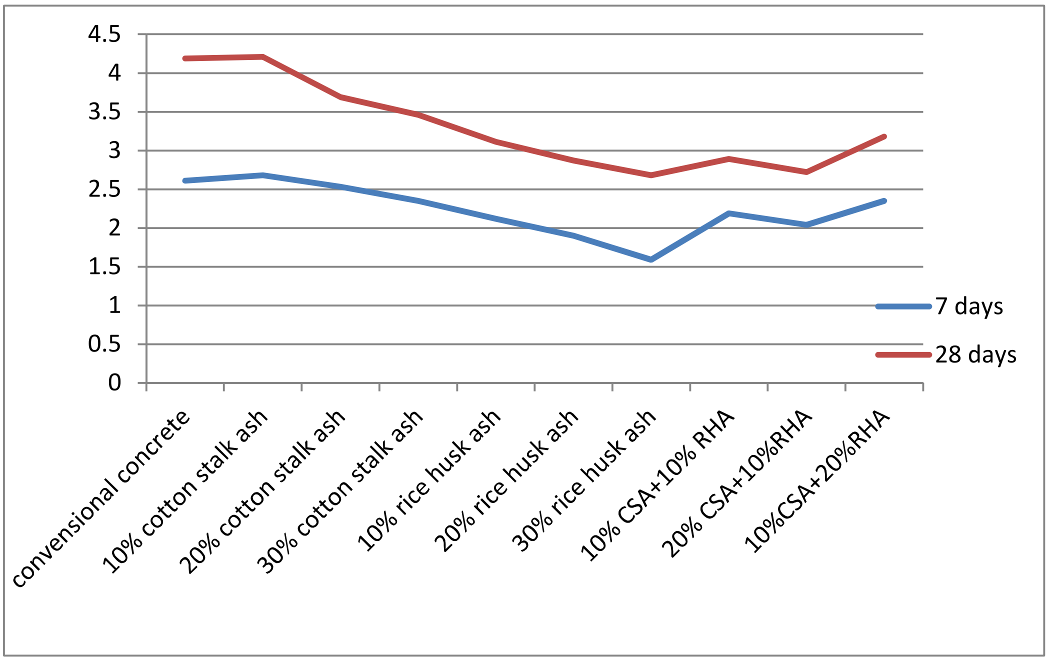
Table No.- 4.3(b) SPLIT TENSILE STRENGTH AFTER PERIOD OF 28 DAYS

Sr. No.	Sample No.	CSA used (%)	RHA used (%)	Split tensile Load (KN)	Split tensile strength of specimen (N/mm2)	Average Split tensile strength of specimen (N/mm2)
1	1	0	0	305	4.31	4.19
	2			295	4.17	
	3			290	4.10	
2	1	10%	0	310	4.38	4.23
	2			295	4.17	
	3			290	4.10	
3	1	20%	0	270	3.81	3.69
	2			260	3.67	
	3			255	3.60	
4	1	30%	0	250	3.53	3.46
	2			245	3.41	
	3			240	3.39	
5	1	0	10%	230	3.25	3.11
	2			220	3.11	
	3			210	2.97	
6	1	0	20%	205	2.90	2.87
	2			203	2.87	
	3			200	2.82	

7	1	0	30%	195	2.75	2.68
	2			190	2.61	
	3			185	2.61	
8	1	10%	10%	210	2.97	2.89
	2			205	2.90	
	3			200	2.82	
9	1	20%	10%	200	2.82	2.72
	2			195	2.75	
	3			185	2.61	
14	1	10%	20%	175	2.47	2.35
	2			170	2.40	
	3			155	2.19	



Graph 4.3(b) SPLIT TENSILE STRENGTH VARIATION AFTER 28 DAY



Graph 4.3© SPLIT TENSILE STRENGTH VARIATIONS AT DIFFERENT AGES

5. Conclusion

An investigational study has been developed and accepted out in the current investigation to demonstrate the impact of cotton stalk ash (CSA) and rice husk ash (RHA) in concrete specimen. The subsequent conclusions are drawn in illumination of the experimental findings of various concrete samples with varying ratios of cotton stalk ash (CSA) and rice husk ash (RHA):

- Rice husk ash (RHA) and cotton stalk ash (CSA) both get more workable concrete as compared to normal concrete.
- Rice husk ash (RHA) was proven to get slightly more the workable concrete then cotton stalk ash (CSA).
- It was revealed that as the amount of rice husk ash (RHA) in concrete increased, so did its workability.
- By substituting cotton stalk ash for 10% of the cement, the highest compressive strength as per this investigation for 28 days is observed 53.67 N/mm2 (CSA).
- The highest achieved flexural strength for the period of 28 days was 5.98 N/mm2 when cotton stalk ash replaced 10% of the cement (CSA).
- The highest split tensile strength for the period of 28 days was 4.23N/mm2 when cotton stalk ash replaced 10% of the cement (CSA).
- By substituting cotton stalk ash, rice husk ash for 20, 10% of the cement, the compressive strength as per this investigations for 28 days is observed 49.47 N/mm2 (CSA,RHA) is not achieved highest value but achieve the target mean strength.

6. References

[1] James E. O. Ovri*, Ovie P. Umukoro, 2015. The Compressive and Flexural Strengths of Self Compacting Concrete Using Rice Husk Ash. International Journal of Advanced Materials Research Vol. 1, No. 3, 2015, pp. 80-85

[2] T. Subramani, K. S. Ramesh, 2015. Experimental Study On Partial Replacement Of Cement With Fly Ash And Complete Replacement Of Sand With M sand. International Journal of Application or Innovation in Engineering & Management (IJAIEM) Volume 4, ISSN 2319 – 4847

[3] Rohit Siwach[a], S. S. Kajal[b], NikitaRajpal[c], 2015. Effect of Fly Ash and Rice Husk Ash on Strength Characterstics of Pavement Quality Concrete. International Journal of Science, Engineering and Technology Research (IJSETR) Volume 4, ISSN: 2278 – 7798

[4] M. Sivakumaz[1], T. Manikandan[2], 2014. An Experimental Study on Strength Development of Concrete Containing Composite Ash (Flay Ash-F & Rice Husk Ash). International Journal of Engineering Research & Technology (IJERT) Vol. 3, ISSN: 2278-0181

[5] Godwin A. Akeke, Maurice E. Ephraim, Akobo, I. Z. S and Joseph O. Ukpata, 2013. Structural Properties of Rice Husk Ash

Concrete. International Journal of Engineering and Applied Sciencesvol 3, ISSN2305-8269

[6] Mohamed Amin Sherif: Effect of neno cotton stalk and palm leaf ashes on ultrahigh-performance concrete properties incorporated recycled concrete aggregate.

[7] Ibrahim saad Agwa: Effects of using rice straw and cotton stalk ashes on the properties of lightweight self-compacting concrete.

[8] Manish s. bawane, review paper on different aspects for management of cotton stalk residue.

[9] http://en.wikepedia.org/wiki/cottonstalkash

[10] www.sciencedirect.com