ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 4(G), pp. 25974-25977, April, 2018

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

STUDY THE COMPRESSIVE STRENGTH OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH BAGASSE ASH AND GLASS POWDER

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DOI: http://dx.doi.org/10.24327/ijrsr.2018.0904.1968

ARTICLE INFO

Article History:

Received 8th January, 2018
Received in revised form 21st February, 2018
Accepted 05th March, 2018
Published online 28th April, 2018

Key Words:

Concrete, Compressive Strength, Bagasse, Glass Powder

ABSTRACT

The Ordinary Portland Cement (OPC) is one of the main ingredients used for the production of concrete. Unfortunately the production of cement involves emission of large amount of carbon dioxide gas into atmosphere , a major contributor for green house effect and the global warming , hence it is inevitable either to search for another material or partially replace it by some other material. The search of any other material which can be used as an alternative for cement should lead to global sustainable development and lowest possible environmental impact. Concrete property can be maintained with advance mineral admixtures such as fly ash or glass powder as partial replacement of cement 0 to 15%. Compressive strength of concrete with different amount of glass powder and bagasse was studied as partial replacement of cement. From the experimental investigations, it has been absorbed that, the optimum replacement of glass powder and bagasse to cement without changing much compressive strength is 10%. Use of glass powder and bagasse in concrete imparts several environmental benefits and thus it is eco-friendly. It saves the cement requirement for the same strength thus saving of raw materials such as lime stone coal etc. required for manufacture of cement. Bagasse is pozolanic material and it improving the properties of concrete like compressive strength and durability.

INTRODUCTION

The interest of the construction industry in using waste or recycled materials in concrete is increasing because of the emphasis placed on sustainable construction. The waste glass from in and around the small and large scale shops and industries is packed as a waste and disposed as landfill. Glass is in an inert material which should be recycled and used many times without changing its chemical property. Besides using waste glass as cullet in the glass manufacturing, waste glass is crushed into specified sizes for use as an aggregate in various applications such as water filtration, grit plastering, sand cover for sport turf and cement or sand replacement in concrete. Also the use of bagasse in concrete imparts several environmental benefits and thus it is eco-friendly. It saves the cement requirement for the same strength thus saving raw materials such as limestone, coal etc. required for the manufacture of cement.

Bagasse is pozzolanic material and improving the properties of concrete like compressive strength and durability.

Compressive strength of concrete with different amount of glass powder and bagasse was studied as partial replacement of cement. From the experimental investigations, it has been absorbed that, the optimum replacement of glass powder and bagasse to cement without changing much compressive strength is 10%. Use of glass powder and bagasse in concrete imparts several environmental benefits and thus it is eco-friendly. It saves the cement requirement for the same strength thus saving of raw materials such as lime stone coal etc. required for manufacture of cement. Bagasse is pozolanic material and it improving the properties of concrete like compressive strength and durability.

LITERATURE REVIEW

Shetty Ashish Vishwanath (May-2017) Utilization of industrial and agricultural waste products in the industry has been the focus of research for economic, environmental, and technical reasons. Sugar cane bagasse is fibrous waste product of sugar refining industry, along with ethanol vapor. This waste product is already causing serious environmental pollution which calls for urgent ways of handling the waste. Since last few years

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tremendous efforts have been made to increase the use of cement replacement materials in concrete productions, because the cement production consumes high energy and is responsible for 5% of global anthropogenic CO emissions (each tone of cement produces about 1 ton of CO) and there use can also improve the properties of concrete. Sugar cane bagasse ash is recently accepted as a pozzolanic material. Study of using bagasse ash, glass powder as pozzolanic material is not well known and its uses are limited and most of the bagasse ash and glass is disposed in the landfills and only a few studies have been reported on the use of bagasse ash and glass powder as a pozzolanic material in respect of the cement paste.

Bouzouboa, 2004at Canmet Canada have done studies on the mechanical properties of concrete made with blended high volume fly ash cements. Physical properties of high volume fly ash cements and mortars had also been studied. The use of the high volume fly ash cements improves the resistance of the concrete to the chloride ion penetration. The present study investigates the potential of fly ash as cement replacement in concrete. The objectives are to reduce the amount of ordinary Portland cement needed in building construction so as to achieve economic construction and sustainable development through the preservation of the environment.

Li Yijin 2009studied that the addition of ultra-fine bagasse to cement paste, mortar and concrete can improve their fluidity, but some coarse bagasse can not reduce water. This paper investigates the effect of fineness and replacement levels of bagasse on the fluidity of cement paste, mortar, and concrete. Three different fineness were chosen and their replacement levels were 20%, 30%, and 40% respectively. The experiment results show that particle size distribution, Zeta potential, density and particle morphologies of bagasse are the major factors affecting their fluidity.

Sarath Chandra Kumar October, 2011 observed that the utilization of bagasse in concrete as partial replacement of cement is gaining immense importance today, mainly on account of the improvement of the long term durability of concrete combined with ecological benefits. Technological improvements in thermal power plants operation and bagasse collection systems have resulted in improving the consistency of bagasse. To study the effect partial replacement of cement by bagasse, studies have been conducted on concrete mixes with 300 to 500 kg/cum cementitious material at 20%, 30%, 40% and 50% replacement level. In their work the effect of bagasse on workability, setting time, density, air content, compressive strength, modulus of elasticity, shrinkage and permeability by Rapid Chloride Permeability Test are studied.

XianyuJin January, 2012 reported the results of experimental study on the effects of mineral admixtures such as silica fumes, slag, bagasse on the mechanical behaviour of young concrete under either uniaxial compression or tension. In their work uniaxial compression and uniaxial tension tests have been conducted on the concrete specimens at ages of ½, 1, 2, 3, 7 and 28 days.

They utilizes the circumferential control and adaptive deformation control and made the complete stress-strain curves for young concrete under either uniaxial compression or uniaxial tension. Their experimental results shows that the different mineral admixtures do have different influences on properties of young concrete also shows the best results on the mechanical properties of young concrete.

Influence of a fine glass powder on the durability characteristics of concrete and its comparison to bagasse; Nathan Schwarz, Hieu Cam, Narayanan Neithalath, Elsevier 2007 according to this paper, a detailed investigation carried out to ascertain the durability characteristics of fine glass powder modified concretes is reported in this paper. Tests were designed to facilitate comparison between concretes modified with either glass powder or bagasse at the same cement replacement level. The optimal replacement level of cement by glass powder is determined from strength and hydration tests as 10%. The later age compressive strengths of glass powder and bagasse modified concretes are seen to differ by only 5%. The durability characteristics are ascertained using tests for rapid chloride permeability, alkali-silica reactivity, and moisture transport parameters. The chloride penetrability values indicate some amount of pore refinement. The potential of glass powder to reduce the expansion due to alkali-silica reaction is established from tests conducted in accordance with ASTM C 1260, but bagasse is found to be perform better at similar replacement levels. Glass powder–bagasse blends that make up a 20% cement replacement level are found to be as efficient as 20% bagasse in reducing expansion. The control concrete is seen to exhibit the lowest overall moisture intake after 14 days of curing, and fly ash concrete the highest, with the glass powder concrete in between. The trend is reversed at later ages, demonstrating that both the replacement materials contribute to improved durability characteristics. The sportivity and moisture diffusion coefficient values calculated from the moisture intake-time data also demonstrate a similar trend. These studies show that fine glass powder has the potential to improve the durability of concretes.

Recycling of waste glass as a partial replacement for fine aggregate in concrete; **Zainab Z. Ismail, Enas A. AL-Hashmi, Elsevier 2008**; According to this paper, waste glass creates serious environmental problems, mainly due to the inconsistency of waste glass streams. With increasing environmental pressure to reduce solid waste and to recycle as much as possible, the concrete industry has adopted a number of methods to achieve this goal. The properties of concretes containing waste glass as fine aggregate were investigated in this study. The strength properties and ASR expansion were analysed in terms of glass content. An overall quantity of 80kg of crushed waste glass was used as a partial replacement for sand at 10%, 15%, and 20% with 900kg of concrete mixes. The results proved 80% Pozzolanic strength activity given by waste glass after 28 days. The flexural strength and compressive strength of specimens with 20% waste glass content were 10.99% and 4.23% respectively, higher than those of the control specimen at 28 days. The mortar bar tests demonstrated that the finely crushed waste glass helped reduce expansion by 60% as compared with the control mix.

METHODOLOGY

- Collection of literature review
- Data collection and Analysis
- Material Collection
- Preliminary Test of Raw materials
- Casting and Curing
- Testing of specimen

Result
Comparing the results

Material Collection

Cement

Ordinary Portland Cement, 43 grade confirming to IS:269-1976. OPC 43 grade was used for casting all the specimens. Different types of cement have different water requirements to produce paste of standard consistence. Different types of cement will also produce concrete having different rates of strength development. The choice of brand and type of cement is most important to produce a good quality of concrete. The type of cement affects the rate of hydration, so that the strengths at early ages can be considerably influenced by the particular cement used. It is also important to insure compatibility of the chemical and mineral admixtures with cement.

Fine AG Regate

Locally available river sand confirming to grading zone II of IS:383-1970. Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm sieve will be used for casting all the specimen.

Coarse Aggregate

Locally available crushed blue granite stones confirming to graded aggregate of nominal size 12.5mm as per IS:383-1970. Crushed granite aggregate with specific gravity of 2.77 and passing through 4.75 mm sieve and will be used for casting all specimen.

Bagasse ASH

It is one of the major crops grown in over 110 countries an its total production is over 1500 millions tons. In India production is over 300 million tons per year, that cause around 10 million tons of bagasse ash as an unutilized and waste material. After the extraction of all economical sugar from, about 40-45% fibrous residue is obtained which is reused in the same industry as fuel in boilers for heat or power generation laving behind 8-10% ash as waste, known as bagasse ash.

Glass Powder

The waste glass from in and around the small and large scale shops and industries is packed as a waste and disposal as landfill. Glass is an inert material which could be recycled and used many times without changing its chemical properties. Besides using waste glass as cullet in glass manufacturing, waste glass is crushed into specified sizes for use as aggregates in various applications such as water filtration, grid plastering, sand cover for sport turf and sand or cement replacement.

Water

Casting and curing of specimens were done with the portable water that is available in labrotries.

Test for Raw Materials

Sieve Analysis for Fine Aggregates

IS Sieve Size	Weight Retained (gm)	Cumulative Wt. Retained (gm)	Cumulative %. Wt. Retained	Cumulative % passing	
10 mm	0	0	0	10	ZONE-III
4.75 mm	0	0	0	100	
2.36 mm	5	5	0.5	99.5	
1.18 mm	24	29	2.9	97.1	
600 micron	368	397	39.7	60.3	
300 micron	381	778	77.8	22.2	
150 micron	167	945	94.5	5.5	
Pan	55	1000	1000	0	

Fineness Modulus of Sand

Fineness Modulus of Fine Aggregate =∑% retained on Sieve Size / 100

= (0.5 + 2.9 + 39.7 + 77.8 + 94.5) / 100

= 2.154

Sieve Analysis for Coarse Aggregates

IS Sieve size	Wt. retained (gm)	Cumulative Wt. retained (gm)	Cumulative %. Wt. retained	Cumulative % Passing.
12.5 mm	0	0	0	100
10 mm	28	28	1.4	98.6
4.75 mm	1768	1796	89.8	10.2
2.36 mm	182	1978	98.9	1.1
1.18 mm	21	2000	100	0

Fineness Modulus of Coarse Aggregates = 2.9

Mix Design

Mix design is the process of selecting suitable ingredient if concrete and determines their relative proportions with the object of certain minimum strength and durability.

Factors to be considered in Mix design:-

- Grade of concrete
- Type of cement
- Type and size of aggregate
- Type of mixing and curing
- Water / cement ratio
- Degree of workability
- Density of concrete
- Air content

Grade	M25
Type of Cement	OPC 53
Maximum size of Aggregate	20 mm
Minimum Cemnet Content	310 Kg/m^3
Maximum Water Cement Ratio	0.45
Workablity	50 – 75 mm (slump)
Exposure Condition	NORMAL
Degree of Supervision	GOOD
Type of aggregate	Angular
Maximum Cement Content (MORT & H CI, 1703.2)	540 kg/ m^3
Chemical Admixture Type	Super Plasticizer

Prepration of CUBE Specimens

Mixing

Mix the concrete either hand or by laboratory batch mixer with correct proportions rules to be followed.

Sampling

- Clean the mounds and apply oil.
- Fill the concrete in the molds in layers approximately 5cm thick
- Compact each layer with no less than 35 strokes per layer using a tamping rod.
- Level the top surface and smoothen it with a trowel.

Curing

The test specimens are stored in moist air for 24 hours and after this period the specimens are marked and removed from the molds and kept submerged in clear fresh water until taken out prior to test.

Test Results of Specimen Cubes

Ratios for special Concrete (extra ingredients):-

***Sample-I:-* (5% replacement of cement)**

Bagasse Ash – 2.5 % replacement with cement
Glass powder – 2.5 % replacement with cement

***Sample-II:-* (10% replacement of cement)**

Bagasse Ash – 5% replacement with cement
Glass powder – 5% replacement with cement

***Sample-III :-* (15% replacement of cement)**

Bagasse Ash – 7.5% replacement with cement
Glass powder – 7.5% replacement with cement

Compressive strength of cube – 7 days

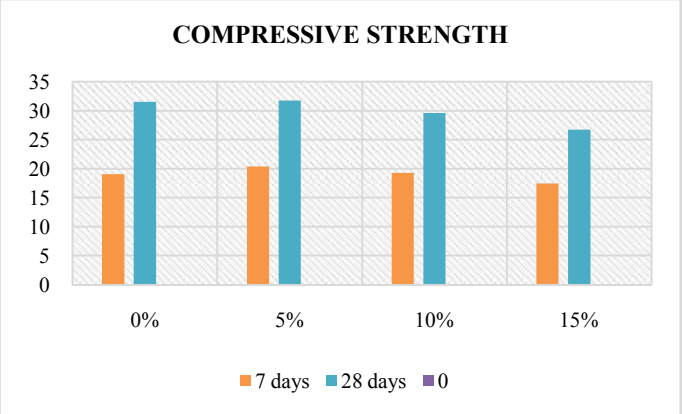
MIX	Compressive Strength (N/mm2) 7 Days			
	0%	5 %	10 %	15 %
M25	19.4	19.6	18.9	17.9
	19.6	20.4	19.1	17.3
	18.2	21.1	19.8	17.1

Compressive strength of cube – 28 days

MIX	Compressive Strength (N/mm2) 28 DAYS			
	0%	5 %	10 %	15 %
M25	32.1	32.0	30.4	26.7
	31.6	31.2	29.3	27.3
	30.9	31.7	29.0	26.1

FINAL RESULT

MIX	M25			
	0 %	5%	10 %	15 %
7 DAYS	19.06	20.37	19.27	17.43
28 DAYS	31.53	31.76	29.6	26.7



CONCLUSION

Concrete property can be maintained with advance mineral admixtures such as bagasse or glass powder as partial replacement of cement 0 to 15%. Compressive strength of concrete with different amount of glass powder and bagasse was studied as partial replacement of cement. From the experimental investigations, it has been absorbed that, the optimum replacement of glass powder and bagasse to cement without changing much compressive strength is 10%.

Use of glass powder and bagasse in concrete imparts several environmental benefits and thus it is eco-friendly. It saves the cement requirement for the same strength thus saving of raw materials such as lime stone coal etc. required for manufacture of cement. Bagasse is pozzolanic material and it improving the properties of concrete like compressive strength and durability**.**

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