Evaluation of Properties of Partially Replaced Aggregate Concrete

K.P MohithGowda, S.Kavitha, M.S Sachin

Abstract*: This paper presents a experimental study considers the effect of recycled plastic waste as partial replacement of coarse aggregate and manufactured sand as partial replacement of fine aggregate strength, durability of concrete are the main parameters for the design of reinforced concrete structures. These are the two requirements for the long term performance of the concrete structures. The characteristics strength of M30 concrete and partially replaced concrete is checked. Both the specimens were immersed in 3% of H2SO4 and NAOH for 30,60,90 days to evaluate decrement in the strength. The modulus of elasticity of concrete is a very important parameter reflecting the ability of concrete to deform elastically. Modulus of elasticity for M30grade concrete and partially replaced concrete is also checked.

***Index Terms*: Cement, M-sand, plastic, water, durability, Stress-Strain relationships**

I.INTRODUCTION

In construction concrete is most used man made material in the world. Normal concrete is a mixture of cement, coarse aggregate and fine aggregate. The main concern is to utilize wastes as aggregates in concrete. Today, top need in the construction business is maintainability. The measure of plastic expended yearly has been becoming relentlessly because of easy to use properties (low thickness, quality, toughness and ease of the materials. The yearly utilization of plastic is expanding step by step and consequently there is an enduring increment in the creation of plastic waste also it is non degradable and it requires transfer emergency in global view point. Likewise during mining of rocks, stone residue is vastly discharged and the transfer of the equivalent is of extraordinary concern.

In the present examination coarse total and fine total is mostly supplanted by plastic and manufactured sand, in this manner furnishing a maintained choice to manage plastic and produced sand.

The auxiliary properties, for example, compression quality, split rigidity, flexural quality, strength and stress strain relationship are contemplated for cement with incomplete substitution of reused plastic and M-sand and similar investigation is made with regular concrete.

Plastic Aggregates

Plastics wastes are collected from the disposal fields and were recycled to get good ones. It was melted at high temperature and the perfect brittleness was obtained. After

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In the aid of design of concrete structure strength and durability are two most important parameters. Need in any of two for example sturdiness and quality may drives the structure unfit for the reason. On the other end the structure isn't solid, yet it has adequate quality, with the maturing the quality of the structure diminishes because of weakening of cement and fortification because of remote particles assault.

Environment plays an vital role whereas choosing sturdy materials for ferroconcrete structures. In coastal region erosion rate is excessively high, in this cases care is to be taken like consumption recompense of fortification, epoxy painting of support, greatest spread to support to maintain a strategic distance from erosion, decent evaluation of cement to be worked, water-bond proportion and utilization of good nature of water for development and thickness of cement must be high.

The substance opposition of the cements was contemplated by compound assault by absorbing them various chemicals. The examples were restored in water for 28 days after that they are expelled from tank. The cubes were cured in 3% H2SO4 and NAOH chemicals and the pH was constant throughout. The compressive strength is determined in intervals of 30,60 and 90 days and contrast the results with regular concrete.

II. PRELIMINARY INVESTIGATION OF MATERIALS AND METHODOLOGY USED FOR PREPARING CONCRETE SPECIMENS

A preliminary investigation was done in detail to find out the properties of the different materials. Tests were conducted as per the standards.

Cement

Ordinary Portland cement of 43 grade confirming to Indian standards code IS 8112:1989 was used in this investigation
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Aggregate

Fine aggregate was used throughout the investigation according to grading zone II as per IS codes. Coarse aggregate of size 0.02m is used for experimentation. Workability of fresh concrete depends on shape and texture.

the melting process the liquid state plastic was cooled to room temperature and it is transferred to moulds of size 100 mm. Then this plastic is cut down to 20mm sized aggregate.

water

The water to be used in the manufacture of concrete blocks shall not be detrimental to its durability.

Table 1.0 Test on materials

Materials	Tests performed
Cement	• Fineness test • Specific gravity
Fine aggregate (Sand and manufactured sand)	• Water absorption • Sieve analysis • Specific gravity
Coarse aggregate (Recycled plastic)	• Water absorption • Impact test • Specific gravity

Table 2.0 Properties of cement

Sl no	Properties	Test value	Limitations
1	Specific gravity	3.15	3.15
2	Fineness of cement	6%	≤10%
3	Initial setting time	35 min	≥30 min
4	Final setting time	320 min	≤ 600 min

Methodology

The calculated weights of cement, sand, coarse totals and water were taken for mixture. The cement and sand are places in large water tight tray and dry mixing is done, the coarse aggregate is then placed and all these ingredients are mixed thoroughly for period of 60 seconds. The calculated quantity of portable water is poured to the dry mix and the rotation is done for the gauge period of not more than 3 min.

Experimental Investigation

accelerated setting time of concrete. The granite waste is the finely powdered dust material obtained from the quarry site in Tamilnadu, India. It is obtained as a waste product during the sawing of the granite pieces. Primarily the work focuses on the study on granite waste. The physical properties of the supplementary cementitious materials are discussed in Table 1.

the concrete workability is determined using slump cone test. The recycled plastic aggregates were soaked in water for 2 hours and then they were removed from water. The outer faces of the substances were dries using clean cloth. The calculated weights of cement, sand, coarse aggregates, crushed recycled plastic and water taken for mixing.

The cement and sand are placed in large water tight tray and dry mixing is done, the coarse aggregate is then placed and all these ingredients are mixed thoroughly for period of 60sec. The required quantity of portable water is poured to the dry things and the hand mixing is done for the gauge period of not more than 3 min. the workability of partially replaced concrete mix is determined using slump cone test. The cube casting is done as per IS 516-1959. Minimum 6 cubes are casted. Cubes should be casted as much as possible after mixing completely. Cubes are cleaned and greased. It is filled in 3 layers with 16 mm dia pole with 30 blows. It is prescribed that last layer amount concrete is filled so that after compaction no solid is overabundance in 3D square/barrel/pillar and just surfaced by trowel. The pouring substances to be filled from bucket is mixed first but no selective filling in cube is allowed. Excess water in cube after filling is not taken out but after some time little bit concrete is added. And levelled. Sample of concrete is collected and filled in cube to whole batch of concrete. The dates are mentioned on the face of specimens after a day of initial or final setting by markers. After 24 hours after filling and remain in shade under wet cloth/wet jute bag, concrete cube are soaked in pond. The casted cubes, cylinders and beams after a day were separated from the supports and were soaked in the tank. The cubes, cylinders and prisms were kept in water for a period of 1 month. After 28 days the samples were tested.

Durability Characteristics

The durability tests were conducted using cubes casted. The casted samples were soaked in fresh water for 28 days and later that the cubes were soaked in Sulphuric acid (H2SO4) and Sodium hydroxide (NAOH). Then cubes soaked in 3% of H2SO4 and NAOH maintaining with constant ph and cubes are tested to find compressive strength in a period of 30, 60, and 90 days. The cubes were casted for normal M30 concrete and for optimum replacement partially replaced concrete and results are compared.

Stress Strain Characteristics

Stress strain test is conducted using cylinders. The cylinders were casted for M30 concrete and as well as for optimum replaced concrete. This cylinders were cured for less than two days of 1 month and after that cylinders are tested under compressive testing machine from that stress strain curve is obtained. From stress-strain graph elastic modulus is elastic modulus is found out.

Table 3.0 Test on cement

Sl no	Properties	Test value	Limitations
1	Specific gravity	3.15	3.15
2	Fineness of cement	6%	≤10%
3	Initial setting time	35 min	≥30 min
4	Final setting time	320 min	≤ 600 min

Table 4.0 Test on Sand

Sl no	Properties	Result
1	Fineness	2.575
2	Water absorption	1.85%
3	Specific gravity	2.6

Table 5.0 Test on Coarse aggregate

Sl no	Tests conducted	Results
1	Water absorption	2.01%
2	Specific gravity	2.7
3	Impact value	15.98%

Table 6.0 Test on Recycled Plastics

Sl no	Tests conducted	Results
1	Water absorption	3.45%
2	Specific gravity	0.96
3	Impact value	0%

Mix Design

Table 7.0 Mix Design

1	Mix to be designed	M30
2	Size of aggregate	20mm
3	Type and maximum size of aggregate	Angular aggregate 20mm and down
4	Target compressive strength of concrete after 28 days curing.	For M30, it is 38.25 N/mm².
5	Type of exposure	M30- mild exposure.
6	Characteristic compressive strength of the concrete after 28 days curing	For M30, it is 30 N/mm²

Results and discussions

Table 8.0 Test on compressive strength

SPECIMEN SL NO	PERCENTAGE REPLACEMENT	LOAD	STRENGTH	AVERAGE STRENGTH
1	0%	844	37.50	38.08
2		873	38.80	
3		853	37.95	
1	10%	628	27.9	28.80
2		667	29.5	
3		650	28.90	
1	20%	776	34.5	35.92
2		805	35.8	
3		843	37.46	
1	30%	608	27.03	25.68
2		570	25.3	
3		557	24.73	

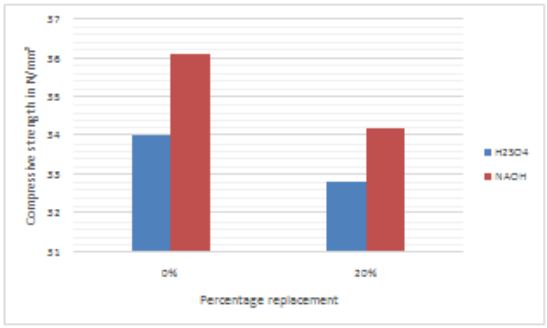
Table 9.0 Test on tensile strength

SPECIMEN SL NO	PERCENTAGE REPLACEMENT	LOAD	STRENGTH	AVERAGE STRENGTH
1	0%	255	3.60	3.88
2		290	4.1	
3		279	3.94	
1	10%	211	2.98	3.33
2		236	3.34	
3		259	3.67	
1	20%	258	3.65	3.70
2		245	3.45	
3		285	4.02	
1	30%	213	3.02	2.90
2		197	2.78	
3		205	2.9	

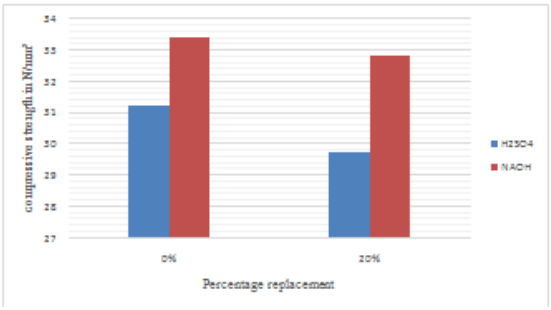
Table 10.0 Test on flexural strength

SPECIMEN SL NO	PERCENTAGE REPLACEMENT	LOAD	STRENGTH	AVERAGE STRENGTH
1	0%	81.4	3.8	3.75
2		78.2	3.65	
3		81	3.78	
1	10%	68.57	3.2	2.98
2		66	3.08	
3		57	2.66	
1	20%	78	3.63	3.57
2		76.7	3.58	
3		75	3.5	
1	30%	62.6	2.92	2.87
2		60	2.78	
3		62.35	2.91	

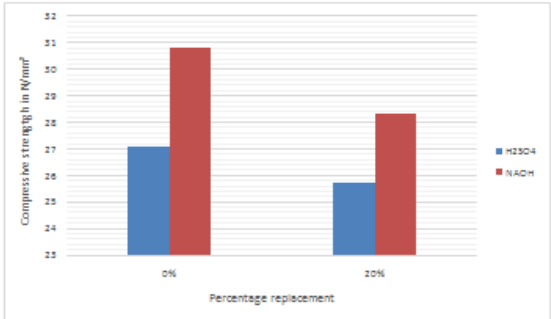
Graph 1.0 Test on Durability



M30 concrete & partially replaced concrete cured in chemicals after 30days



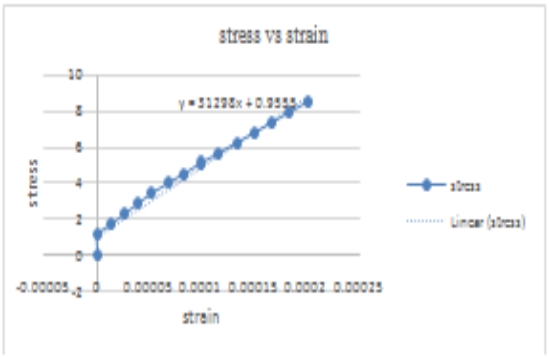
M30 concrete & partially replaced concrete cured in chemicals after 60days



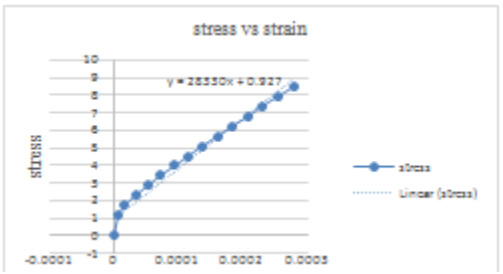
M30 concrete & partially replaced concrete cured in chemicals after 90days

8. The elastic modulus of M30 grade of concrete from stress-strain graph 31092 mpa.

Graph 2.0 Stress Strain Relationship



Graph showing stress strain relationship for M30 concrete



Graph showing stress strain relationship for partially replaced concrete

III. CONCLUSION

1. Since plastic is a waste material and non-biodegradable material, utilization of plastic in concrete is the best method of exposal.
2. Utilization of plastic as incomplete substitution of coarse aggregate in concrete up to 20% replacement has shown not much change in compressive, split tensile and flexural strength compare to conventional concrete for 28 days of curing.
3. Since the availability of natural sand is less now a days. So M-sand is efficiently used by 50%.
4. From the results obtained, 20% replacement of plastic in coarse aggregate and 50% M-sand in fine aggregate partial replacement used for durability and stress-strain study and compare with conventional concrete.
5. Result of M30 concrete and partially replaced concrete after 30 days curing in 3% of chemical, Compressive strength of M30 concrete and partial replaced concrete is 34.02 N/mm2 and 32.756 N/mm2 in H2SO4 and 36.1 N/mm2 and 34.2 N/mm2 in NAOH.
6. Result of M30 concrete and partially replaced concrete after 60 days curing in 3% of chemical, Compressive strength of M30 concrete and partial replaced concrete is 31.23 N/mm2 and 29.658 N/mm2 in H2SO4 and 33.4 N/mm2 and 32.8 N/mm2 in NAOH.
7. Result of M30 concrete and partially replaced concrete after 90 days of curing in 35 of chemical; Compressive strength of M30 concrete and partial replaced concrete is 27.08 N/mm2 and 25.6 N/mm2 in H2SO4 and 30.8 N/mm2 and 28.3 N/mm2 in NAOH.
9. The elastic modulus of partially replaced M30 concrete from graph is 29462 mpa.

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