Utilization of Waste Plastic Bags And Glass Powder In M25 Grade P. C. C.

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Abstract- *Plastic is one of the most widely used man-made material in the world and also one of the key pollutant causing many environment problems and hence it would not be wrong to say that the invention of plastic was a big mistake. The glass powder once used cannot be recycled on a large scale and hence it becomes useless and becomes a kind of burden on the earth. It has been asserted from many researches that an approximately 56 lakhs tones of plastic and on an average about 3 to 7 million of glass powder is generated in India per annum. So this paper focusses on the reuse of plastic and glass powder in concrete as a partial replacement to fine aggregates and cement respectively. The plastic used were a plastic bags which is a LDPE plastic and were used by shredding and the glass obviously was powdered so as to replace cement and the grade of concrete selected was M25 grade concrete. In this research it was found that when the fine aggregates were partially replaced by the Shredded plastic bags at 10% and cement when replaced partially with glass powder at 20%, the considerable increase in strength and workability of concrete was observed making it suitable to be used as a P.C.C.*

Keywords- Shredding, glass powder, Plastic bags, Compressive strength, P.C.C, Fine aggregates,

I. INTRODUCTION

Concrete is one of the most broadly used material nowadays so as to meet on of the basic need of human being i.e. shelter and now which has been inducted into infrastructure as all other components such as roads, bridges , industries and other units of commercial sector which are important along with shelter to form civilization. As the concrete which we regularly use is manufactured mainly from the conventional material and hence it is called as conventional concrete. The rate of use of this conventional concrete is rapidly increasing with increase in civilization and if the civilization progresses with the same rate. The conventional materials will not be enough to fulfill these demand of the future growth and hence there is need to find some alternative even if not possible completely but at least partially. The paper focusses on the utilization of plastic and glass powder as a partial replacement to fine aggregates and cement respectively. The plastic and glass powder were selected as replacement to the conventional concrete material because they are already a kind of burden on the earth and hence has to be extensively reused widely day to day. The plastic was used in the form shredded particles in the form of fine aggregate so as to increase the workability of the concrete being used as a P. C. C. and the glass was used in the form of glass powder as when glass is powder it exhibits pozzolanic properties and as an amorphous material being high in silicium and calcium content cannot be ignored also, when glass is finely ground it even becomes cementitious also on the other hand broken glass waste is unnecessarily occupying the area of open land spaces and hence it has to be utilize some or the other way So we found it suitable to use as concrete material. In this research the plastic replaced F. A. in the increasing percentage of 0%, 2, 4%, 6% 8% & 10% where as glass powder partially replaced the cement in the increasing percentage of 0%, 5%, 10%, 15% &20%. At the every mix so prepared, the behaviour of concrete under compression, flexure and tensile conditions were studied and also its workability was overviewed so as to know the feasibility of the newly formed concrete. If these idea comes in to the practice will make a considerable changes leading to the manufacture of eco-friendly concrete which will ultimately lead to a sustainable environmental development.

II. OBJECTIVES

- To study the mechanical properties of concrete.
- To study the durability properties of concrete.
- To study the workability of concrete
- To study the feasibility of newly formed concrete to be used as a P. C. C.
- To find the alternatives to the conventional concrete material.
- To reduce the waste glass and waste plastic quantities.
- To make an ecofriendly material.

III. CONCRETE CONSTITUENTS

A. Cement:

The cement used was OPC 53 Grade cement. The tests conducted on cement were fineness test, standard

consistency, soundness, and compressive strength and the experimental values observed were 3.5%, 31.5%, 54.3 N/mm2 and 2mm respectively and all were observed within the limits of the Indian Standards.

B. Fine aggregates:

The fine aggregates used were a crushed sand. The size of fine aggregate was 4.75 and below and were confirming to Zone 1, and the test conducted on F. A. were specific gravity, water absorption, and fine modulus and the experimental values observed for the same were 2.8, 0.6% & 2.805 respectively. The procedures carried out for the tests above were as per IS: 2386-1963.

C. Coarse Aggregates:

The coarse aggregates used were of size between 4.75mm to 20mm and were locally available. The test conducted on C. A. were specific gravity, water absorption, and fine modulus and the experimental values observed for the same were 2.74, 0.45% & 3.064 respectively. Along with these tests the Impact value and crushing value of coarse aggregates were also observed as they play an important role in the compressive strength on concrete and were observed to be 1.05% and 8.48% respectively. The procedures carried out for all the tests above were as per IS: 2386-1963.

D. Water:

The water was locally available and it was observed to be colourless and odourless with nill organic impurities.

E. Plastic Shredded aggregates:

The LDPE plastic bags were collected from the locality and were taken to the plastic shredding factories for the purpose of shredding. The size of the shredded plastic aggregates so obtained were 4.75mm and below and had a smooth texture and were nearly about rounded in shape. The melting temperature was observed was 185°C.

F. Glass powder:

The glass powder was collected from the local glass manufacturing factories and the broken glass collected from the locality was crushed under CTM so as to finely powder it as that of cement. The fineness test was conducted on glass powder and the result observed was 8.7%, as it was less than 10% hence found suitable to be used to partially replace the cement.

IV. EXPERIMENTAL WORK

A. Mix Design:

The main aim of mix design is to enable a concrete technologist to design a concrete mix for a particular strength. Mix designed can be defined as The process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete as economically as possible which has a certain minimum properties, notably, strength, workability and durability. The Concrete Mix design calculation procedure is covered in IS 10262: 2019. Here the mix design for M25 Grade Plain Cement concrete was prepared and the mix proportion is 1:2.09:3.35.

Tab. No: 1 Conventional Concrete Mix Proportions

Mix Design	cement	F. A.	C. A.	Water
M25	350 kg	734.16 kg	1172.17 kg	197.16 L

Tab. No: 2 Mix Type With varying % of Plastic and Glass powder

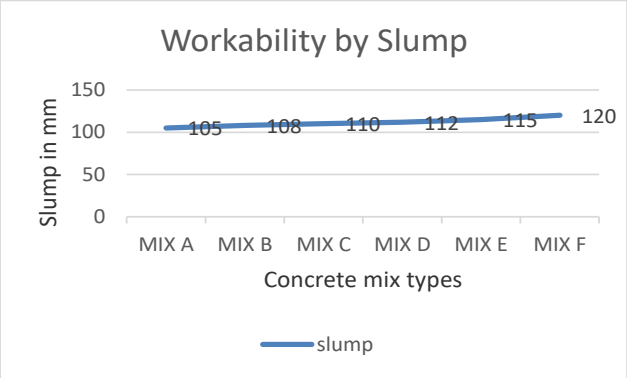
Mix Type	Cement %	F.A %	C.A %	Shredded Plastic Bags (LDPE) %	Glass Powder %
Mix A	100	100	100	0	0
Mix B	100	98	100	2	0
Mix C	95	96	100	4	5
Mix D	90	94	100	6	10
Mix E	85	92	100	8	15
Mix F	80	90	100	10	20

B. Workability:

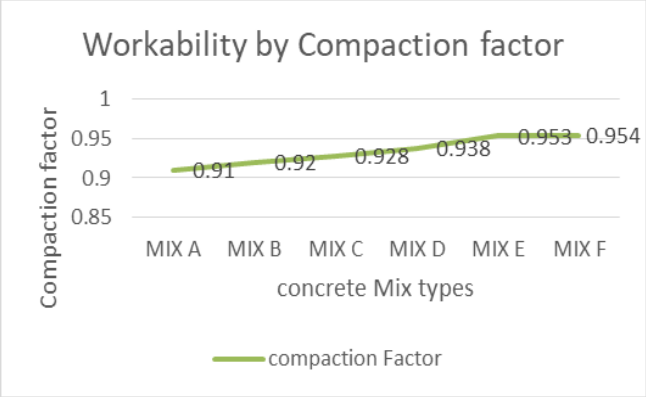
Workability is that property of fresh concrete which determines the ease and homogeneity with which concrete can be mixed, placed, compacted and finished. Here the workability was observed through slump cone test and compaction factor test. The workability test was conducted on concrete on the Mix A, B, C, D, E & F and its was observed that the workability of the concrete was increasing with increase in percentage of glass powder and shredded plastic in a concrete and it was obvious as both Glass powder and plastic has a Smooth surface.

Tab. No: 3 Workability results

Mix Type	*% Shredded Plastic*	*% Glass Powder*	*Slump*	Compaction Factor
Mix A	0	0	105	0.91
Mix B	2	0	108	0.92
Mix C	4	5	110	0.928
Mix D	6	10	112	0.938
Mix E	8	15	115	0.953
Mix F	10	20	120	0.954



Graph. No: 1 Workability by slump cone test



Graph. No: 2 Workability by compaction Factor

Photo. No: 1 Checking Workability of concrete

C. Compression Test:

In this test the concrete cubes prepared were of standard size 150 × 150× 150 mm.These cubes where tested at 3rd, 7th& 28th day under UTM to know the compressive strength of designed concrete for various mix such as Mix A, Mix B, Mix C, Mix D, Mix E & Mix F.

The compression Strength is calculated by the formula:

$$F_c = P_c / A.$$

Where,

F_c = Compressive strength.
P_c = Load at failure in KN.
A = Area under compression mm^2.

Photo. No: 2 Compressive Strength Test

Photo No: 3 casting of cubes

Tab. No: 4.a. 3 Days Compressive Strength

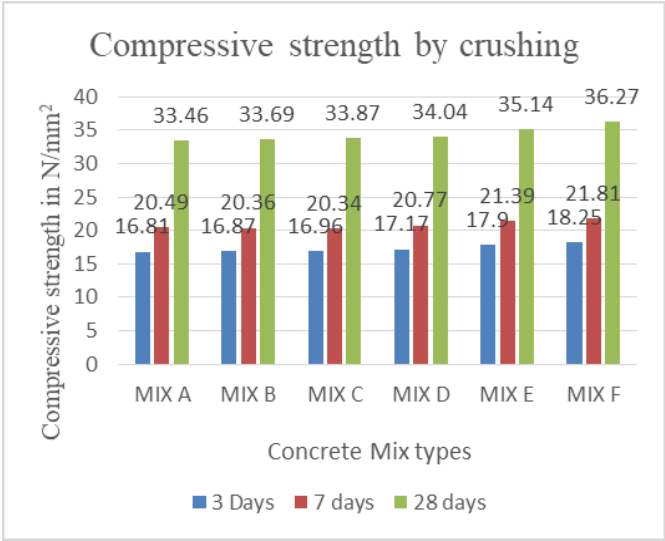
Sr. No.	% shredded plastic	% Glass powder	Load (KN)	Compressive Strength (N/mm²)	Avg.
1.	0	0	392	17.42	16.81
2.			370	16.44	
3.			373	16.57	
4.	2	0	394	17.51	16.87
5.			378	16.80	
6.			367	16.31	
7.	4	5	388	17.24	16.96
8.			385	17.11	
9.			372	16.53	
10	6	10	376	16.71	17.17
11			390	17.33	
12.			393	17.47	
13	8	15	402	17.87	17.90
14.			400	17.78	
15			406	18.04	
16.	10	20	411	18.27	18.25
17.			405	18	
18.			416	18.49	

Tab. No: 4.b. 7 Days Compressive Strength:

Sr. No.	% shredded plastic	% Glass powder	Load (KN)	Compressive Strength (N/mm²)	Avg.
1.	0	0	478	21.24	20.49
2.			450	20	
3.			455	20.22	
4.	2	0	479	21.29	20.36
5.			455	20.22	
6.			440	19.56	
7.	4	5	466	20.71	20.34
8.			461	20.49	
9.			446	19.82	
10	6	10	456	20.27	20.77
11			476	21.16	
12.			470	20.89	
13	8	15	480	21.33	21.39
14.			478	21.24	
15			486	21.6	
16.	10	20	491	21.82	21.81
17.			484	21.51	
18.			497	22.09	

Tab.No: 4.c. 28 Days Compressive Strength

Sr. No.	% shredded plastic	% Glass powder	Load (KN)	Compressive Strength (N/mm²)	Avg.
1.	0	0	783	34.8	33.46
2.			738	32.8	
3.			745	33.1	
4.	2	0	785	34.49	33.69
5.			757	32.55	
6.			732	33.64	
7.	4	5	776	34.48	33.87
8.			768	34.1	
9.			743	33.02	
10	6	10	748	33.24	34.04
11			780	34.67	
12.			770	34.22	
13	8	15	788	35.02	35.14
14.			763	34.93	
15			798	35.47	
16.	10	20	806	35.82	36.27
17.			795	35.33	
18.			847	37.64	



Graph. No: 3 Compressive Strength for 3, 7 & 28 days

D. Flexural Test:

In this test the concrete beams prepared were of standard size 100 × 100 × 500 mm. These beams where tested at 28th day under UTM to know the flexural strength of designed concrete for various mix such as Mix A, Mix B, Mix C, Mix D, Mix E & Mix F. The load at the failure is noted. The test is carried out as per the IS: 516-1959. The flexural Strength is calculated by the formula: $F_f = P_f \times L / b \times d^2$

Where,

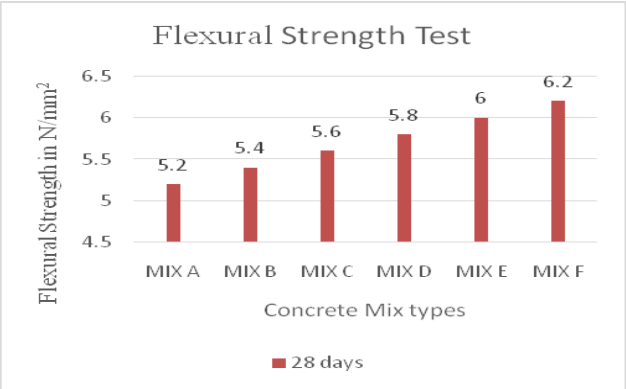
F_f = Flexural Strength.
P_f = Load at Failure.
L = Length of specimen.

b = width of specimen
d = depth of specimen

Photo. No: 4 Compaction of cubes using table vibrator

Tab. No: 5. 28 Days Flexural Strength

Sr. No.	% shredded plastic	% Glass powder	Load (KN)	Flexural Strength (N/mm²)	Avg.
1.	0	0	13.5	5.4	5.2
2.			12.5	5	
3.			13	5.2	
4.	2	0	13.5	5.4	5.4
5.			13	5.2	
6.			14	5.6	
7.	4	5	13.5	5.4	5.6
8.			14.5	5.8	
9.			14	5.6	
10	6	10	14.5	5.8	5.8
11			15	6	
12.			14	5.6	
13	8	15	14.5	5.8	6
14.			15.5	6.2	
15			15	6	
16.	10	20	16	6.4	6.2
17.			15	6	
18.			15.5	6.2	



Graph. No: 4 Flexural Strength for 28 Days

E. Split Tensile test:

In this test the cylindrical specimen of diameter 150mm and 300 mm long is placed under the CTM and over the plywood of size 85 × 95 × 300 mm and the load is applied gradually to know the flexural strength of designed concrete for various mix such as Mix A, Mix B, Mix C, Mix D, Mix E & Mix F. The load at the failure is noted. The test is carried out as per the IS: 516-1959.

Split tensile Strength is calculated by the formula*:*

$F_t = 2P_t / \pi DL$

Where,

F_t = Split tensile Strength.

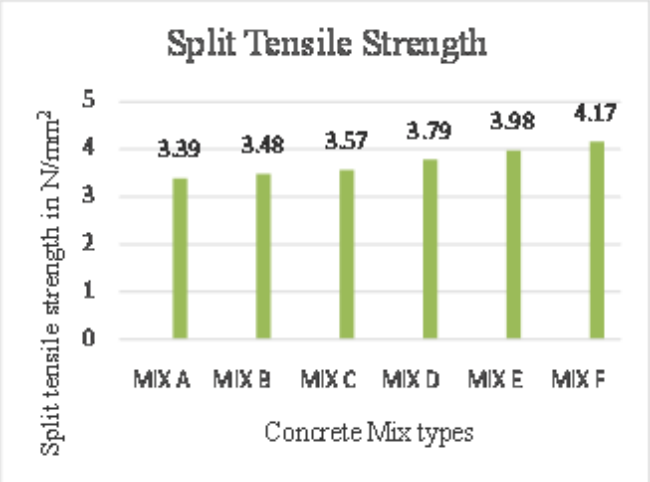
P_t = Load at Failure

D = Diameter of cylindrical specimen

L = length of specimen

Tab. No: 6. 28 Days Split Tensile strength

Sr. No.	% shredded plastic	% Glass powder	Load (KN)	Split Tensile Strength (N/mm²)	Avg.
1.	0	0	238	3.36	3.39
2.			239	3.38	
3.			242	3.42	
4.	2	0	245	3.46	3.48
5.			246	3.48	
6.			247	3.49	
7.	4	5	252	3.56	3.57
8.			253	3.57	
9.			254	3.59	
10	6	10	266	3.76	3.79
11			269	3.81	
12.			268	3.8	
13	8	15	280	3.96	3.98
14.			283	4	
15			281	3.98	
16.	10	20	294	4.15	4.17
17.			296	4.18	
18.			267	4.2	



Graph. No: 5 Split tensile Strength for 28 Days

V. CONCLUSION

The idea of using waste plastic along with waste glass powder for partially replacing the fine aggregates and cement respectively is relatively new. The utilization of waste plastic and glass powder in production of plain cement concrete is a productive way of disposal of waste plastic and waste glass. The laboratory test which have been conducted on on the concrete of various mix proportion in which plastic shredded bags replaced the fine aggregates at the percentage of 0%, 2, 4%, 6% 8% & 10% & where as glass powder partially replaced the cement in the increasing percentage of 0%, 0%, 5%, 10%, 15% &20% have shown satisfactory and positive results. The Mix F has shown the most satisfactory result in which Plastic shredded bags and glass powder have replaced fine aggregates and cement by 10% and 20% respectively, have given the highest Compressive strength and workability which mostly govern the feasibility of concrete in any construction activity and they were 36.27 N/ mm^2 and 120 mm respectively. Also the Flexural and split tensile strength for the same mix were 6.2 N/mm^2 and 4.17 N/mm^2 respectively. It was also concluded that the strength and workability of concrete was increasing with increase in rate of percentage of plastic and glass in concrete. The increase in the workability of concrete was found to be usual as the glass powder and shredded plastic aggregates both were of smooth surface texture and hence it is concluded that with rough surface textured aggregates the workability of the concrete can be controlled. In future there is a scope to use plastic as a binding agent along with the glass powder in the form of molten slurry to replace the cement.

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