ISSN: 2278-4632
Vol-10 Issue-5 No. 10 May 2020

To increase the strength and minimizing the cost of concrete by waste material

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Abstract:

This study deals with the problem of the generated waste from the fields of construction, such as plastic, glass, demolished concrete and was to investigation such waste use in the concrete to replace sand.

Such materials can be used as the recycled materials but recycled material needs to high energy to recycled. such recycling process helps conserve the natural resources. Apart from them these all material can used in concrete. Crushed concrete was used about 25% of coarse aggregate by mass while plastics, demolition waste and glass were used to replace up to 25% of fine aggregate by mass in mixture of concrete. these tests included compressive strength, tensile strength, workability.it is concluded that such experimental concrete mixes can be used to minimize the energy, cost as well as environmental problems.

Keywords: *- Crushed glass, Plastic, Crushed concrete, Workability, Compressive and tensile strength, Durability.*

1.INTRODUCTION

Concrete is the mouldable material which consists of cement, sand and aggregate. Concrete plays vital role in any construction as well as for any infrastructure. About 2.7 billion m^3 of the concrete was generated in 2002.concrete used as the binder materials between the construction units when the cement is reacts with the water.

Glass and plastic are the type of the non-decaying waste material. Non decaying materials cannot break or decayed by any living organism that by it produces harmful effects to the environment. Plastic produces high amount of environmental issues. Plastic are made from polymerisation or polycondensation process. Plastic are obtained from crude oil, natural gas, cellulose, coal and salt. Glass is contrived from the natural sand. Plastic is lighter than the glass. Crushed concrete is made from the asphalt debris.

The problems of generation of waste exists worldwide, specially highly dense population areas. For the mean of this paper, data was obtained from the Sanganer to study the amount of generated waste. There was 90% of the total waste of 1560.9 tons/year is fall under category of construction of building waste of which 89% is dumped and about 35%of this waste made of glass, concrete and plastic. So that's by recycling of waste is mandatory.

High amount of the generated waste cannot be terminated. However, the environmental impact can be less by using proper use of this waste. This process is called "waste hierarchy". This motive is to reduce, reuse and recycle of generates waste.

2. OBJECTIVE OF PAPER

- The objective of the paper is to use the generated from construction field and industry.

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- The waste which is used is plastic, glass and crushed aggregate.
- The use of these waste will reduce the solid waste in the society and decrease the harmful effects on environment.
- To identify the effects of these materials on OPC various tests were conducted like as unit weight, workability, compressive strength, tensile strength, flexural strength etc.

3. EXPERIMENTAL PROGRAM

3.1 Cement

The 53 grade of the cement was used in the casting of the cubes. In this 53-grade concrete 53 indicates the standard compressive strength (53N/mm2) of the cement which attained within the 28 days. The strength of the cement increased by the 50% (53N/mm2) in 7 days, increased by 65% (53N/mm2) in 14 days, increased by 99.99% (almost 53N/mm2) in 28 days. This grade of the cement is generally used in the prestressed work and R.C.C. works of higher grades.

Fig 1: - Cement

Table 1: Physical properties of 53 grade of OPC

S.No	Property	Test Value	Requirements as per IS: 12269 - 1987
1	Fineness of cement	4.52	10% (should not be more than)
2	Specific gravity	2.99	3.15
3	Normal consistency	33%	-
4	Setting time		
	Initial setting time	40 minutes	30 minutes (should not be less than)
	Final setting time	6 hours	600 minutes (should not be greater than)
5	Compressive strength at		
	3 days	34 N/mm^2	27 N/mm^2 (min)
	7 days	44.8 N/mm^2	37 N/mm^2 (min)
	28 days	59 N/mm^2	53 N/mm^2 (min)

3.2 Coarse aggregate

Coarse aggregate are those particles which size is greater than the 4.75mm. It used for the inner filler material in the mixture concrete. Coarse aggregate used in the railway tracks, concrete etc. The test was conducted on the 20mm and 10mm size of the aggregate after the passing from the sieve.

Fig 2: - Coarse aggregate

Coarse aggregate usually consists of slag, gravel or pebbles, and remaining coarse particles.
The aggregate size was conducted through the sieve analysis. To find the fineness modulus from the sieve analysis sieves arranged in following serial: - 80mm, 40mm, 20mm, 10mm, 4.75mm, 2.36mm, 1.18mm, 0.6mm, 0.3mm and 0.15mm.

Table 2: - coarse aggregate properties

Properties	value
Density (compacted in kg/cum)	1830

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Fineness modulus	7.53
Specific gravity	2.78
Water absorption (%)	1.60
Surface moisture	Nil

Water absorption ratio(WAR)	1%
Void ratio(VR)	0.568

3.3 Fine aggregate

Fine aggregate are those particles are retained on the 0.075mm sieve and pass through the 4.75mm sieve. This aggregate basically includes crushed stones, sand or crushed slag screenings. This type of aggregate is used in construct the structural members, concrete slabs and where smooth surface is desirable.

Fig 3: - Fine aggregate

The aggregate size was conducted through the sieve analysis. To find the fineness modulus from the sieve analysis sieves arranged in following serial: - 4.75mm, 2.36mm, 1.18mm, 0.6mm, 0.3mm and 0.15mm.

Table 3: - fine aggregate properties

Properties	value
Fineness modulus(FM)	3.24
Specific gravity(S.G)	2.66
Size	Passing through 4.75m sieve

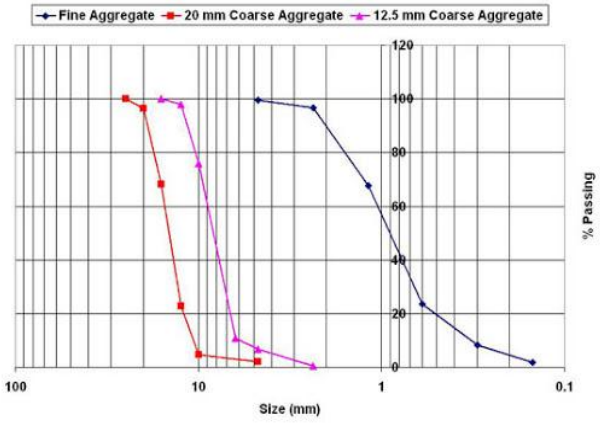

Fig 4: - Coarse and fine aggregate Properties

3.4 Crushed glass

Crushed glass sand can be used as a backfill for foundations, trenches and pipes as well as used in mixing concrete, production of insulation materials, road surfaces.

Table 4: Crushed glass properties

Properties	Value
Density	125kg/m3
Crushed strength	1.72MPa
Softening temperature	600 °C
Colour	White

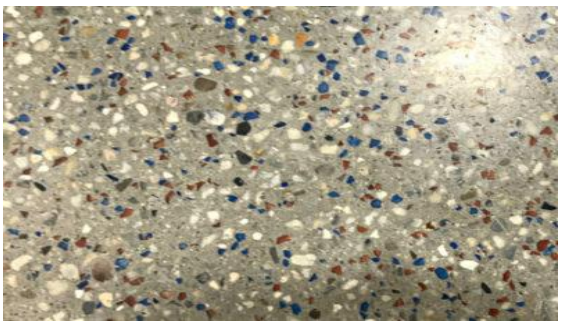

Fig 5: - Crushed glass in polished concrete

3.5 Plastic

Plastic consists from the synthetic or semi-synthetic organic compounds. Plastic is a malleable material and can moulded into any shape. Plastic is made from polycondensation or polymerisation process.

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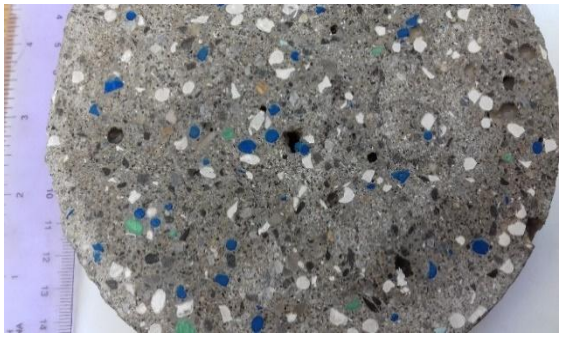

Fig 6: -Plastic mix with concrete

3.6 Crushed concrete

Crushed concrete also called recycled crushed concrete. it is the eco-friendly material which can be used with the mixture of concrete.

Fig 7: - Crushed aggregate

4. METHODOLOGY

1. Locally available material was used in the mixture of the concrete. From the fine aggregate, crushed limestone and natural sand, the coarse aggregate was taken. Temperature of the water was the room temperature.
2. The cement, fine aggregate, coarse aggregate, water, was used to produce the concrete of sufficient strength and workability.
3. Waste particle was grinded into small fragments which was within the limit of fine aggregate gradation.
4. Plastic, glass and crushed concrete was substitute from 0-20%, each applied as individually at different times.

4.1 Plastic as the replacement for sand

Plastic have high molecular weight. plastic waste is reused in this study by means of crushing. Small particle size of plastic was used. Fig 4 shows the graph between the plastic, sand, and crushed glass as well as grain size distribution. This curve also mentioned fine aggregate (sand) gradation for the mixture of the concrete according to the BS882:1992. These used particles gradation comes within the fine aggregate defined limits of gradation.

Slump test and unit weight test were done just after the mixing of the concrete. strength test was performed after continuous curing of 20 days.

Size of the cube was 10*10*10 cm and for the beam 10*10*40 cm & 15 cm diameter and 30 cm height of cylinder were prepared from each mix of concrete. Below table shows proportions:-

Plastic (%)	Mix proportion (kg/m^3 of concrete)					Nominal w/c ratio	Slump (mm)	Unit weight (kg/m^3)
	Water	Cement	C.A.	F.A.	Plastic			
0	250	445	962	585	0.0	0.56	78	2320
5	250	445	962	555.7	17.8	0.56	73	2307
10	250	445	962	526.5	35.5	0.56	69	2856
15	250	445	962	497.2	53.2	0.56	63	2693
20	250	445	962	468.0	71.0	0.56	57	2495

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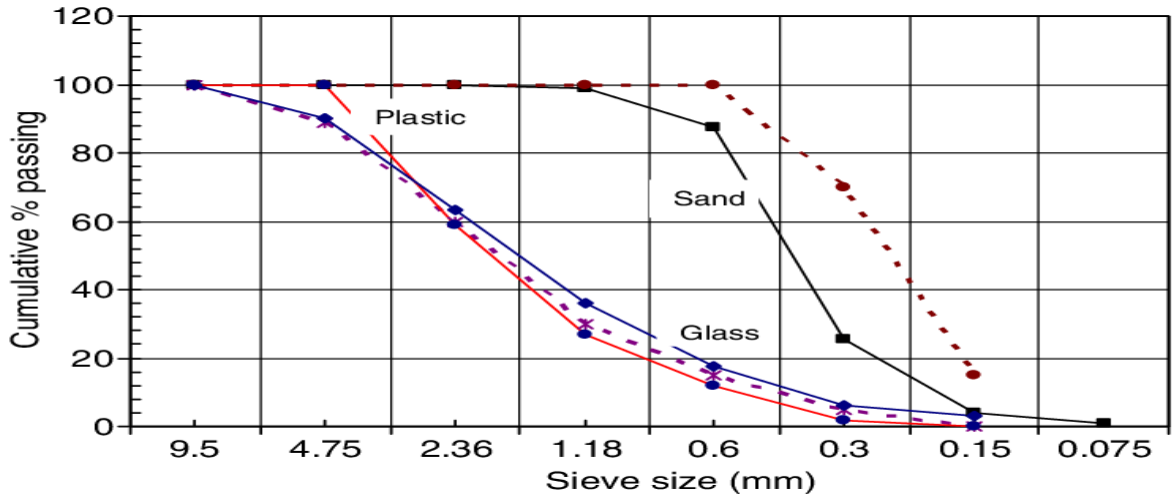

Fig. 8: -Curve for used particles of plastic, sand and crushed glass

4.2 Sand is partially substitute by the crushed glass

The waste glass was crushed manually in the laboratory. After crushed process glass was passed by sieve. Gradation curve is between used glass and compressive strength. According to the BS882:1992 standard the limits is predefined of the using proportion of mixture of the concrete**.** Below table shows proportions:-

Plastic (%)	Mix proportion (kg/m^3 of concrete)					Nominal w/c ratio	Slump (mm)	Unit weight (kg/m^3)
	Water	Cement	C.A.	F.A.	Glass			
0	250	445	962	585	0.0	0.56	76.3	2305.6
5	250	445	962	585	27.44	0..56	75.3	2301.0
10	250	445	962	585	54.9	0.56	74.6	2302.2
15	250	445	962	585	82.3	0.56	73	2289.3
20	250	445	962	585	109.8	0.56	72.7	22863

4.3 Sand is partially substitute by the crushed concrete

During the modernization of the building. Crushed concrete was used up to 20% (mass ratio) of the partial replacement of the sand. The crushed concrete was produced by the crushing the old and used concrete blocks. Crushed concrete was screened by the using proper sieve sizes. This sieved crushed concrete acts as the natural aggregate in the concrete mixture. After crushing the tests were performed on the crushed concrete. slump and unit weight result were obtained from the laboratory tests. Below table shows proportions:-

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Plastic (%)	Mix proportion (kg/m^3 of finished concrete)					Nominal w/c ratio	Slump (mm)	Unit weight (kg/m^3)
	Water	Cement	C.A.	F.A.	Crushed concrete			
0	250	445	962	585	0.0	0.56	75	2273
5	250	445	962	585	48.05	0.56	65	2311
10	250	445	962	585	96.1	0.56	52	2296
15	250	445	962	585	144.15	0.56	45	2311
20	250	445	962	585	192.2	0.56	41	2315

5. RESULTS & ANALYSIS

5.1 Effect on Slump

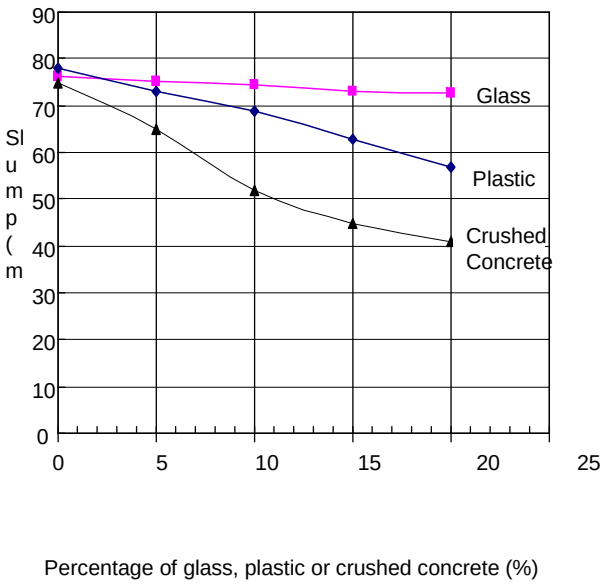

Fig. 9. Graph between slump and percentage of different wastes

Fig. 9 indicates that when increase the plastic percentage slump was decrease. When replacing 20% plastic slump get reduced by 25% of the original value. The age of the plastic particle was sharper than the fine aggregate that was the reason for the decrease in slump value.

Slump was 57mm when plastic content was 20% so this was acceptable and mix can be considered as workable.

Slump value was not affected by the crushed glass.

For crushed aggregate the value of the slump reduced when increase in the amount

of the crushed aggregate. Slump value was reduced because the absorption of crushed aggregate was more than coarse aggregate. To overcome this effect superplasticizer should be used.

5.2 Effect on Strength

5.2.1 Effect of plastic on strength

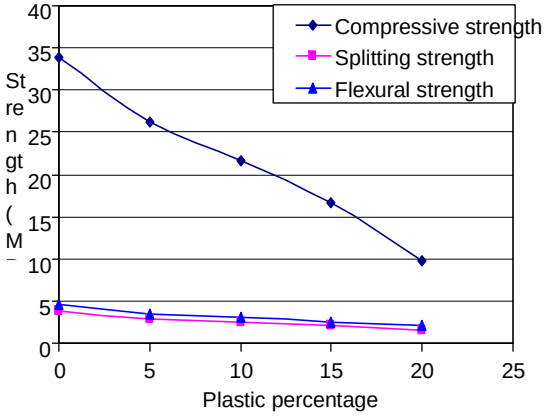

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Fig. 10. Relationship between the strength and percentage of plastic content.

Fig. 10 indicates that strength was decrease when increase in the percentage of the plastic. When plastic was added 20% compressive strength reduced was reduced by 72% of original value. For 5% plastic it was reduced by 23%. The strength was reduced because plastic strength was less than aggregate.

5.2.2 Effect of Glass on Strength

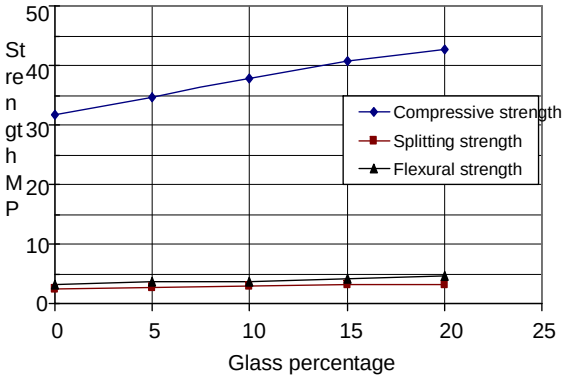

Fig. 11. Graph between strength and % of crushed glass.

Fig. 11 Indicates that all type of strength was increased in higher amount. The increased in the strength was maximum for 20% replacement of crushed glass.

5.2.3. Effect of Crushed Aggregate on Strength

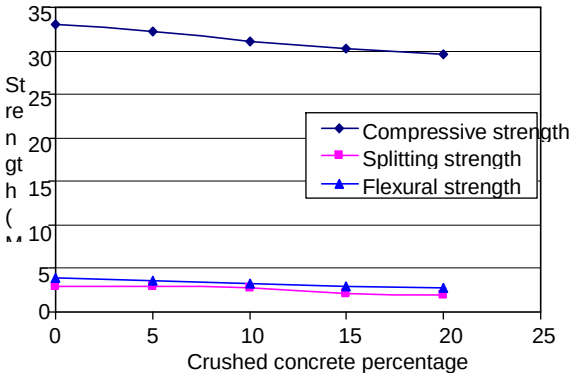

Fig. 12. Graph between the strength and % of crushed concrete aggregates.

Fig. 12 Indicates that reduction in the all strength as normal concrete. For 20% replacement of crushed aggregate was reduced by 13% which was acceptable.

6. CONCLUSION

The tests were carried out to analyse the effect of waste such as concrete waste plastic and glass on concrete mix. These tests help to understand the use of the waste material into construction field.

1. Crushed concrete increase the cement and water and reduced workability due to its irregular shape.

2. Concrete strength was increased with the addition of the crushed glass aggregate but it was affecting the durability due to presence of the alkali content.

3. Replacement of the crushed glass was not affecting the slump of the concrete mix but replacement of the plastic and the crushed concrete reduced the slump.

4. When replacing the plastic and the crushed concrete by 20% the strength of the concrete mix was less than the normal. So, this type of concrete should be used where low strength is required in the construction.

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