Utilization of Different Waste in Concrete

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Abstract— The measure of waste glass has step by step expanded over the late years because of a perpetually developing utilization of glass items. The vast majority of the waste glasses are being dumped into landfill locales. The area filling of waste glasses is undesirable on the grounds that they are not biodegradable, which makes them ecologically less neighborly. There is gigantic potential for utilizing waste glass as a part of the solid development segment. Then again, with characteristic sand stores the world over becoming scarce, there is an intense requirement for an item that matches the properties of regular sand in cement. In the most recent 15 years, it has turned out to be clear that the accessibility of good quality regular sand is diminishing. Ecological concerns are likewise being raised against uncontrolled extraction of normal sand. The contentions are for the most part with respect to securing riverbeds against disintegration and the significance of having normal sand as a channel for ground when waste glasses are reused in making solid items, the creation expense of solid will descend. Waste glass powder can display attributes like that of sand. In these research project properties of concrete is evolved using Fly Ash, Recycled concrete aggregate, Glass Powder and Crumb rubber. This project is divided into two parts i.e. Research Program 1: This Program consists concrete containing Fly Ash, Glass powder and Recycle Aggregate. Here cement is partially replaced by 30% Fly Ash, Coarse Aggregate is partially Replaced by 40% Recycled Concrete aggregate and Glass Powder partially replaced Fine aggregate with varying percentage from 15% to 25% at interval of 5%, and Research Program 2: This Program consists concrete containing Fly Ash, Glass powder and Recycle Aggregate. Here cement is partially replaced by 30% Fly Ash, Coarse Aggregate is partially Replaced by 40% Recycled Concrete aggregate and crumb rubber partially replaced Fine aggregate with varying percentage from 5% to 10% at interval of 2-3%.

Key words: Fly Ash, Recycled Concrete Aggregate, Glass Powder, Crumb Rubber, Compressive Strength, Workability

I. INTRODUCTION

There has been alarming rate of increase in the price of building materials in the recent past. This has necessitated government, private and individuals to go in research for locally sourced materials to supplement (replace-fully or partially) the conventional materials. The increasing demand for cement and concrete is met by the partial replacement of cement. The whole concept of this idea is to ensure that an average working class citizen of India will be able to own a house. Concrete is a composite material which consists eccentrically of a binding medium. Concrete is no longer made of aggregate Portland cement and water only. Often but not always it has to incorporate at least one of the additional ingredients such as admixture or cementitious material to enhance its strength and durability. Within which are embedded particles or fragments of relative inert filler in Portland cement concrete, here binding material is Portland cement. The filler material may be any of a wide range variety of natural or artificial i.e. Fine and coarse aggregate; and in some instances an admixture. Concrete is presently one of the most popular materials used in building construction and other civil engineering works. When reinforced with steel, it has a higher capacity for carrying loads. Concrete being a heterogeneous material. The quality of the constituents and the proportions in which they are mixed, determine its strength and other properties.

A vast majority of the cement used in construction work as the Portland cement. Portland cement is manufactured by mixing naturally occurring substances containing calcium carbonate with substances containing alumina, silica and iron oxide.

ASTM C618-05 defined pozzolana as siliceous or siliceous and aluminous materials which in themselves have little or no cementitious properties but in finely divided form and in the presence of moisture, they react with calcium hydroxide which is liberated during the hydration of Portland cement at ordinary temperatures to form compound possessing cementitous properties.

The development and research of materials and the method in civil engineering was to find most imported aspects which are availability, environment compatibility, and financial constraints. The selection of the construction materials should only be made after a complete review of its long-term performance, durability in the structure and environment compatibility.

In main object of present investigation to evaluate the suitability of various waste material when they partially replace the ingredient of concrete. Generally in this research project properties of concrete is evolved using Fly Ash, Recycled concrete aggregate, Glass Powder and Crumb rubber.

This research project has been divided into two major parts, which is given below

A. Research Program 1:

This Program consists concrete containing Fly Ash, Glass powder and Recycle Aggregate. Here cement is partially replaced by 30% Fly Ash, Coarse Aggregate is partially Replaced by 40% Recycled Concrete aggregate and Glass Powder partially replaced Fine aggregate with varying percentage from 15% to 25% at interval of 5%.

B. Research Program 2:

This Program consists concrete containing Fly Ash, Glass powder and Recycle Aggregate. Here cement is partially replaced by 30% Fly Ash, Coarse Aggregate is partially Replaced by 40% Recycled Concrete aggregate and crumb rubber partially replaced Fine aggregate with varying percentage from 5% to 10% at interval of 2-3%.

II. MATERIALS AND METHODS

For this project concrete cube of 15 * 15 * 15cm of M40 grade of concrete was casted. This research article is split in two parts

1) Research Program 1:

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2) Research Program 2:

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A. Material Used

1) Cement

Ordinary Portland Cement of Grade 53 is used, which conforming IS 12269. 53 grade cement is a prime brand cement with a remarkably high cs3 (tricalcium providing long-lasting) durability of concrete constructions. Produces highly durable and sound concrete due to really low percentage of alkalis chlorides, magnesia Cement used in the experimental work is Ordinary Portland cement of grade 53 conforming to IS 12269The physical properties of the cement obtained in conducting appropriate tests as per IS: 269/4831

2) Water

Water used in the concrete is conforming the specification of IS 456 : 2000. Water used for mixing is free from injurious amount of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete.

3) Glass Powder

Glass Powder is collected from Avantika Glass Industries, Bhopal.

4) Fly Ash

Fly Ash is collected from Dark India limited, Bhopal

5) Crum Rubber

Crumbed Rubber was taken from the scrap tyre recycling industries in Bhopal. The recycled crumbed tyre used is treated for surface modification by sodium hydroxide (NaOH) solution. The treatment consisted of soaking the recycled tyre particles in a NaOH solution for a period of 20 minutes, and then it was washed under running water and left to air dry at room temperature.

6) Recycle Aggregate

Recycle aggregate is a waste material collected from demolished concrete structure, for this project recycle aggregate is collected from a demolished concrete structure situated near hoshangabad road Bhopal. These totals are used after strictly passing from 20mm IS sieve.

Coarse Aggregate

In this research paper aggregate which retains on 4.75mm sieve and passes from 20mm sieve which is naturally occurred and crushed stone are used as a coarse aggregate.

7) Fine Aggregates

Aggregate which passed from 4.75 mm sieve and contains only so much coarser material as allowed, fine aggregate is natural sand which is ensuing from the natural decay of rock and which has been deposited by streams or glacial agencies, it is also crushed stone sand which is made by crushing hard rock, it is also crushed gravel sand which created by crushing natural gravel..

B. Mix Proportion

Mix for this project is done as per 10262 : 2009, Batching and Results of mix proportion of aggregate are given below in the table 1-4.

S.No.	Mix	Material Percentage					
		Cement	Fly Ash	Glass Powder	Fine Aggregate	Recycle Aggregate	Coarse Aggregate
1	CC	100%			100%		100%
2	RP1-GP15	70%	30%	15%	85%	40%	60%
3	RP1-GP20	70%	30%	20%	80%	40%	60%
4	RP1-GP25	70%	30%	25%	75%	40%	60%

Table 1: Batching of Concrete for Research Program 1

Mix	**CC**	**G15**	**G20**	**G25**
Water to cement Ratio	0.4	0.4	0.4	0.4
Water	156 l	156 l	156 l	156 l
Cement	390 kg	273 kg	273 kg	273 kg
Fly ash	-	117 kg	117 kg	117 kg
Coarse Aggregate (gravel)	1308kg	775.12 kg	775.12 kg	775.12 kg
Recycled Coarse Aggregate	-	574.44 kg	574.44 kg	574.44 kg
Fine Aggregate (sand)	703.79 kg	302.94 kg	285.12kg	267.3 kg
Glass	0 kg	46.072kg	61.43kg	76.79kg

Table 2: Mix Proportion for Research Program 1

S.No.	Mix	Material Percentage					
		Cement	Fly Ash	Crumb Rubber	Fine Aggregate	Recycle Aggregate	Coarese Aggregate
1	CC	100%			100%		100%
2	RP2-CR5	70%	30%	5%	95%	40%	60%
3	RP2-CR8	70%	30%	8%	92%	40%	60%
4	RP2-CR10	70%	30%	10%	90%	40%	60%

Table 3: Batching of Concrete for Research Program 2

Mix	CC	CR5	CR8	CR10
Water to cement Ratio	0.4	0.4	0.4	0.4
Water	156 l	156 l	156 l	156 l
Cement	390 kg	273 kg	273 kg	273 kg
Flyash	-	117 kg	117 kg	117 kg
Coarse Aggregate (gravel)	1308 kg	775.12 kg	775.12 kg	775.12 kg
Recycled Coarse Aggregate	-	574.44 kg	574.44 kg	574.44 kg
Fine Aggregate (sand)	703.79 kg	338.58 kg	327.89 kg	320.76 kg
Crumbed Rubber Aggregate	-	6.35 kg	10.16 kg	12.7 kg

Table 4: Mix Proportions for Research Program 2

RP2-G20	35
RP2-G25	25

Table 5: Workability Result of Research Program 1

Fig. 1: Graph 1 & Graph 2: Workability Result of Research Program 1

C. Experimental Program

1) Slump Cone Test

The workability of all concrete mixtures was determined through slump test utilizing a metallic slump mould. The difference in level between the height of mud and that of the highest tier of the subsided concrete was measured and drawn as a slump. The slump tests were accomplished according to IS 1199- 1959.

2) Compressive Strength Test

From each concrete mixture, cubes of size 150mm x 150mm x 150mm have been shed for the determination of compressive strength, to determine compressive strength, compressive strength testing machine is used, constant load is applied on specimen by constant pressure. This test is performed as per specification given under IS 516-1959.

III. Result and Discussion

When concrete containing Fly Ash, Glass powder and Recycle Aggregate, where cement is partially replaced by 30% Fly Ash, Coarse Aggregate is partially replaced by 40% Recycled Concrete aggregate and Glass Powder partially replaced Fine aggregate with varying percentage from 15% to 25% at interval of 5%. And concrete containing Fly Ash, Glass powder and Recycle Aggregate, where cement is partially replaced by 30% Fly Ash, Coarse Aggregate is partially replaced by 40% Recycled Concrete aggregate and crumb rubber partially replaced Fine aggregate with varying percentage from 5% to 10% at interval of 2-3% is prepared and the result of the test performed on it and their analysis is are given below

A. Research Program 1

When all the ingredient of the concrete is partially replaced by waste material, result of result program 1 are given below in table 5 and graph 1-2 (Workability), table 6 and graph 3-4 (Compressive Strength). It has been observed that with increase in the content of glass powder workability of the concrete decreased.

1) Workability

Mix	Slump Value (mm)
CC	70
RP1-G15	55

2) Compressive Strength

When concrete contains Fly ash, recycled concrete aggregate, glass powder with basic ingredient of concrete so variation in compressive strength of concrete varies. Result of compressive strength of concrete is given in table 15 and graph 3-4.

Mix	Compressive Strength (in N/mm2)		
	7 days	14 days	28 days
CC	26.89	37.27	47.54
RP1-G15	30.98	37.5	41.42
RP1-G20	29.87	35.64	36.25
RP1-G25	34.74	38.45	42.31

Table 6: Compressive Strength Result of Research Program 1

Fig. 2: Graph 3 & Graph 4: Compressive Strength Result of Research Program 1

3) Combined Result

Mix	Compressive Strength (N/mm^2) 28 Days	Workability (mm)
CC	47.54	70
RP1-G15	41.42	55
RP1-G20	36.25	35
RP1-G25	42.31	25

Table 7: Combined Result of Research Program 1

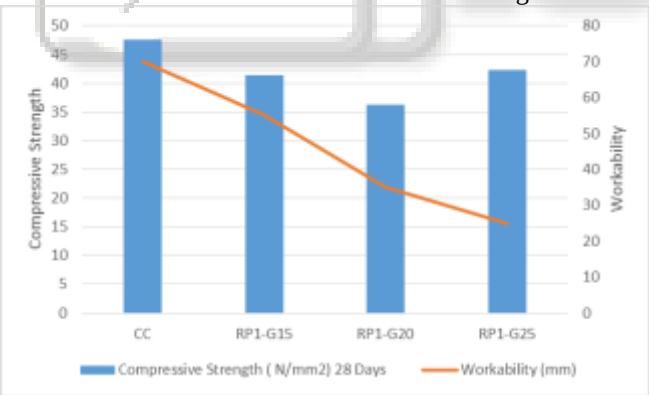


Fig. 3: Graph 5 & Graph 6: Combined Result of Research Program 1

B. Research Program 2

The introduction of recycled rubber tyres to concrete increases the slump and workability. All concrete mixes were designed to have a slump of 25mm; however all of the mixes had a slump of much more value. It was noted that the slump value was increased as the percentage of rubber was increased. The mix consisting of 5% rubber had a slump of 25mm, followed by the 8% rubber mix having a 110mm. slump while the mix with 10% replacement of aggregate by rubber had a slump of 135mm. In general, as the percentage amount of rubber increased, the amount of energy required for casting specimens decreased substantially. Workability increases with increasing percentage of rubber in concrete. Results show a significant decrease in the compressive strength as the rubber replacement amount increases Graph 7-8, Table 8 shows the variation, Compressive Strength test result are given below in table 9 and Graph 9-10.

1) Workability

Mix	Slump Value (mm)
CC	25
RP2-CR5	30
RP2-CR8	90
RP2-CR10	110

Table 8: Workability Result of Research Program 2

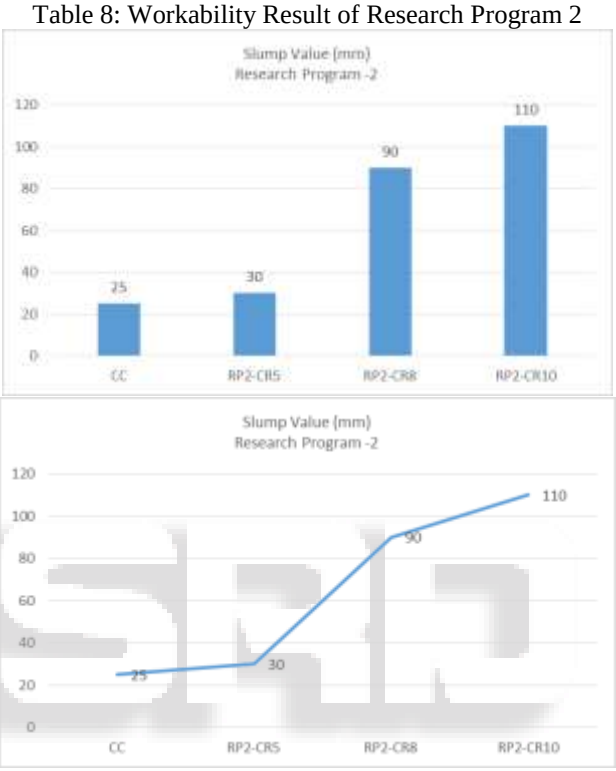
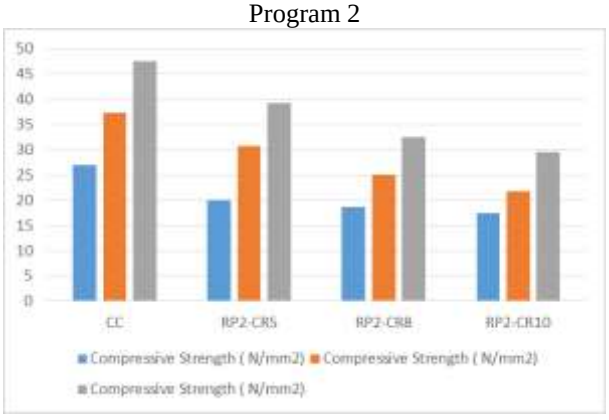


Fig. 4: Graph 7 & Graph 8: Workability Result of Research Program 2

2) Compressive Strength

Mix	Compressive Strength (N/mm^2)		
	7 days	14 days	28 days
CC	26.89	37.27	47.54
RP2-CR5	20.12	30.84	39.31
RP2-CR8	18.64	25.09	32.54
RP2-CR10	17.52	21.72	29.56

Table 9: Compressive Strength Test Result of Research Program 2



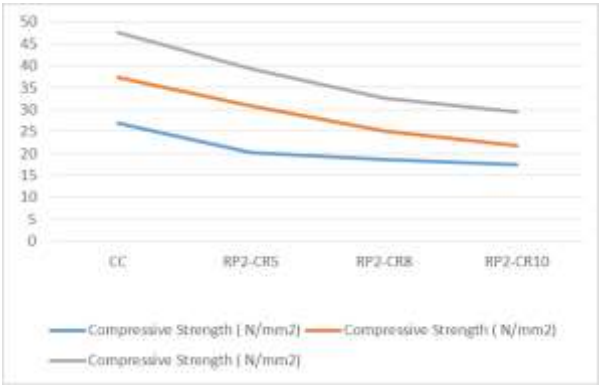


Fig. 5: Graph 9 & Graph 10: Compressive Strength Test Result of Research Program 2

3) Combined Result

Mix	Compressive Strength (N/mm^2) 28 Days	Workability (mm)
CC	47.54	25
RP2-CR5	39.31	30
RP2-CR8	32.54	90
RP2-CR10	29.56	110

Table 10: Combined Result of Research Program 2

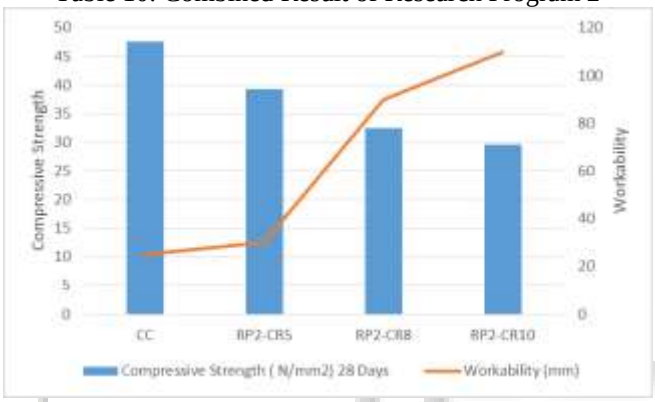


Fig. 6: Graph 11: Combined Result of Research Program 2

IV. CONCLUSION

Research on the usage of waste materials is very important because, waste materials is gradually increasing with the increase in population and increasing urban developments. Utilization of Crumb rubber, Glass Powder and recycled aggregate with Fly ash in concrete will eradicate the disposal problem of these waste materials and prove to be environment friendly, thus paving way for greener concrete. The reason that many investigations and analysis has been made on Crumb rubber, Glass Powder and recycled aggregate with Fly ash in concrete is because, they are easy to obtain and economic than natural aggregate. After the detailed study following conclusions have been derived from the present study.

A. Research Program 1

1) The experimental results shows that compressive strength of G15 (15% glass powder as sand replacement) and G25 (25% glass powder as sand replacement) increases by 4.86% and 9.12% respectively as compared to normal standard concrete obtained at 28 days of age.
2) The slump value doesn't changes with change in glass percentage in concrete.
3) Workability decreases with increase in the percentage of glass powder replacement.
4) Utilization of waste glass in concrete can turn out to be economical as it is no useful waste and spare of cost.
5) Utilization of waste glass in concrete will eradicate the disposal problem of waste glass and prove to be environment friendly, thus paving way for greener concrete.
6) Utilization of waste glass in concrete will save natural resources, particularly river sand therefore constitute the concrete construction industry sustainable.

B. Research Program 2

1) The slump value increases with the increase in percentage of crumb rubber as our experiment shows therefore we can say that workability of concrete increases with increase in rubber percentage.
2) Use of rubber doesn't have positive effect on compressive strength instead compressive strength decreases with increase in crumbed rubber percentage.
3) Tyre waste concrete maybe specially recommended for concrete structures located in areas of severe earthquake risk and also for the production of railway sleepers.
4) This material can also be used for non-load bearing purposes such as noise reduction barriers.
5) Recycled rubber tyres used as aggregate could be successful in its use as lightweight concrete in non-structural applications, and it represents a viable alternative to recycle tyres helping the conservation of the environment in the process.
6) Utilization of crumb rubber and recycled aggregate and fly ash in concrete can turn out to be economical as they are easily available at some places and at cheaper cost as compared to natural one.

C. Comparison

1) The compressive strength of concrete decreases gradually with increase in percentage of rubber, while it is found that there is increase in strength at 15% to 25% replacement of fine aggregate by of glass powder.
2) Workability of rubber reinforce concrete increases gradually with increase in rubber percentage while it is found that workability of glass reinforced concrete decreases with increase in glass percentage.
3) Upon examination of broken blocks containing recycled tire, it was seen that the pieces of concrete tested tend to stay together linked through the rubber particles. In general, for all testing the specimens did not shattered as the OPC control mix, the rubber containing specimens cracked but the cracks were arrested by the rubber fibers. While in glass reinforced concrete all the testing specimen shattered more easily as compared to OPC control mix, owing to bad bonding property of glass with other ingredients of concrete.
4) The glass reinforced concrete achieved strength

rapidly as compare to rubber reinforced concrete.

5) The final strength achieved at 28 days was greater for glass reinforced concrete as compared to rubber reinforced concrete.

This study and investigation aimed at accessing possible use of various industrial wastes as alternative material in production of concrete. After planning and investigating various materials we hereby conclude that concrete production leads to various environment related issues. Therefore there is an urgent need for replacement of its various constituents by alternative materials as a raw material for concrete production. Various materials can be used to replace the conventional constituents of concrete without compromising with the strength of the concrete. It also serves to be economical as well as ecofriendly.

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