

Experimental Study on Concrete by Partial Replacement of Solid Plastics and Granite Powder

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ABSTRACT: Now a day, every building construction in the country faces the shortage of construction materials and increase in productivity waste. The production of waste to the environmental has become a serious concern. This paper deals with reuse of waste solid plastics and granite powder in concrete which corresponds to formation of light weight concrete as well as increase in strength of concrete. Waste solid plastics are used as partial replacement for coarse aggregate and use of granite powder as partial replacement of cement in M25 grade of concrete. Solid plastics are incrementally added in 5% and 10% to replace the coarse aggregate, where replacement of granite powder in cement is kept constant as 10% in both the mix. Physical properties of the material are obtained by conducting test on coarse aggregate, fine aggregate, cement, solid plastics and granite powder. Cubes, Prisms and cylinders were casted and tested for 7, 14 and 28 days. Finally, the strength of compressive, tensile and flexure is been obtained.

KEYWORDS: Environmental effect, Solid plastics, Granite powder, Compressive, Flexure, Tensile.

I. INTRODUCTION

Concrete is like hard stone, it forms after the mixing of cement, sand, ballast and water. It is then allowed to cure for strong stone like character. This hard like stone or hardening is caused by chemical reaction between the cement and water. Cement, stone or brick ballast and sand is distinguished from Binding material, coarse aggregate and fine aggregate. The mortar is used in concrete is called “matrix”. About four tons of concrete are produced per person per year worldwide and about 1.7 tons per person in the country (approximately). The present consumption of concrete in the world is estimated to be approximately 12 million tons per annum.

Cement concrete consists of fine aggregate, coarse aggregate and cement mixed in suitable proportions in addition to water. In cement concrete depending upon the strength (N/mm^2) of concrete at 28 days, concrete is further classified as low strength concrete ($20 N/mm^2$), medium strength concrete ($20 N/mm^2$ to $40 N/mm^2$) and high strength concrete ($40N/mm^2$).

1.1 GENERAL

1.1.1 Plastics

Most plastics are synthetic, so they are carefully designed by chemists and laboriously engineered under very artificial conditions. They had never spontaneously appear in the natural world and they are still a relatively new technology, so animals and other organisms haven't really had chance to evolve so they can feed on them or break them

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down. Since a lot of the plastic items we use are meant to be low cost and disposable, we create an awful lot of plastic trash. These things together make an environment polluted.

Another solution is to recycle more plastic, but that also involves better public education. It is easy to dismiss plastics as cheap and nasty materials that wreck the planet by using them in the current developing modern building as replacement in concrete. If the thermosetting plastics are reused the cost of the recycling process as well the pollution that is caused by the burning of plastic can be reduced. Thermosetting plastics are used as partial replacement in construction materials particularly concrete in construction.

1.1.2 Granite powder

Granite powder, a waste material from the granite polishing industry, is a promising material for use in concrete similar to those of Pozzolanic materials such silica fume, fly ash etc. The density of the granite powder is between 2.65 to 2.75 g/cm³. The specific gravity of granite powder may be 2.7 to 3.1. The particle size distribution, coefficient of curvature and coefficient of uniformity is found by hydrometer analysis.

The Main objective of using granite powder in this study is to investigate experimentally the suitability of granite powder waste as a substitute material as a partial replacement of cement in concrete production.

II. METHODOLOGY

- Testing of materials
- Mix Design of M25 grade of concrete
- Fresh concrete test (Slump test, Compaction factor, Vee-Bee consistometer, Flow table)
- Hardened concrete test (Compressive, Tensile and Flexure strength)
- Result and discussion
- Conclusion

2.1 TESTING OF MATERIALS

2.1.1 Cement

Cement is a powder which sets a hard mass after mixing with water. It is a binding agent for materials.

It mainly consists of calcareous materials (lime stone or chalk) and argillaceous materials (clay or shale). The Ordinary Portland Cement grade 43 of “Ultratech” brand conforming to BIS standard is used in this paper. OPC 43 grade is used as it satisfied the requirement of IS: 269-1969. The properties of cement are given in following Table 1.

Table 1: Physical Properties of Cement

S.No	Characteristics	Values
1	Specific Gravity of cement	3.15
2	Fineness of cement	4%
3	Consistency of cement	36.5%
4	Value of expansion (Soundness test)	8mm
5	Initial setting time	37 min
6	Final setting time	480 min

2.1.2 Aggregate

The major and most important constituent of concrete is Aggregate. An aggregate occupies 70 to 80% of the whole volume of the concrete. The both fine aggregate and coarse aggregates are naturally available materials. Aggregates were considered as inert material. Aggregates is been found recently to be chemically active to some extent.

Aggregate are naturally in different sizes. The size of aggregate selected is related to the mix proportions and type of work. The aggregate distribution is called grading of aggregates. The properties of aggregate are given in table 2.

Table 2: Physical properties of Fine Aggregate and Corse aggregate

S.No	Characteristics	F.A.	C.A.
1	Specific Gravity	3.15	2.8
2	Fineness	2.35	3.6
3	Water absorption	1.4%	0.9%
4	Maximum size	-	20mm
5	Flakiness Index	-	7.2%
6	Elongation Index	-	20.8%

2.1.2.1 Fine Aggregate

Fine aggregates are naturally available sources like form rivers or lakes. When there is unavailability of natural sand, crushed stone dust in used as fine aggregate.

2.1.2.2 Coarse Aggregate

Productions of disintegration of rocks are coarse aggregate. These coarse aggregates are chosen by retaining on a IS 4.75 mm sieve. Stones such as granite, basalt, quartzite which are hard and durable in nature give a good coarse aggregate.

2.1.4 Water

Water is an important ingredient of concrete. As a general guidance, if the water is fit for drinking it is fit for making concrete. However, some water contained a small sum of salt is not suitable for concrete. Other yard-stick adopted is if the PH is between 6 to 8 the water is accepted to be suitable.

2.1.5 Solid Plastics

At present these plastic wastages are disposed by either burning or burying. If the thermosetting plastics are reused, the cost of the process as well the pollution that is caused by the burning of plastic can be reduced. The thermosetting plastics are used in construction materials particularly in concrete. Solid Plastics of 5% and 10% are used as partial replacement for coarse aggregate. The properties of Solid plastics are given in the following Table 3.

Table 3: Physical properties of Plastics

S.No.	Characteristics	Values
1	Specific gravity	1.04
2	Melting point	75-100°C
3	Fineness	< 3.5 mm

2.1.6 Granite Powder

It is a non-biodegradable waste that can be easily inhaled by human being and animals and is also harmful to the environment. Granite powder is non-soluble in water. The Main objective of this study is to investigate experimentally the suitability of granite powder waste as a substitute material as a partial replacement of cement in concrete production. Granite powder is kept as 10% as a constant mix for cement. The properties of solid plastics are given in the following Table 4.

Table 4: Physical properties of Granite powder

S.No	Characteristics	Granite powder
1	Specific Gravity	2.79
2	Solubility in water	Insoluble
3	Color	Dark gray

III. MIX DESIGN

The mix for M25 grade of concrete is designed as per IS: 10262-2009. The mix design is based on the physical properties of concrete. Mix proportion for M25 grade of concrete are given in the table 5.

Table 5: Mix proportion

Material	Cement	F.A	C.A	Water
Quantity (kg/m ³)	492.5	630	1170	197
Mix ratio	1	1.2	2.4	0.40

Description for replacement of various proportions:

M1: 10% Granite powder + 90% Cement 10% Solid plastic + 90% Coarse Aggregate

M2: 10% Granite powder + 90% cement

5% Solid plastic + 95% Coarse aggregate

3.1 FRESH CONCRETE TEST

Testing of fresh concrete are important in concrete construction. The tests are concerned with fresh concrete are to check the workability of concrete. The following tests are commonly measured to find the workability of fresh concrete:

- Slump test
- Compaction factor test
- Flow test
- Vee bee consistometer test

The results for above tests are tabulated in the following table 6.

Table 6: Fresh concrete test results

Mix	Slump test	Flow test	Vee Bee	Compaction Factor test
N.M	95mm	48%	6sec	0.92
Mix 1	90mm	50%	8sec	0.88
Mix 2	98mm	45%	6sec	0.91

3.2 HARDENED CONCRETE TEST

Testing of hardened concrete is important in concrete constructions. The test on hardened concrete is to find the strength, creep effects, durability, etc. The following tests are conducted for hardened concrete:

- Compressive strength test
- Flexural strength test
- Split tension test

3.2.1 Compressive strength test

The compressive tests are conducted on cube specimen having a size of 15x15x15cm. The metal moulds are used to cast the cubes. The top layer of the casted specimen is covered with metal plate to avoid evaporation. It is demoulded after 24 hours and cured into the fresh water. Finally the cubes are tested by compression testing machine at 7, 14 and 28 days.

3.2.2 Flexural strength test

The size of the beam used for flexural strength test is 15 x 15x 70cm. The metal mould is used for casting. The loading capacity of testing machine should have specific rate of loading to permissible errors on load applied not greater than (+/-) 0.50%. The flexural strength is obtained by modulus of rupture f_b .

3.2.3 Split tension strength

Split tension test gives 5 to 12% higher value than the direct tensile strength. It is an Indirect tension test. The load is applied till the failure occurs along the vertical direction.

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Table 7: Compressive strength

S. No	MIX	COMPRESSIVE STRENGTH (N/mm ²)		
		7 Days	14 Days	28 Days
1.	N C	20	24	28.5
2.	M 1	16	18.6	23.2
3.	M 2	23	26	30.8

Table 8: Split tension strength

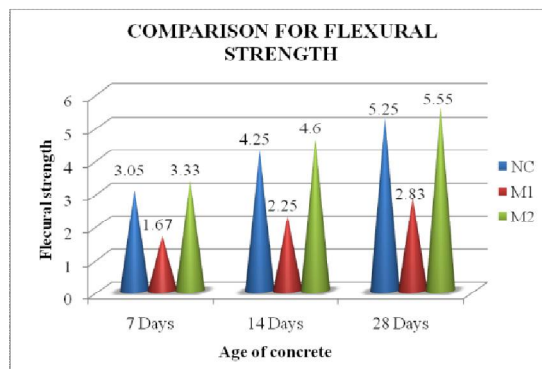
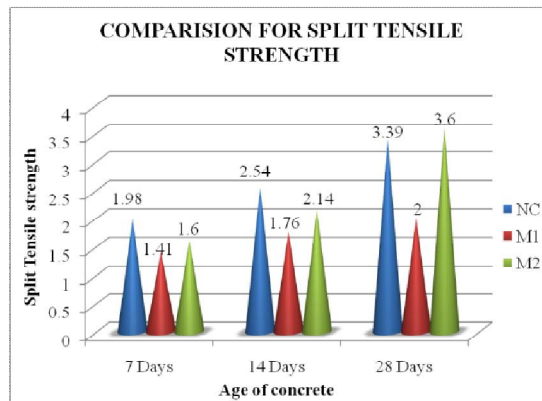
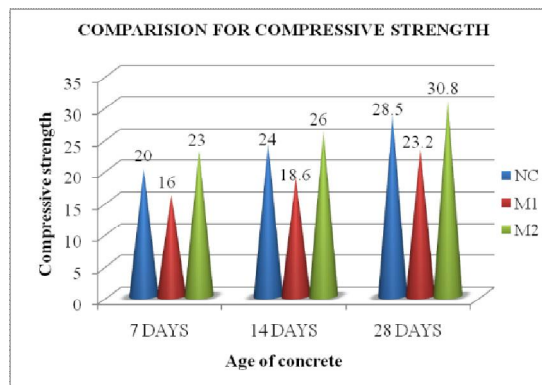
S. No	MIX	SPLIT TENSILE STRENGTH (N/mm ²)		
		7 Days	14 Days	28 Days
1.	N C	1.98	2.54	3.39
2.	M 1	1.41	1.76	2.0
3.	M 2	1.6	2.14	3.6

Table 9: Flexural strength

S. No	MIX	FLEXURAL STRENGTH (N/mm ²)		
		7 Days	14 Days	28 Days
1.	N C	3.05	4.25	5.25
2.	M 1	1.67	2.25	2.83
3.	M 2	3.33	4.6	5.55

IV. RESULTS AND DISCUSSIONS

The variation of Compressive strength, split tensile strength and flexural strength with respect to type of concrete cubes, beams and cylinder made by using granite powder and solid plastics as a replacement by weight of cement and coarse aggregate is compared and represented in following figures.



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V. CONCLUSION

- From the experimental analysis, it is concluded that Mix 2, replacement of 10% Granite Powder and 5% solid plastics is found to be the most preferable one when compared with other mixes.
- It is recommended for both Structural and Non- Structural applications.
- The cost of construction will reduce and also helps to avoid the disposal technique of waste plastics and water granite powder.
- When plastic used in concrete it can be with stand at high temperature and also reduction in weight is achieved.

REFERENCES

1. Use of granite waste as partial substitute in concrete. International Journal of Engineering Research and Applications, April 2015.
2. Strength properties of concrete with partial with partial replacement of cement by granite quarry dust. International Journal of Engineering Research & Technology (IJERT), 9th September 2014.
3. Experimental study of concrete by partial replacement of cement with granite dust powder. International Journal on Engineering Technology and Sciences – IJETS, 6th June 2015.
4. R. Dharmaraj and R. Malathy, "Performance Evaluation of Sodium Nitrite Corrosion Inhibitor in Self Compacting Concrete", Indian Journal of Science and Technology, Vol 8(36), 2015, pp-1-6.
5. Utilization of waste plastics as partial replacement of coarse aggregate in concrete. Indian Journal of Science and Technology, June 2015.
6. Properties of concrete by addition of solid plastic waste. International Journal of Science and Research (IJSR).
7. Construction Materials. Dr. S. Seetharaman and Er. M. Chinnasamy.
8. Construction Techniques Equipment and Practices. Dr. P. Purushothama raj.
9. Plain and Reinforced concrete code of practice. IS 456 : 2000
10. IS : 10262 - 2009, "Indian standard specification for method of concrete mix proportioning guidelines" Bureau of Indian standards, New Delhi 2009.