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A Study and Comparative Analysis of Mechanical Properties of Concrete after Partial Replacement of Sand with Granite Powder for M30 Grade

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***Abstract* – With the rising population and booming construction sector, there is an immense burden on environment. Concrete as we know as a composite material made up of cement, sand, aggregates, water and admixtures. It is one of the key components in any construction. So far, valuable research and development has been conducted in the field of concrete technology. The scientists and engineers have replaced cement partially by fly ash and invented PPC cement thereby reducing burden of excessive burden of limestone excavation from mines to an extent. Fly ash being a waste material extracted from thermal power plant chimneys has now become useful component of cement and concrete.**

Fine aggregate is one of the most essential components of concrete. The most commonly used fine aggregate is natural river sand. Due to the extensive use of concrete, the global consumption of natural river sand is very high. Now as we are progressing with time, need of the hour is to remove burden on rivers from where sand is mined illegally and on a massive scale. The sand mined from rivers leads to drying of rivers, reducing habitat of species and increase problem of migration on account of water scarcity. This problem could be addressed by using waste products from industries and partially replacing them with sand to an extent. This could ease the burden on rivers which are currently main source of sand. Due to excessive cost of transportation from natural sources the river sand is expensive. Also exploitation of the natural sources on a massive scale creates environmental problems.

The granite waste is a by-product generated by the granite industry which has accumulated over years. Only small quantity of it has been utilized and the remaining has been dumped in the surrounding areas resulting in environment problem. With the colossal increase in the quantity of waste requiring disposal, coupled with severe scarcity of dumping sites, and sharp increase in the transportation and dumping costs the quality of environment, has got seriously deteriorated preventing sustainable development. Granite powder (GP) gets easily carried away by the air easily as it is a fine material and causes health problems like lung diseases and inhaling problems moreover it causes environmental pollution. The worst effects of air pollution are on the majority of people living in and around the dumping sites. In this study, concrete prepared with granite powder was tested and compared with control mix of M30 grade. The blended mixes i.e. GPC5, GPC10, GPC15, GPC20, GPC25 and GPC30 were prepared in which sand was replaced by GP in different proportions of 5%, 10%, 15%, 20%, 25% and 30% respectively. The basic parameters on which control mix and blended mixes were compared are compressive strength, flexural strength, split tensile strength, water absorption, density and workability. The compressive strength test was done for mixes after 7 and 28 days of curing. The parameters like flexural strength, split tensile strength, water absorption and density were evaluated after 28 days of curing.

In this study an attempt has been made to overcome problem of river sand to an extent by partially replacing it with GP and develop a sustainable concrete from the granite scrap. Alternative materials such as granite powder would reduce the demand on river sand and contribute in sustainable development

Keywords- Fly Ash, Compressive strength, Workability, Granite scrap, Tensile Strength, Flexural strength.

I. INTRODUCTION

Mixture of cement, natural sand, coarse aggregate and water is known as Concrete. Concrete is considered to be successful when it is versatile against harsh environment and can withstand unfavourable weather conditions with ease. With the help of innovative chemical admixtures and various supplementary materials SMs the engineers and scientists are further trying to increase its limits. When industrial wastes are used in the concrete to reduce burden of over-consumption of natural resources, save energy and minimize pollution of the environment, the resultant concrete is known as Green concrete. Between the different varieties of solid industrial wastes generated the marble and granite wastes, have the potentiality to be used for concrete.

These by-products could be used as a filler (partially replacing sand) material to reduce the total voids content in

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concrete and/or pozzolonic material (partially replacing cement) in the concrete mix while maintaining its physical and mechanical properties.

Tanveer Asif Zerdiet. al. (2016) developed an economical alternative by partial replacement of sand with granite powder (GRP) in concrete. In this experimental study, the main objective was to study the influence of partial replacement of sand with granite powder, and to compare it with the compressive strength of ordinary M20 grade concrete. Sand was replaced with GRP at 0%, 10%, 20% & 30% by weight for M20 grade of concrete designated as R, GR1, GR2, GR3. Strength and durability property of concrete was tested on fresh and hardened concrete for all the mixes. Workability test and strength test were conducted for fresh concrete and compressive strength test was conducted for 3 days, 7 days, 14 days and 28 days curing. Compressive strength for concrete mixes designated as R, GR1, GR2 and GR3 was 10.38, 16.88, 23.37 and 25.70 N/mm^2. GR3 had highest compressive strength for 3, 7, 14 and 28 days cured concrete mix. The results showed that GRP assimilation resulted in enhancement in the compressive strengths of concrete by replacement up to 20% of GRP without affecting significant characteristics of the mix. When beyond 30 % sand was replaced with granite powder the compressive strength obtained was almost equivalent to that of basic mix, so the 30% use of granite powder in concrete gave more strength, hence 30% of GRP could be replaced with sand in concrete.

Result indicated that compressive strength increased gradually with addition of GPR from 10% replacement of sand with GRP, 20 % replacement of fine aggregate with GRP and 30% of GRP with sand. Beyond this range of the proportion of GRP, compressive strength decreased. The reason was that the GRP did not combine with gel during hydration process leading to weak micro structure of concrete.

The analysis confirmed that GRP is a non-reactive material and could act as filler in concrete. GRP could be used as a sustainable replacement for cement and fine aggregate.

Arivumangai and T. Felixkala (2014) made M30 grade concrete by replacing sand with granite powder by 0, 25 and 50% designated as GP0, GP25 and GP50 respectively and cement was partially replaced with silica fume, fly ash, slag and super plasticizer for each concrete mixes. The dosage of super plasticizer was not increased beyond 2% by weight of the cement as higher dosage of super plasticizer delayed the hardening process. Silica fumes used had its two fold effects which are reduction of w/c ratio and increase of strength of hardened concrete. High performance concrete mixes were prepared by using locally available river sand, coarse aggregate of 10-20mm and Portland cement of 53 grades. They conducted experimental study on compressive strength, split tensile strength 28, 56 and 90 days. Hydrometer analysis was carried out on the powder to determine the particle size distribution since the granite powder was fine. Durability study due to chloride attack was also done and percentage of weight loss was compared with normal concrete.

The chloride resistance of the concrete was studied by chemical attack after immersing concrete blocks in 5% NaCl solution.

After 90 days of curing, the specimens were removed from the curing tank. The compressive strength of all the granite powder concrete mixes was closer to that of reference mix (GP0) for all the days of curing. The compressive strength of GP25 was 2 to 9% higher than that of GP0 for all the days of curing. The other mixes with higher than 25% GP showcased lesser compressive strength than the mix with the river sand. Split tensile strength decreased with increase of granite powder in the mix and the results indicated that the optimum replacement was 25%. The 25 per cent granite powder concrete enhanced the chloride resistance and thus could improve the chemical resistance of concrete. Test results indicated that the use of granite powder and admixtures in concrete have improved the performance of concrete in strength as well as in durability aspect.

II. MATERIALS USED

2.1 Cement

Cement is a binder material which sets and hardens. It has ability to bind other materials together. Cements used in construction can be characterized as hydraulic or non-hydraulic depending upon its ability to be used in the presence of water. The cement used in this study was OPC-43 grade which was purchased from local dealer. The properties of cement were determined after conducting tests specified by IS 8112:2013.The specific gravity of cement used was 3.15

Table 2.1: Properties of Cement

Chemical Composition	Value
CaO	62%-67%
SiO_2	17% - 25%
Al_2O_3	3% - 8%
Fe_2O_3	3%-4%
MgO	0.1%-3%
SO_3	1%-3%
Na_2O	0%-0.5%
Gypsum ($CaSO_4.2H_2O$)	2.5%

2.2 Course Aggregates

Aggregates which are retained on 4.75 mm IS sieve. Sieve analysis is done to differentiate between various sizes of aggregates. Coarse aggregates are described as graded aggregates according to size of their nominal size i.e. 40mm, 20 mm, 16 mm and 12.5 and 10 mm etc. for example a graded aggregate of nominal size 10 mm means an aggregate most of which passes 10 mm IS sieve. As per IS: 2386 – Part III (1963) various tests are done on coarse aggregates to determine its .different properties. The source of coarse aggregates was Hathipura, Bassi. For obtaining good concrete, the aggregates must be free from silt, dust or any other foreign particle which deteriorates its strength in the longer run

Table 2.2 Properties of coarse aggregate 10mm and 20mm

Properties	Coarse Aggregate	
	10mm	20mm
Bulk Density	1525 kg/m3	1481kg/m3
Sp. Gravity	2.63	2.62
Water Absorption	0.46%	0.46%

2.3 Fine Aggregates

The aggregates which passes through 4.75 mm IS sieve are fine aggregates. According to source fine aggregate may be described as: According to size the fine aggregate may be described as coarse sand, medium sand and fine sand. IS specifications classify the fine aggregate into four types according to its grading as fine aggregate of grading Zone-1 to grading Zone-4. These grading zones classified as per percentage passing material from various sieves and there are mainly four zones and they all have different passing percentage. The source of fine aggregates was Banas River, Tonk.

Table 2.4 Properties of fine aggregate

Properties	Natural fine aggregate
Bulk density	1625 kg/m^3
Specific gravity	2.65
Water absorption	1.15 %
Fineness modulus	2.67

2.4 Granite Powder

Granite is a common and widely occurring type of intrusive, felsic, igneous rock. Granites usually have a medium to coarse grained structure. Its particles are angular in shape and white and black in color having size ranging between pebbles to boulders. The Granite powder was obtained from stone cutting industry in V.K.I.A, Jaipur.

Granite powder is a waste material obtained from granite cutting industry can be used in concrete similar to those of pozzolonic materials such as silica fume, fly ash, slag etc. It can also be used as a filler material (substituting sand) to reduce the void content in concrete.

The physical and chemical characteristics of the granite powder are tabulated below. To verify the physical characterization of the granite powder, its grain size distribution analysis was carried out.

Table 2.5 Physical properties of granite powder

Physical Properties	Range
Bulk density	1485 Kg/m^3
Fineness modulus	2.01
Water absorption	4.37 %
Specific gravity	2.63

Table 2.6 Chemical properties of granite powder

Chemical Properties	Composition %
Sio_2	72.14%
Al_2O_3	17.13%
MgO	0.92 %
Na_2O	5.32%
K_2O	7.59%

2.5 Fine Aggregates

There are various type of chemical admixture which are used in construction and they are retarding admixture, accelerating admixture, water reducing admixture, air-entraining admixture, Super plasticizing admixture and retarding super plasticizing admixture. Super plasticizers, also known as plasticizers or high-range water reducers (HRWR), reduce water content by 12 to 30 percent and can be added to concrete with a low-to-normal slump and water-cement ratio to make high-slump flowing concrete in this thesis i.e. naptha based water reducing super plasticizer as per IS 9103:1999 used. The super plasticizer which is used for the experimental performance is Kavassu Plast SP-431/ Shali plast SP-431. This super plasticizer has been taken from Shalimar Chemicals Pvt. Ltd., Jaipur

Table 2.7 Properties of chemical admixture

Properties	Sulphonated Napthalene Formaldehyde (Value)
Type of admixture	Super plasticizer chloride free, as per ASTM C 494 & IS: 9103
Specific Gravity@27ºC	1.20 +/- 0.04
Dry Material %	41- 45 %
Chloride %	NIL
Alkalies	NIL
Ash Content	10.00 - 14.00%
PH	7-9
Colour	Faint Black Brown Liquid

III. METHODOLOGY AND TESTS

3.1 Fine Aggregate Grading

As per IS-383:2016 Banas sand of zone - II was recommended for concrete mix. The sieves recommended for gradation of Banas sand are 10mm, 4.75mm, 2.36mm, 1.18mm, 600micron, 300 micron and 150 micron.

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Table 3.1 Sieve analysis of fine aggregate (IS 383/2386)

Sieve size	Retained (gm)			% Retained weight	Cumulative % Retained	% Passing Cumulative	Limit as per IS 383:2016
	Sample 1	Sample 2	Average				
10 mm	0	0	0	0	0	100	100
4.75 mm	11.5	11.5	11.5	1.15	1.15	98.85	90-100
2.36 mm	16	18	17	1.7	2.85	97.15	75-100
1.18 mm	72	75	73.5	7.35	10.2	89.80	55-90
600 Micron	522	493	507.5	50.75	60.95	39.05	35-59
300 micron	276	355	315.5	31.5	92.45	7.55	8.0-30
150 micron	90	42	66	6.6	99.5	0.5	0-10
PAN	12	5.5	8.75	0.875			
Total	1000	1000	1000	100	**267.10**		

Fineness Modulus = 267.10/100 = **2.67**
Grading Zone = II

3.2 Course aggregate grading (10mm)

As per IS-383:2016, the sieves recommended for gradation of Gunawata, Bassi, coarse aggregate are 12.5mm, 10mm,4.75mm and 2.36mm.

Table 3.2 Sieve analysis of 10 mm aggregate (IS 383/2386)

Sieve size	Retained (gm)			% Retained weight	Cumulative % Retained	% Passing Cumulative	Limit as per IS 383:2016
	Sample 1	Sample 2	Average				
12.5 mm	0	0	0	0	0	100	100
10 mm	35	46	40.5	2.01	2.01	97.99	85-100
4.75 mm	1365	1361	1363	68.15	70.16	29.84	0-20
2.36 mm	495	490	492.5	24.62	94.79	5.21	0-5
1.18 mm	105	103	104	5.2	100	0	0
600 micron	0	0	0	0	100	0	0
300 micron	0	0	0	0	100	0	0
150 micron	0	0	0	0	100	0	0
PAN	0	0	0	0	**566.96**		
Total	2000	2000	2000	100			

Fineness Modulus = 566.96/100 = **5.67**

3.3 Coarse Aggregate Grading (20mm)

As per IS-383:2016, The Sieves recommended for gradation are of Gunawata, Bassi. The coarse aggregates used are of size 40mm, 20mm, 10mm, and 4.75mm.

Table 3.3 Sieve analysis of 20 mm aggregate (IS 383/2386)

Sieve size	Retained (gm)			% Retained weight	Cumulative % Retained	% Passing Cumulative	Limit as per IS 383:2016
	Sample 1	Sample 2	Average				
40 mm	0	0	0	0	0	100	100
20 mm	1185	1166	1176	58.80	58.80	41.20	85-100
10 mm	734	745	740	36.97	95.74	4.23	0-20
4.75 mm	75	85	80.5	4.0125	99.75	0.25	0-5
2.36 mm	4	6	5	0.25	100	0	0
1.18 mm	0	0	0	0	100	0	0
600 micron	0	0	0	0	100	0	0
300 micron	0	0	0	0	100	0	0
150 micron	0	0	0	0	100	0	0
PAN	0	0	0	0	**754.58**		
Total	2000	2000	2000	100			

Fineness Modulus = 754.58/100 = **7.54**

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3.4 Granite Powder Grading

Table 3.4 Sieve analysis of granite powder (IS 383:2016)

Sieve size	Retained (gm)			% Retained weight	Cumulative % Retained	% Passing Cumulative
	Sample 1	Sample 2	Average			
10 mm	0	0	0	0	0	100
4.75 mm	0	0	0	0	0	100
2.36 mm	32	35	33.5	3.35	3.35	96.65
1.18 mm	129	126	127.5	12.75	16.1	83.9
600 micron	137	138	137.5	13.75	29.85	70.15
300 micron	346	348	347	34.7	64.55	35.45
150 micron	228	230	229	22.9	87.45	12.55
PAN	128	123	125.5	12.55		
Total	1000	1000	1000	100	**201.3**	
Total	1000	1000	1000	100	**201.3**	

Fineness Modulus = 201.30/100 = **2.01**

3.5 Mix Proportioning

Mix proportion is process for mixing of cement, sand, coarse aggregate and water mainly in which it is required to keep balance of mixing ratio. The mix has been conducted for trial mix, control mix and blended mixes which are given below.

3.5.1 Trial Mix

Trials have been made to prepare M30 grade of concrete as per specifications of IS 10262:2009. These trials have prepared with admixture (naphtha based super plasticizer).

3.5.2 Control Mix

Control mix was designed as per IS 10262:2009 specifications and recommendation which are given below.

Table 3.5 Control mix proportion For M30 (For 1 Cum. of Concrete)

S.No	Materials	Weight(Kg)	Slump(mm)
1	Cement(OPC-43)	357	115
2	Coarse aggregate(20mm)	694	
3	Coarse aggregate(10mm)	482	
4	Fine aggregate	721	
5	Water	168	
6	Admixture @ 1% of cement	3.57	
7	W/C Ratio	0.47	

3.5.3 Blended Mix

In this blend of control mix, variations had been made with sand. Sand was partially replaced in percentage by granite powder which varied from 5% to 30% at interval of 5% for concrete mix of M30.

Table 3.6 Partial replacement of fine aggregate with granite powder (5%) for M30

S.No.	Materials	Weight(Kg)	Slump(mm)
1	Cement(OPC-43)	357	102
2	Coarse aggregate(20mm)	694	
3	Coarse aggregate(10mm)	482	
4	Fine aggregate	685	
5	Granite powder	36	
6	Water	168	
7	Admixture @ 1% of cement	3.57	
8	W/C Ratio	0.47	

Table 3.7 Partial replacement of fine aggregate with granite powder (10%) for M30

S. No.	Materials	Weight(Kg)	Slump (mm)
1	Cement(OPC-43)	357	93
2	Coarse aggregate(20mm)	694	
3	Coarse aggregate(10mm)	482	
4	Fine aggregate	649	
5	Granite powder	72	
6	Water	168	
7	Admixture @ 1% of cement	3.57	
8	W/C Ratio	0.47	

Table 3.8 Partial replacement of fine aggregate with Granite Powder (15%) for M30

S. No.	Materials	Weight(Kg)	Slump (mm)
1	Cement (OPC-43)	357	86
2	Coarse aggregate (20mm)	694	
3	Coarse aggregate (10mm)	482	
4	Fine aggregate	613	
5	Granite powder	108	
6	Water	168	
7	Admixture @ 1% of cement	3.57	
8	W/C Ratio	0.47	

Table 3.9 Partial replacement of fine aggregate with granite powder (20%) for M30

S. No.	Materials	Weight(Kg)	Slump (mm)
1	Cement (OPC-43)	357	74
2	Coarse aggregate (20mm)	694	
3	Coarse aggregate (10mm)	482	
4	Fine aggregate	577	
5	Granite powder	144	
6	Water	168	
7	Admixture @ 1% of cement	3.57	
8	W/C Ratio	0.47	

Table 3.10 Partial replacement of fine aggregate with granite powder (25%) for M30

S. No.	Materials	Weight(Kg)	Slump (mm)
1	Cement (OPC-43)	357	62
2	Coarse aggregate (20mm)	694	
3	Coarse aggregate (10mm)	482	
4	Fine aggregate	541	
5	Granite powder	180	
6	Water	168	
7	Admixture @ 1% of cement	3.57	
8	W/C Ratio	0.47	

Table 3.11 Partial replacement of fine aggregate with granite powder (30%) for M30

S. No.	Materials	Weight (Kg)	Slump (mm)
1	Cement (OPC-43)	357	55
2	Coarse aggregate (20mm)	694	
3	Coarse aggregate (10mm)	482	
4	Fine aggregate	505	
5	Granite powder	216	
6	Water	168	
7	Admixture @ 1% of cement	3.57	
8	W/C Ratio	0.47	

Table 3.12 Consolidated table for partial replacement of fine aggregate with granite powder for M30

S. No	Mix Name	Cement (Kg)	Coarse aggregate		Granite powder (Kg)	Fine aggregate (Kg)	Water (Kg)	Admixture (Kg)	w/c ratio
			20 mm	10 mm					
1	Control Mix	357	694	482	-	721	168	3.57	0.47
2	GP C5	357	694	482	36	684.95	168	3.57	0.47
3	GP C10	357	694	482	72	648.9	168	3.57	0.47
4	GP C15	357	694	482	108	612.85	168	3.57	0.47
5	GP C20	357	694	482	144	576.8	168	3.57	0.47
6	GP C25	357	694	482	180	540.75	168	3.57	0.47
7	GP C30	357	694	482	216	504.7	168	3.57	0.47

IV. RESULTS AND DISCUSSIONS

4.1 Slump Test

This test was done to determine workability of concrete in fresh state. The results obtained after conducting slump test on control mix, GPC5, GPC10, GPC15, GPC20, GPC25 and GPC30 mixes for M30 grade were 115mm, 102mm, 93mm, 86mm, 74mm, 62mm and 55mm respectively. This pattern shows that slump decreases with increase in percentage of granite powder in concrete. The reason behind such behavior of concrete prepared with granite powder was rough surface and angular shape of granite powder. The dose of admixture and water to cement ratio were also kept constant for all mixes.

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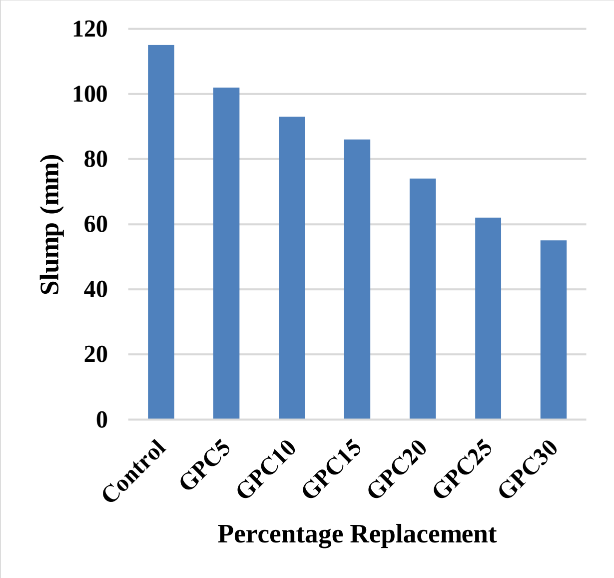

Figure 4.1 Variation in slump with enhancement of granite powder

4.2 Compressive Strength

For M30 grade, the compressive strength after 7 days was 26.97, 27.21, 27.91, 26.51, 25.5 and 22.37 MPa for GPC5, GPC10, GPC15, GPC20, GPC25 and GPC30 respectively. The compressive strength after 28 days was 42.62, 43.88, 45.24, 42.15, 39.97 and 34.18 MPa for GPC5, GPC10, GPC15, GPC20, GPC25 and GPC30. The compressive strength of control mix after 7 and 28 days is 26.43 and 41.35 MPa respectively for M30. As the granite powder particles are small, rough and angular in shape, so initially the granite powder particles start filling up the voids of the concrete matrix which result improvement in compressive strength till 15% of partial replacement of sand with granite powder i.e. GPC15.But after 15% of partial replacement of sand with granite powder, the voids of the concrete matrix by granite powder gets filled up and further addition of granite powder does not take part in concrete matrix and thus remains unutilized which results in decrease in compressive strength.

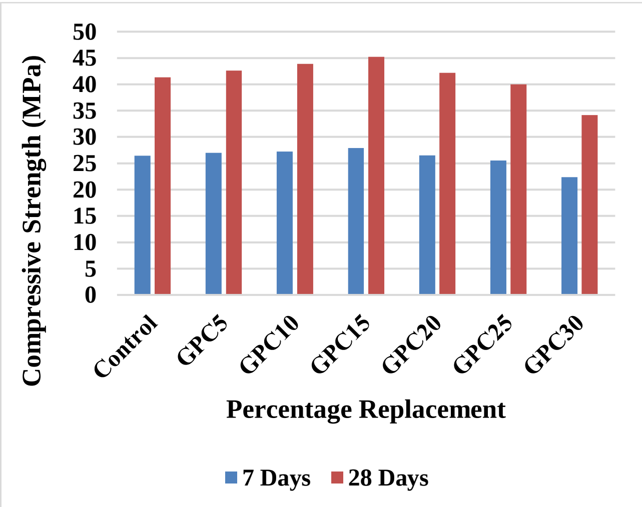

Figure 4.2 Variation in compressive strength with enhancement of granite powder

4.3 Flexural Strength

The flexural strength of the concrete was obtained by using centre point loading method. For M30 grade, the flexural strength for GPC5, GPC10, GPC15, GPC20, GPC25 and GPC30 was 5.03, 5.17, 5.68, 4.84, 4.08 and 3.19 MPa respectively. The flexural strength of Control Mix after 28 days of curing was 4.97 for M30. The pattern for flexural strength was similar as pattern obtained in compressive strength. The reason behind this behavior was particle size and shape of granite powder

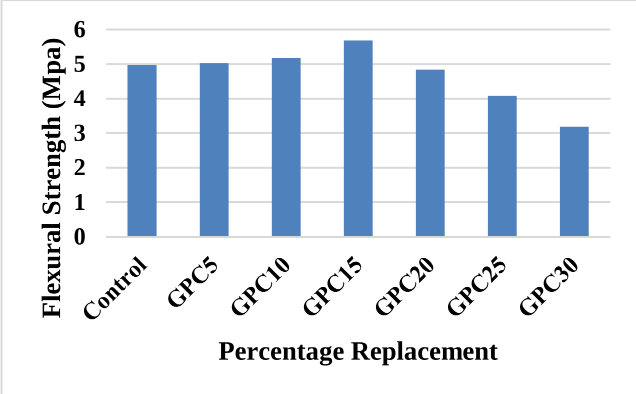

Figure 4.3 Variation in flexural strength with enhancement of granite powder

4.4 Split Tensile Strength

The behavior of split tensile strength for concrete mixes prepared with granite powder was similar as behavior obtained in results of compressive strength and flexural strength. The split tensile strength was checked after 28 days of curing. The split tensile strength for concrete mixes prepared with granite powder GPC5, GPC10, GPC15, GPC20, GPC25 and GPC30 was 2.94, 3.04, 3.15, 2.84, 2.12 and 1.54 MPa respectively. For Control Mix the split tensile strength was 2.9 MPa. The rough and angular particle of granite powder with higher fineness than river sand has helped in improving the strength of concrete up to 15% replacement of river sand. The effect on strength properties was also plotted in Figure 4.4.

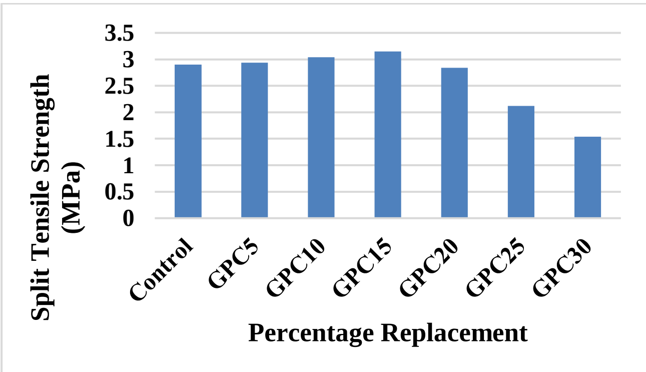

Figure 4.4 Variation in flexural strength with enhancement of granite powder

4.5 Water Absorption

Water absorption test was done to determine the percentage of moisture absorbed by the concrete in 24 hours. The water absorbed for concrete prepared with

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granite powder after curing and oven drying for 24 hours each was 10.72, 10.49, 9.92, 10.35, 10.89 and 12.63% for GPC5, GPC10, GPC15, GPC20, GPC25 and GPC30 respectively. The water absorbed by control mix was 11.16%. Initially, the water absorption is less up to 15% of partial replacement of sand with granite powder i.e. GPC15 as the granite powder particles fills the voids of concrete matrix because granite powder particles are fine, rough and angular in shape and thus concrete cube become dense. This outcome is satisfying the outcomes achieved in strength parameters. But beyond 15% further increment of granite powder does not takes part in concrete matrix and remain unutilized so the waster absorption increases.

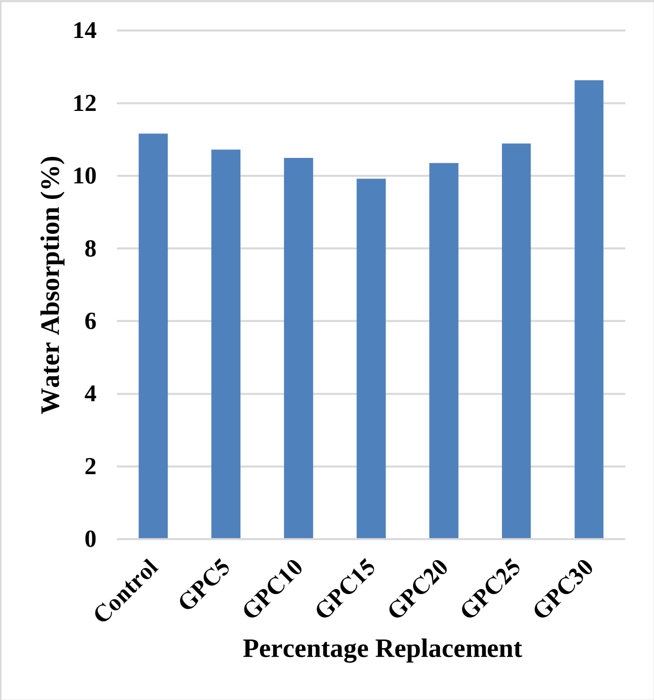

Figure 4.5 Variation in water absorption with enhancement of granite powder

4.6 Density

The density of M30 obtained for GPC5, GPC10, GPC15, GPC20, GPC25 and GPC30 was 2498, 2510, 2517, 2508, 2497 and 2473 kg/m^3 respectively. For control mix the density was 2495 kg/m^3. This test was done after 28 days of curing and oven drying for 24 hours. The parameters like density and water absorption were inversely proportional with each other. The density of concrete with granite powder was increased up to 15% replacement because the filling of voids takes place with fine, rough and angular particle of granite powder. After that fineness of granite powder was not contributing in filling of voids in concrete.

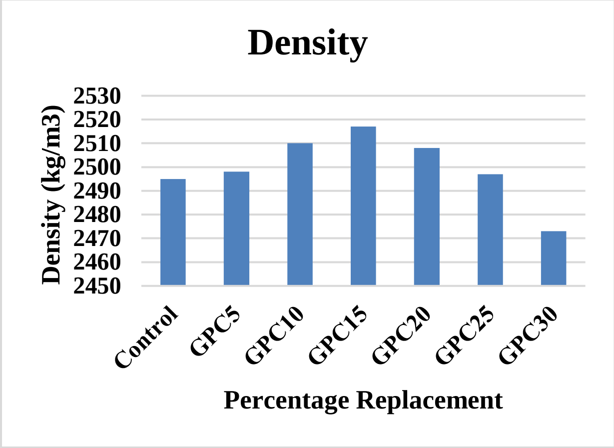

Figure 4.6 Variation in density with enhancement of granite powder

V. CONCLUSIONS

The test results show that granite powder has beneficial effects on concrete.

1. The slump decreased with successive partial replacement of sand with granite powder keeping w/c ratio and admixture constant.
2. Blending mix GPC15 showcased the highest 7 and 28 days compressive strength i.e. 27.91 and 45.24MPa respectively. This was possible as initially the granite powder particles started filling up the voids of the concrete matrix. On further successive partial replacement of sand with granite powder i.e. beyond GPC15, the compressive strength decreased by 19.84% and 24.4% for 7 and 28 days as the voids in the concrete matrix got filled and the additional granite powder did not take part effectively in concrete matrix and thus strength reduced.
3. Blend mix GPC15 had the highest flexural and split tensile strength i.e. 5.68 and 3.15MPa in comparison to other blend mixes and control mix.
4. This study indicates that physical and mechanical properties of the concrete can be enhanced by use of granite powder as a partial replacement material of sand up to a certain limit.
5. Granite powder can be a useful material in concrete when partially replaced with sand thereby easing the burden of excessive sand mining to an extent.

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