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Experimental Investigation of Strength and Durability Properties of Concrete by Using industrial by product Granite Powder and Polypropylene Fibre

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Abstract

This study focusing on experimental investigation of locally available granite industrial waste powder that is granite powder as fine aggregate and partial replacement of cement at constant rate. By this producing M30 concrete observe mechanical strength and durability properties of concrete. Influence water cement ratio and curing properties of concrete on mechanical properties of various mix proportions can be premeditated. The percentage of granite powder is added 0%, 12%, 14%, 16% replacement of fine aggregate. Cement can be replaced for cement at constant percentage at 7.5% weight of cement.

For maintain workability super plasticizer is added at 1% by weight of cement. For improving the tensile strength of concrete adding polypropylene fibers to concrete at 0.2%, 0.4% and 0.6% by weight of cement. Durability test conducted on 60days and 90days concrete with 1N by using NAOH pellets, at constant pH of solution. Tests conducted on concrete are compressive strength, split tensile strength and alkalinity attack test. Our study is expected to give good results and future scope. This work gives us how effectively we can use the industrial by products and how to use recycled aggregates in modern concretes.

Keywords:

Granite Powder;
Polypropylene Fibers;
super plasticizer;
sodium hydroxide (NAOH);
Alkalinity;
Workability;

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1. Introduction

Present construction industry looking towards the eco-friendly material for building construction but it is possible when the material availability so that our researchers, engineers all are using various types of waste produced from the various industries such as thermal power plants, steel plants, quarry dust and granite industry waste apart from this researchers producing new materials to reduce the impact to the environment.

2. Literature Review and Objectives:

C.B Echeta,E.E Ikaponmwosa and A .O Fadipe[1] " **Effect of partial replacement of granite with washed gravel on the strength and workability of concrete "** The maximum compressive strength at 28 days is 37.2 n/mm2 with 20%replacement of washed gravel, comparing with nominal 28 days strength 24.2 n/mm2.higher compressive strength we get at 20% to 40% replacement of gravel.

It is suggested that additional investigation on there is gradation effect which varies that gravel fines are more in concrete which give good strength increase in concrete mix.

A.Arivimagai , T. felixkala[2] "**Strength and durability properties of granite powder concrete** "this study mainly concentrated to Replace the use of River sand with granite powder to reduce environmental impact. The main parameter is M30 grade of concrete with replacement of granite powder as 0%,25% and 50% and cement was partial replacement with fly ash,slag,silica flume and super plasticizer.

T. felixkala and partheeman[3] "**granite powder concrete**" in this investigation possibility of use of granite powder as replacement of sand and partial The conclusions made by comparison of results that at 25% GP get good mechanical properties ,strength in concrete was increased with increase in curing time but with increase in curing temperature decrease in strength. Plastic shrinkage and dry shrinkage properties also more than the cc specimens, replacement of cement with fly ash, silica flum,slag and superplastisizer in concrete. Percentage of granite powder was added to the concrete was 0%,25%,50% and 100% and cement was replaced with 7.5% silica fume,10% fly ash,10% slag and 1% superplaticizer.

Dr T. felixkala[4] **"effect of granite powder on strength properties of concrete"** this study mainly focus on replacement of granite powder for M60 grade of concrete and partial replacement of cement with silica fume ,fly ash, and slag and superplasticizer. Finally what he was found that at 25% replacement of granite powder is beneficial to the concrete.

Mr. G Raja and Mr. K.M Ramalingam[5] **"Experimental study on partial replacement of fine aggregate by granite powder in concrete"** granite fines which are the by-product produced in granite factories while cutting huge granite rocks to the preferred shapes, at the same time as cutting the granite rock, the powder produced is carried by the water and this water is store in tank. The specimen casted with 40% replacement of granite fines to fine aggregate gives higher strength when compare to control specimen.

Sidharth sen and R nagavinodhini[6] **"Experimental study on polypropylene fiber and granite powder in concrete"**in this study mainly concentrated on replacement of granite powder to sand to effective use of waste.along with this polypropylenes are used to increase its life lime. They considered that 0.5%, 1.0% and 1.5% of Polypropylene fibers and use 5%, 10% and 15% granite powder. The investigation is carried out for M25 grade concrete for 7days and 28 days, finally the conclusions drawn from this is at 1.5% and 15% they get good mechanical properties. Further study need for beyond these proportions.

Kanmalai Williams C. , Partheeban P Felix Kala T[7] **"mechanical properties of high performance concrete Incorporating granite powder as fine aggregate"** experimental study on the high performance concrete made with granite powder as fine aggregate. The percentage of granite powder added by weight a range viz. 0, 25, 50, 75 and 100% as a replacement of sand used in concrete and cement was replaced with 7.5%Silica fume, 10% fly ash, 10% slag and 1% superplasticiser. The highest compressive strength was achieved in samples containing 25% granite powder concrete, which is 47.35 KPa after 90 days.

A. Arivumangai, and T. Felixkala[8] **" Strength and Durability Properties of Granite Powder Concrete"** most commonly used fine aggregate across world be sand. River sand is luxurious due to too much cost of transportation from natural sources. The main parameter investigated in this study is M30 grade concrete with replacement of sand by granite powder by 0, 25 and 50% and cement was partial replacement with silica fume, fly ash, slag and super plasticizer.The testresults showed improved durability when compared with conventional sample.

Objectives

1. To study the mechanical properties and durability properties of concrete with Granite Powder and Poly Propylene Fibers.

2. To find out the optimum percentage of replacement of cement and sand with granite powder with also addition of PPF.

3. Materials and methods

Apart from OPC and Natural Sand and Gravel, Granite powder wastes majorly produced from tamilnadu state in process of sawing and polishing of granite stones was used .Granite powder is a non biodegradable material produced from granite industries so we need to use it to reduce wastes.

In this study Polypropyleneis used and it is easy material to be injected into mould due to its semi crystalline nature. For increase in mechanical properties of monomers need for high molecular weight so that it leads to low viscosity. The pseudo plastic nature of polypropylene enhances this effect at high shear rates.For injection moulding temperature required is 200 to250^{o}C.It may be increased based on the time up to 280 to 300oc.for the flame retardant grades it recommended that not exceed 220^{0}C.at mould filling rates are generally on the high side to provide good surface finish and strong mouldings free of welding lines and flow front. Sufficient vent of the mould is important to prevent flame marks.

For melting flow habit to the monomers are assigning by melt flow index but due to pseudo plastic nature of polypropylene this should not be taken to literally. Sometimes spiral flow mould data is provided for easy flow of monomers. But this is no substitute for the fundamental melt rheological and thermal data which is now becoming more widely available.

Moulding shrinkage of pp is almost 1% but it is difficult to identify the value of moulding shrinkage due to influence of moulding conditions. These are important factors which affect the shrinkage of polypropylene mouldings:

Table -1: Physical Properties

Tensile strength	0.95-1.30 N/mm^2
Notched impact strength	3.0-30.0KN/m^2
Thermal coefficient of extension	100-150 x10-6
Density	0.905g/cm^3

Table-2: Resistance to Chemicals

Description	**Rating**
Dilute acid	Very good
Dilute alkalis	Very good
Oils and greases	Moderate
Aliphatic hydrocarbons	Poor
Aromatic hydrocarbons	Poor
Halogenated hydrocarbons	Poor
Alcohols	Very good

Table-3: Polypropylene used

S.No.	Properties
1	Name : Recon 3s
2	Shape : Polypropylene Triangular Fiber
3	Type : CTP2424
4	Length : 12mm
5	Use : 900grms/m3

Methods of Testing: The tests carried out are tensile strength, compressive strength and alkalinity attack test.

4. Results and Discussion:

We are conducted various tests on harden concrete. The results obtained from the test are must comparable with conventional concrete. These comparing will give brief idea about mix we completed.

Table - 4: Compressive Strength value

S.No.	Days	Compressive Strength[N/mm^2]
1	3	17.22
2	7	23.11
3	14	29.45
4	28	33.2
5	60	37.98
6	90	39.62

In the spilt tensile strength of conventional concrete at 90 days maximum strength is 2.05 N/mm^2.

Table –5: Split Tensile Strength Value

S.No.	Days	Split Tensile Strength[N/mm^2]
1	28	1.53
2	60	1.75
3	90	2.05

In conventional concrete at 90 days we get compressive strength is 40.44 N/mm2.for alkalinity test increase in strength of concrete.

Table - 6: Alkalinity Test values

S.No.	Days	Compressive Strength[N/mm^2]
1	60	36.44
2	90	40.44

Table-7 show results of compressive strength of concrete at 0.2% polypropylene fiber for various mix proportions.

S.No.	Days	CC	0-0.2%	12-0.2%	14-0.2%	16-0.2%
1	3	17.22	18.88	18.44	18.66	18.22
2	7	23.11	24.66	23.55	25.24	23.11
3	14	28.54	25.11	24.44	29.45	24.21
4	28	33.20	26.66	29.33	33.11	28.85
5	60	37.98	34.88	34.44	35.11	33.77
6	90	39.62	36.66	36.44	36.44	35.86

Table-8 show results of compressive strength of concrete at 0.4%polypropylene fiber for various mix proportions.

S.No.	Days	CC	0-0.4%	12-0.4%	14-0.4%	16-0.4%
1	3	17.22	21.11	20.00	21.77	19.25
2	7	23.11	25.33	24.00	24.88	23.55
3	14	29.45	28.00	26.88	29.77	27.11
4	28	33.22	31.11	30.22	32.44	29.77
5	60	37.98	36.88	36.22	36.66	35.77
6	90	39.62	37.55	37.11	38.22	36.44

Table-9 show results of compressive strength of concrete at 0.6%polypropylene Fiber for various mix proportions.

S.No.	Days	CC	0-0.6%	12-0.6%	14-0.6%	16-0.6%
1	3	17.22	21.11	20.22	21.33	20.88
2	7	23.11	23.11	22.22	23.55	22.66
3	14	29.45	28.00	26.48	28.88	27.55
4	28	33.20	30.88	30.44	31.11	30.66
5	60	37.98	36.00	35.55	36.44	34.66
6	90	39.62	36.88	36.44	37.55	36.44

Table-10 show results of Split tensile strength of concrete at 0.2%polypropylene fiber for various mix proportions.

S.No.	Days	CC	0-0.2%	12-0.2%	14-0.2%	16-0.2%
1	28	1.53	1.64	1.75	1.82	1.72
2	60	1.75	1.85	1.90	1.96	1.85
3	90	2.05	2.13	2.21	2.54	2.15

Table-11 show results of Split Tensile strength of concrete at 0.4%polypropylene fiber for various mix proportions.

S.No.	Days	CC	0-0.4%	12-0.4%	14-0.4%	16-0.4%
1	28	1.53	1.86	1.85	1.98	1.81
2	60	1.75	2.41	2.31	2.56	2.24
3	90	2.05	3.51	3.80	3.98	3.75

Table-12 show results of split tensile strength of concrete at 0.6%polypropylene fiber for various mix proportions.

S.No.	Days	CC	0-0.6%	12-0.6%	14-0.6%	16-0.6%
1	28	1.53	1.70	1.71	1.86	1.75
2	60	1.75	2.35	2.58	2.98	2.35
3	90	2.05	2.70	3.05	3.45	2.98

Table - 13: Alkalinity attack test (Compressive Strength) at 0.2%polypropylene fiber for various mix proportions.

S.No.	Days	CC	0-0.2%	12-0.2%	14-0.2%	16-0.2%
1	56	32.44	32	32.44	32.66	40

Table - 14: Alkalinity attack test (Compressive Strength) at 0.4% polypropylene fiber for various mix proportions (60 days)

S.No.	Days	CC	0-0.4%	12-0.4%	14-0.4%	16-0.4%
1	60	32.44	33.33	36.44	36.88	40.44

Table - 15: Alkalinity attack test (Compressive Strength) at 0.6% polypropylene fiber for various mix proportions (60 days)

S.No.	Days	CC	0-0.6%	12-0.6%	14-0.6%	16-0.6%
1	60	32.44	36.44	36.88	37.33	40.88

The Table-16 show results of compressive strength [alkalinity] of concrete at 0.2%polypropylene fiber for various mix proportions.

Table - 16: Alkalinity attack test (Compressive Strength) at 0.2 % polypropylene fiber for various mix proportions 90 days

S.No.	Days	CC	0-0.2%	12-0.2%	14-0.2%	16-0.2%
1	90	36.44	37.33	37.33	37.55	39.55

The Table-17 show results of compressive strength [alkalinity] of concrete at 0.4%polypropylene fiber for various mix proportions.

Table - 17: Alkalinity attack test (Compressive Strength) at 0.4% polypropylene fiber for various mix proportions 90 days

S.No.	Days	CC	0-0.4%	12-0.4%	14-0.4%	16-0.4%
1	90	36.44	37.11	37.55	37.77	41.33

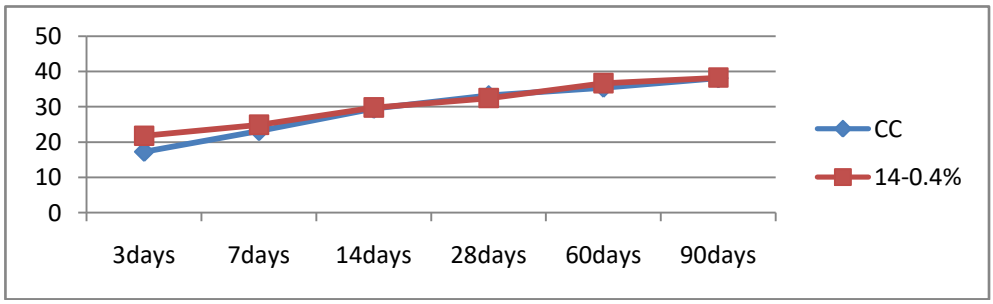
The Table-18 show results of compressive strength [alkalinity] of concrete at 0.6%polypropylene fiber for various mix proportions.

Table - 18: Alkalinity attack test (Compressive Strength) at 0.6% polypropylene fiber for various mix proportions 90 days

S.No.	Days	CC	0-0.4%	12-0.4%	14-0.4%	16-0.4%
1	90	36.44	36.88	37.33	38.00	41.11

Table-19 show results of compressive strength of concrete at14- 0.4%polypropylene fiber for compression with Conventional Concrete (CC), which is also depicted in graph 1.

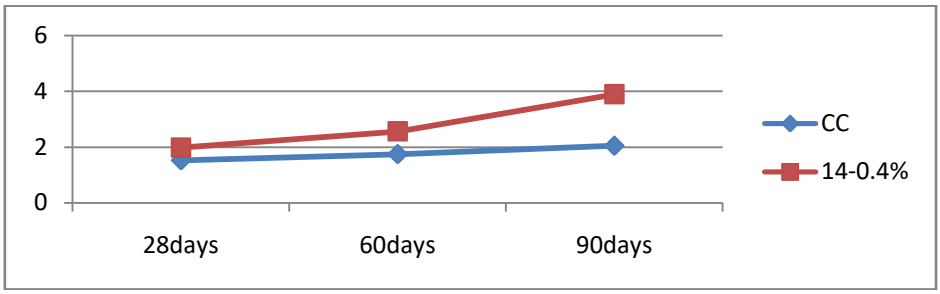
S.No.	Days	CC	14-0.4%
1	3	17.22	21.77
2	7	23.11	24.88
3	14	29.45	29.77
4	28	33.20	32.44
5	60	35.42	36.66
6	90	38.10	38.22



Graph 1: Showing comparison of CC and 14-0.4% mix

Table-20 show results of split tensile strength of concrete at 14- 0.4% polypropylene fiber for compression with conventional concrete which is also depicted in graph 2.

S.No.	Days	CC	14-0.4%
1	3	1.53	1.98
2	7	1.75	2.56
3	14	2.05	3.89

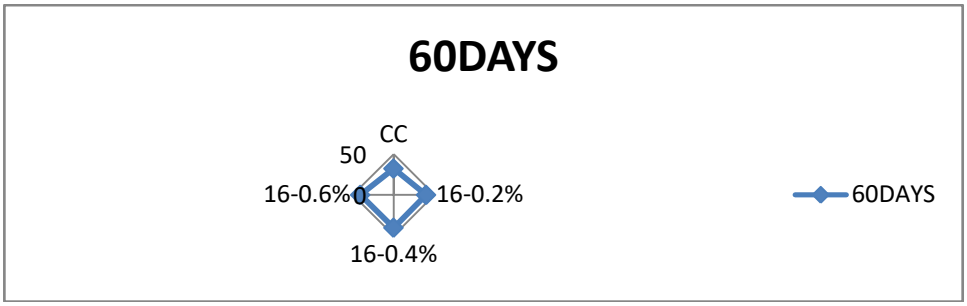


Graph 2: Showing comparison of CC and 14-0.4% mix

Table-21 show results of compressive strength [alkalinity] of concrete various proportions of polypropylene fiber with conventional concrete which is also shown in graph 3.

Table - 21: Comparison of CC and Mix Proportions for 50 days

S.No.	Days	CC	16-0.2%	16-0.4%	16-0.6%
1	60	32.44	40	40.44	40.88

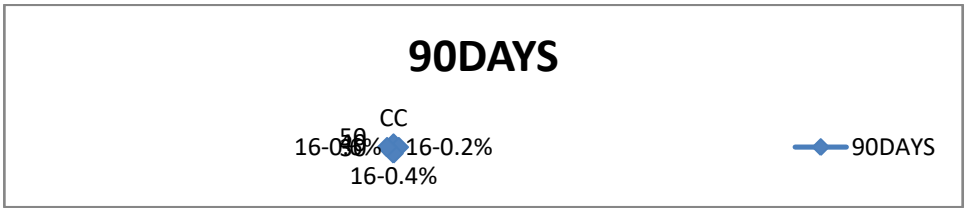


Graph 3: Showing comparison of CC and 16% proportion mix

Table-22 show results of compressive strength [alkalinity] of concrete various proportions of polypropylene fiber with conventional concrete which is also depicted in graph 4

Table - 22: Comparison of 90 days CC and Mix Proportions for 90 days

S.NO	Days	CC	16-0.2%	16-0.4%	16-0.6%
1	90	36.44	39.55	41.33	41.55



Graph 4: Showing comparison of CC and 16% proportion mix

5. Conclusion

Our study mainly consisting of replacement of granite powder for sand and cement. Concrete properties taken in as limited, in literature in many papers, particularly we concerns development strength, tensile strength, compressive strength and alkalinity attack test, cost comparison study. We coming to following conclusion from results obtained:

In addition with granite powder to concrete there is increase in strength of concrete compared to conventional concrete. By addition of polypropylene fibers great increase in split tensile strength of concrete is observed. At constant rate of replacement of cement with GP, it was observed that at all the ages of concrete compressive and split tensile strengths increased. At 14-0.4% replacement of granite powder in concrete, there is optimum results we can obtained in both tensile strength and compressive strength. While conducting Alkalinity test for 60days and 90 days it was found that there is increase in strength of concrete at constant rate of pH value.

Cost of concrete can increase due to use of granite powder along with super plasticizer and polypropylene fiber. The only parameter that can control the cost in my study is super plasticizer and polypropylene fiber. For making concrete is workable, super-plasticizer in all mix proportions were used.

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