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Study on Strength Characteristics of Concrete with Partial Replacement of Cement by Granite Powder and Fine Aggregate by Quarry Dust

S.Sengottaiyan[1], M.Muthumurugan[1], Mrs. U.Nandhini[2]
[1]*Student,B.E civil engineering, Arjun College of Technology, Coimbatore, India*
[2]*Assistant Professor, department of civil engineering, Arjun College of Technology Coimbatore .India*

Abstract: In this project the concrete making materials are replaced to some extent with the naturally available waste products. In order to reuse the waste material, I have replaced the cement and fine aggregate quantities partially in the concrete. The cement is replaced with granite powder in the percentages of 10%, 20%, 30% and the fine aggregate is replaced with the percentages of 15%, 30% and 45% in the M40 grade concrete. The tests are carried out for the determination of compressive, split tensile strength at 7, 14, 28 days. The results are going to be compared with normal conventional concrete.

I. INTRODUCTION

A. General

Concrete is one of the most widely used construction material throughout the world the advantage of it being is it can be mould in to any shape and can be made to take required compressive strength in additional to compressive strength by increasing split tensile strength, the load bearing capacity can be increased approximately. The ingredients for making concrete are cement fine aggregate, coarse aggregate and water. Sometimes creative additives are added to it to improve or alter some properties making concrete is an art which one has to be perfectly through otherwise that will end up with bad concrete. Hence as a civil engineer one should be through with the entire factor of concrete from which he can produce a good concrete.

Granite has been commonly used as a building material since the ancient times. The industry's disposal of the granite powder material, consisting of very fine powder, today constitutes one of the environmental problems around the world. Granite black are cut into smaller blocks in order to give them the desired smooth shape. During the cutting process about 20% the original granite mass is lost in the form of dust. The granite dust settled by sedimentation and then dumped away which results in environmental pollution, in addition to forming dust in summer and threatening both agriculture and public health. Therefore, utilization of the granite dust in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the environment.

In addition to granite powder, silica fume, fly ash, pumice powder and ground granulated blast furnace slag are widely used in the construction sector as a mineral admixtures instead

Fig.2 Quarry dust

B. Waste Granite Powder

The granite powder was obtained in wet form as an industrial by product directly from the deposits of granite Industries which forms during the sawing, shaping from PRP granite factory. The wet granite sludge was dried up prior to the preparation of the

samples. The dried material was sieved through a 90 micron sieve and finally the granite dust was obtained to be used in the experiments as cement.

C. Quarry Dust

The dust is collected from kinathukadavu near the coimbatore. The quarry dust is the by product which is formed in the processing of the granite stones which broken down into the different size of coarse aggregates.

Fig.1 Granite powder

D. Objective

Investigate the performance of cement concrete with a granite powder as a partial replacement for cement in concrete.

II. LITRATURE REVIEWS

A. Bouziani Tayeb

et all They investigated the effect of granite content (GP) on the properties of the sand concrete at fresh and hardened states. The properties of the fresh prepared mixes tested are the mini-sludge flow, the V-funnel flow time and viscosity. At the hardened state, the parameter which has been determined is the 28-day Compressive strength. The obtained test results show that the increase of GP content in SCSC, from 150 kg/m3 to 350 kg/m3, improves the properties at fresh state by decreasing v-funnel flow time (from 5s to 1.5s) and increasing the mini-cone slug (from 28cm to 34cm). With the use of 250 kg/m3 of GP we can reach the highest initial viscosity while retaining good fluidity at high rotational speeds, to the GP contents of 150 kg/m^3 and 350 kg/m^3. In other hand, the 28-days compressive strength decreases with an increase of GP content.

B. Hanifi Binici

et all some mechanical properties of concrete containing Granite Powder (GP) and Quarry dusts (QD) were investigated. Seven concrete mixtures were produced in three series with control mixes having 400 kg cement content. These control mixes were modified to 5, 10 and 15 % GP and QD in place of fine sand aggregate. The compressive strengths of concrete were measured for 7, 28, 90 and 360 days and sodium sulphate resistance were for 12 months. Also, abrasion resistance and water penetration of concretes were investigated. Results indicate that MD and LD fine aggregate concrete has good workability and abrasion resistance is comparable to that of conventional concrete. They also showed that maximum abrasion rate is obtained from control specimen, while minimum abrasion rate is obtained from MD3 specimens. Abrasion resistance is increased as the rate of fine MD and LD is increased. Furthermore, the results indicated that the increase in the dust content caused a significant increase in the sodium sulphate resistance of the concretes. Therefore, the studied MD and LD can be used for more durable concrete production.

C. Testing Programme

1) Material usedFine aggregate should be properly graded to give minimum void ratio and be free from deleterious materials like clay, silt content and chloride contamination etc., Grading of fine aggregate should be such that it does not cause increase in water demand for the concrete and should give maximum voids so that the fine cementitious particles to fill the voids. Hence it is desirable to use the coarser variety of fine aggregate having a high fineness modulus for making workable and strong

concrete.

2) The following tests were carried out on sand as per IS: 2386- 1968

a) Specific Gravity

b) Sieve analysis and Fineness Modulus

c) Bulk density

d) Water absorption

Table 3.3 Test on Fine Aggregate

1.	Specific gravity	2.65
2.	Percentage of voids	24.5%
3.	Fineness modulus	2.934
4.	Bulk density	1.780 kg/m^3
5.	Water absorption	1.2%

Table 3.4 Sieve analysis for sand

D. Coarse Aggregate

Coarse Aggregate consists of natural occurring stones (crushed, uncrushed or broken). It should be hard, strong, dense, durable, and clean. It should be roughly cubical in shape. Flaky pieces should be avoided. It should confirm to IS: 2383(I). The coarse aggregate should be clean, hard, non porous, free from lumps of clay and vegetable matter. Water absorption of aggregate should not more than 10 % of its weight after 24 hours immersion in water. Angular and roughly cubicle particles are ideal.

Sl. no	Sieve size (mm)	Weight retained (gms)	cumulative Weight retained (gms)	Cumulative % retainer	% finer
1	20	0	0	0	100
2	12.5	175	175	8.75	91.25
3	10	1020	1195	59.75	40.25
4	4.75	785	1980	99	1
5	2.36	20	2000	100	0
6	Pan	0	2000	100	0

1) The following tests were carried out on Coarse aggregate as per IS: 2386- 1968

2) Specific Gravity

3) Sieve analysis and Fineness Modulus

4) Bulk density

Table 3.3 Test on coarse Aggregate

1.	Specific gravity	2.74
2.	Fineness modulus	4.63
3.	Bulk density	1.780 kg/m^3
4.	Water absorption	0.8%

E. Water

Water is an important ingredient of cement mortar as it chemically participates in the reactions with cement to form the hydration product, C-S-H gel. The strength of cement mortar depends mainly from the binding action of the hydrated cement paste gel. Higher water – cement ratio or water binder ratio will decrease the strength, durability, water – tightness and other related properties of cement mortar.

For high performance cement mortar mix consideration, it is important to have the compatibility between the given cement and the chemical and mineral admixtures along with water used for mixing. High Performance Cement mortar with its high content of cementitious material is susceptible to a rapid loss of workability on account of high amount of heat of hydration generated. Therefore attention is required to see that the initial hydration rate of cement should not be significantly affected. Quality and quantity of water is required to be looked very carefully.

F. Granite Powder

1) Physical Properties of Granite PowderA granite powder was used, which was obtained as a by-product of granite sawing and shaping. Its specific gravity was 2.55 kg/m^3 and the value of Blaine fineness was 1.50 m^2/g. It can be observed that the granite powder had a high specific surface area; this could mean that its addition should confer more cohesiveness to mortars and concretes. For better physical characterization of the granite powder, its grain size distribution was performed using laser diffraction. It can be observed that 50% of particles had a diameter of 7 μm (d_{50} = 7 μm) and 90% of particles had a diameter lower than 50 μm (d_{90} = 50 μm). The granite powder is produced as "slurry", a mud made of powder and water. Therefore, for its use in concrete it is important to know how much water is contained in the slurry, by drying it and registering the weight loss related to water evaporation. A known weight of slurry was put in an oven to dry at a temperature of 110±5°C. At fixed intervals (1 hour, 4 hours, 24 hours, 48 hours, and 72 hours) the weight loss was registered with the aim to reach a constant weight. It is evident from the graph that the sample loses water quickly and reaches the constant weight after about 24 hours.

2) Chemical properties of used granite powder.

Oxide compounds (mass %)	Granite Dust
SiO2	28.35
Al2O3	0.42
Fe2O3	9.70
CaO	40.45
MgO	16.25

3) Preparation Of Specimen Test specimens were cast using seven variable percentages of granite powder and quarry dust namely, 0%,&0% 10%&15%, 20%&30%, and 30%&45% for each specimen. Ordinary Portland cement conforming to IS 269-1976, river sand and coarse aggregate with 20 mm maximum size were used. The mix was designed for a 28 day cube compressive strength of 40 N/mm^2 as per IS 10262-2009. Same mix was used to cast GP and conventional concrete specimens The specimens were cast in a steel mould and compaction was effected a table vibrator. However to eliminate the effect of possible fibre orientation, concrete mix was filled three layer in a mould. No signs of segregation or air bubbles were observed during casting. The specimens were remoulded after 24 hours and then placed in a curing tank with 90% relative humidity and 23°C for 28 days of curing. For 12 h prior to the testing, the specimens were allowed to air dry in the laboratory.

Sl no	TEST OF SPECIMEN	% of granite powder replaced	% of quarry Dust
1	C	0	0
2	C1	10	15
3	C2	20	30
4	C3	30	45

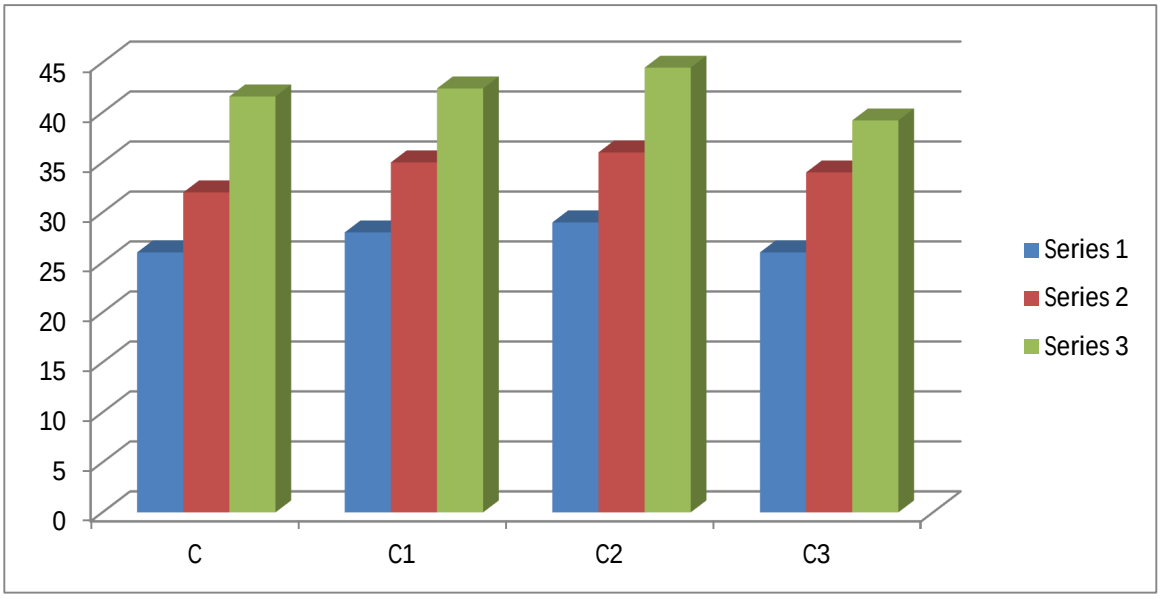
G. Testing Of The Specimen

For each bath of concrete 3 cubes of 150mmx150mmx150mm determine compressive strength of concrete , 6 cylinder of 150mm diameter and 300mm length were tested to determine split tensile strength of concrete

III. RESULT AND DISCUSSIONS

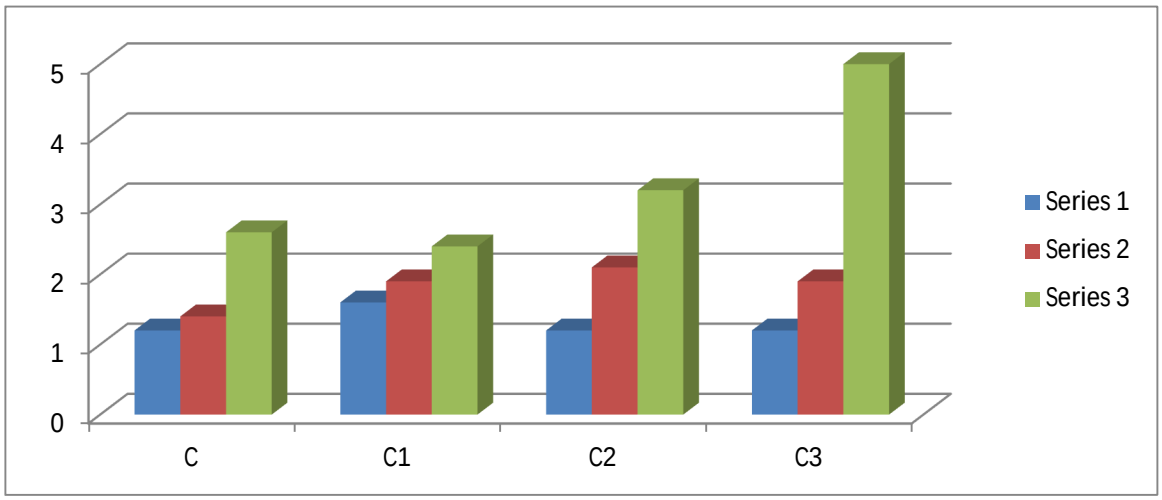
A. Compressive strength result

SL.NO	TEST OF SPECIMEN	% OF CEMENT REPLACED WITH GRANITE POWDER	% OF SAND REPLACED WITH QUARRY DUST	COMPRESSIVE STRENGTH(N/mm^2)		
				7 DAYS	14DAYS	28 DAYS
1	C	0	0	26	32	41.60
2	C1	10	15	28	35	42.40
3	C2	20	30	29	36	44.48
4	C3	30	45	26	34	39.20



B. Split Tensile Strength Result

SL.NO	TEST OF SPECMEN	% OF CEMENT REPLACED WITH GRANITE POWDER	% OF SAND REPLACED WITH QUARRY DUST	SPLIT TENSILE STRENGTH(N/mm^2)		
				7 DAYS	14 DAYS	28 DAYS
1	C	0	0	1.2	1.4	2.60
2	C1	10	15	1.6	1.9	2.40
3	C2	15	30	1.2	2.1	3.2
4	C3	20	45	1.2	1.9	2.8



IV. CONCLUSION

Form the results of experimental investigations concluded that the waste material form quarry and granite factories can be used as a replaced for cement and fine aggregate it is found that 20% replacement of fine aggregate by industrial waste give maximum result in strength and quality aspects than the conventional concrete. The results are proved that the replacement of 20% of fine aggregate by the industrial waste induced compressive strength split tensile strength is higher. Thus the environmental effects form the industrial waste can be significantly

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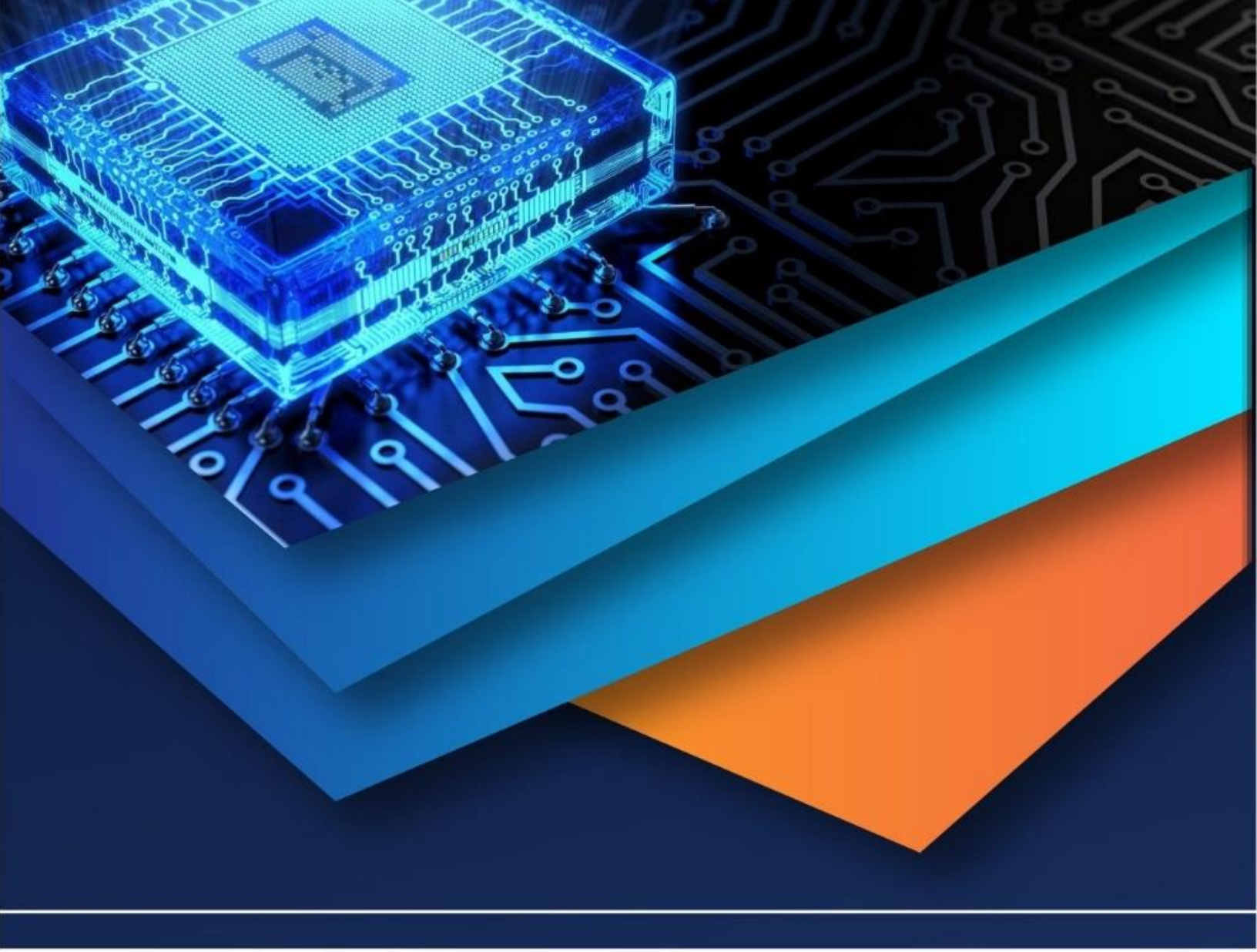

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