An Experimental Study on Partial Replacement of Sand By Quarry Dust And Cement With Silica Fume In Concrete

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Abstract- *Concrete is a versatile building material in the world wide and stand at second place in consumption after water. Therefore the cost of the construction material is increasing day to day and rich peoples and government can afford it but middle class can't afford it. the extensively use of concrete which lead to increase in use of natural sand which resulting in reduction of sand sources the government has banned sand mining due to environmental problems in some of the areas and cement emitting CO_2 to environment which lead to environmental problems. An alternate material has to be used in place of cement by silica fume and fine aggregate by quarry dust.*

This project features an experimental study on the nature of silica fume and quarry dust and its influences on the properties of fresh and hardened concrete. In the present study, an attempt has been made to investigate the strength parameters of concrete made with partial replacement of cement by silica fume and Fine aggregate by quarry dust. Very little or no work has been carried out using silica fume as partial replacement of cement and quarry dust by fine aggregate. In the present study the Compressive strength, density, has been determined for M20 with different mix percentage (Q10 +S5, Q10+S10, Q20+S5, Q20+S10, Q30+S5, Q30+S10) the combinations of materials and these values are compared with the corresponding values of conventional concrete. The present investigation has been aimed at to bring awareness amongst the practicing civil engineers regarding advantages of these new concrete mixes.

Keywords- Quarry Dust, Silica Fume and Compressive Strength.

I. INTRODUCTION

Sustainability was a big issue that being concern in making a development. This is because sustainable development has become a key aspect in society, Economics and development. Sustainable development shall meet the needs of the present without compromising ability of future generation to meets their own needs. It also shows that development that going to be made to sustain the planetary resources by using them effectively without making unnecessary wastage. The usage of Quarry dust and silica fumes to replace the fine aggregate &cement.The addition of quarry dust to normal concrete mixes is limited because of its high fineness. The addition of quarry dust to fresh concrete increases the water demand and consequently the cement content for given workability and strength requirement however potential benefits to using quarry dust is the cost having, because the material cost varies depending on the source.Silica fume is usually categorized as a supplementary cementitious material. It has excellent pozzolanic properties. This term refers to materials that are used in concrete in addition to Portland cement, is because the production of the cement emits carbon dioxide gas to atmosphere. The cement industry is held responsible for some of the carbon dioxide emission, because the production of one ton Portland cement emits approximately one ton of carbon dioxide gas into the atmosphere. The emission of carbon dioxide will increase the effect of global warming due to the emission of greenhouse gasses. Among the greenhouse gasses, carbon dioxide contributes about 65% of global warming.

II. MATERIALS USED

- Cement
- Fine Aggregate (FA)
- Coarse Aggregate (CA)
- Quarry Dust (QD)
- Silica Fume (SF)

Cement

Cement is one of the binding materials in this project. Cement is the important building material in today's construction world. 53 grade Ordinary Portland Cement (OPC) conforming to IS: 8112-1989 is used. Specific gravity of cement = 3.12

Table 2.1 physical properties of cement

Description of test	Test results obtained	Requirements of IS: 8112 1989
Initial setting time	64 minutes	Min. 30minutes
Final setting time	260 minutes	Max. 600minutes
Fineness	410.94 m2/kg	Min. 225 m^2/kg

Fine Aggregate

Locally available clean and dry manair river sand conforming to Grading zone II of IS: 383 –1970.has been used. The sand passing through IS 4.75mm Sieve has been used for casting all the specimens.

The specific gravity =(w2-w1)/(w2-w1) - (w3-w4)=2.6
Water absorption =6.7%
Fines modulus = 3.63

Coarse Aggregate

The crushed 20 mm size aggregate were used
The specific gravity = 2.68
Water absorption = 1%
Fines modulus =6.52

Quarry Dust

The quarry dust is the by-product which is formed in the processing of the granite stones which broken downs into the coarse aggregates of different sizes.

Figure 2.1 Quarry Dust

Physical Properties: The physical and chemical properties of quarry dust obtained by testing the sample as per the Indian Standards are listed in the below table

Table 2.2 Physical Properties Of quarry dust

Properties	Quarry Dust
Specific gravity	2.54-2.60
Bulk density(kg/m^3)	1720-1810
Absorption(%)	1.20-1.50
Moisture content (%)	Nil
Fine particles<0.075mm(%)	12-15
Sieve analysis	Zone II

Silica Fume

Silica fume, also known as microsilica.It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles with an average particle diameter of 150 nm. The main field of application is as pozzolanic material for high performance concrete.It is sometimes confused with fumed silica (also known as pyrogenic silica, CAS number 112945-52-5). However, the production process, particle characteristics and fields of application of fumed silica are all different from those of silica fume.One of the most beneficial uses for silica fume is in concrete. Because of its chemical and physical properties, it is a very reactive pozzolan. Concrete containing silica fume can have very high strength and can be very durable.

The raw materials are quartz, coal, and woodchips. The smoke that results from furnace operation is collected and sold as silica fume, rather than being landfilled. Perhaps the most important use of this material is as a mineral admixture in concrete. Silica fume consists primarily of amorphous (non-crystalline) silicon dioxide (SiO_2). TM C 1240 and AASHTO M 307. The individual particles are extremely small, approximately 1/100th the size of an average cement particle. Because of its fine particles, large surface area, and the high SiO_2 content, silica fume is a very reactive pozzolan when used in concrete.

Fig 2.2 Silica Fume

Properties of Silica Fume

Table 2.3 properties of Silica Fume

S.No	Property	Test Results
1.	Specific gravity	2.2
2.	Bulk Density	576,(kg/m³)
3.	Size,(micron)	0.1
4.	Surface Area,(m²/kg)	20,000
5.	Sio2	(90-96)%

III. EXPERIMENTAL PROCEDURE

In the present experimental work. First, the material, mix proportions, manufacturing and curing of the specimens are explained. This is then followed by description of types of specimens used, test parameters, and test procedures. Development of the process of making Quarry Dust and Silica Fume concrete. In this mix we are used Quarry dust & Silica Fume.To achieve the objectives of the investigation the experimental program was planned to cast around 21 cubes with different percentages of QD and SF.

Mix Design: The concrete mix design was proposed by using Indian Standard for control concrete.The mix proportion of materials is 1:1.5:3 as per IS 10262-2009.The water cement ratio is maintained to 0.5. In this mix design we have replaced sand by quarry dust & cement with silica fume The grade was M20 concrete with different percentages 0%,10%+5%, 10%+10%,20%+5%,20%+10%,30%+5 and,30%+10%.

Fig3.1 Mixing

Casting

The Quarry Dust and Silica Fume concrete is manufactured by as similar to the classical concrete. Initially the dry materials Cement, Aggregates & Sand are mixed. The liquid component of the mixture was then added to the dry materials and the mixing continued for further about 3-6 minutes to manufacture the fresh concrete. The fresh concrete was cast into the moulds immediately after mixing, in three layers for cube specimens. For compaction of the specimens, each layer was given 60 to 70 manual strokes using a tapping rod, and then vibrated for 12 to 15 seconds on a vibrating table. Before the fresh concrete was cast into the moulds, the slump value of the fresh concrete was measured.

Fig 3.2 Casting

Table 3.1 values of slump & compaction factor.

S. No	Percentage	Slump Test In mm	Compaction Factor Test
1	0%	80	0.88
2	Q10+S5	100	0.90
3	Q10+S10	90	0.92
4	Q20+S5	110	0.92
5	Q20+S10	90	0.94
6	Q30+S5	80	0.94
7	Q30+S10	74	0.95

IV. TESTING PROCEDURE

An intensive experimental program is performed to study the effect of internal curing on different types of concrete properties: (i) Fresh properties (Slump, Compaction factor); (ii) Mechanical properties like compressive strength,. The cubes were tested under 200 tons compression testing machine to study the compressive strength of the cubes.

Compressive Strength Test

At the time of testing, each specimen must keep in compressive testing machine. The maximum load at the breakage of concrete block has been noted. From the noted values, the compressive strength has been calculated by using formula:

Compressive Strength = Load / Area
Size of the test specimen = 150mm x 150mm x 150mm

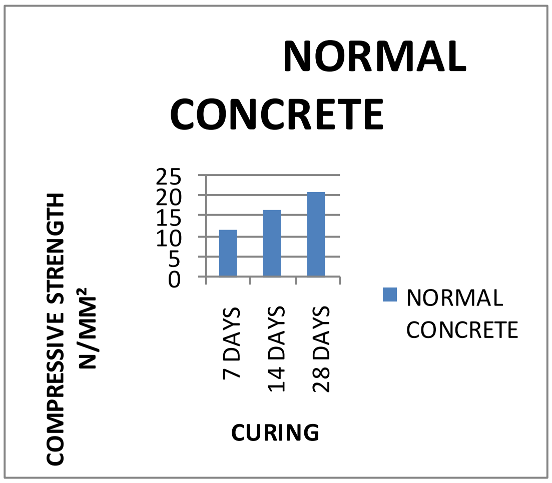
TEST RESULT

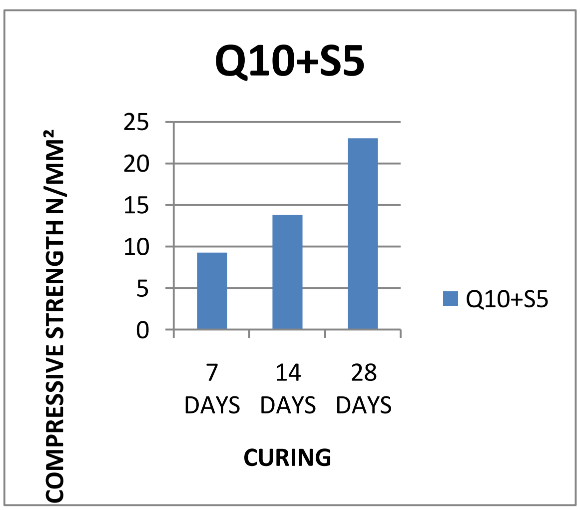
Compressive strength test

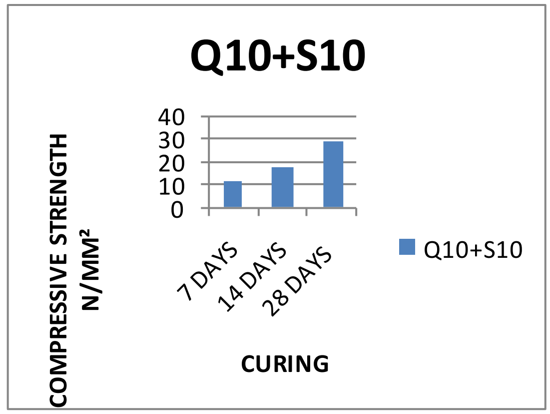
Table 4.1 Compressive Strength Test Result

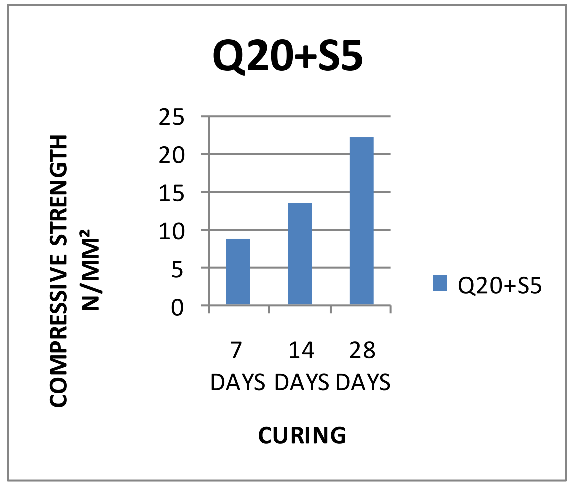
% Replacement		Compressive Strength N/MM²		
QD	SF	7 Days	14 Days	28 Days
0%	0%	11.15	16.48	20.8
10%	5%	9.2	13.8	23
10%	10%	11.46	17.2	28.66
20%	5%	8.8	13.33	22.22
20%	10%	9.64	14.46	24.1
30%	5%	8.7	13	21.6
30%	10%	9	14.2	22.54

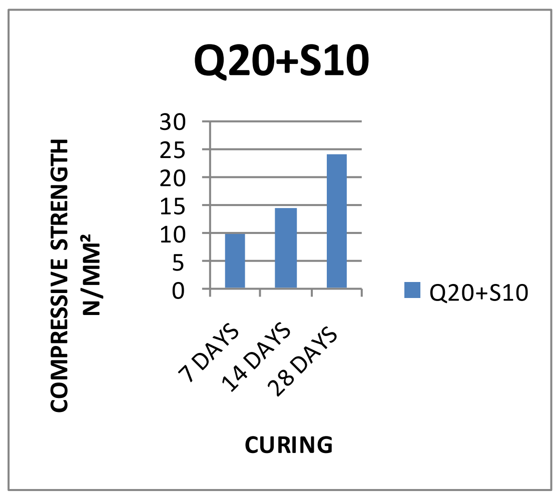
Graphs

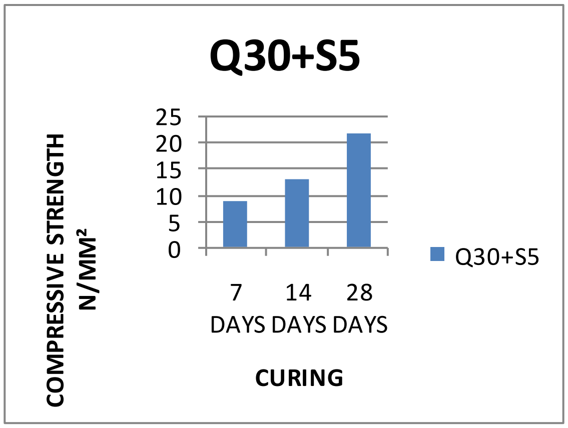


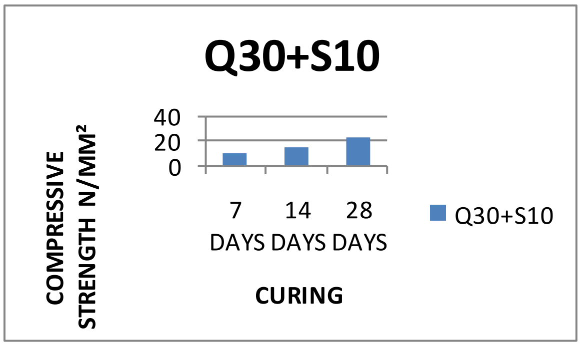


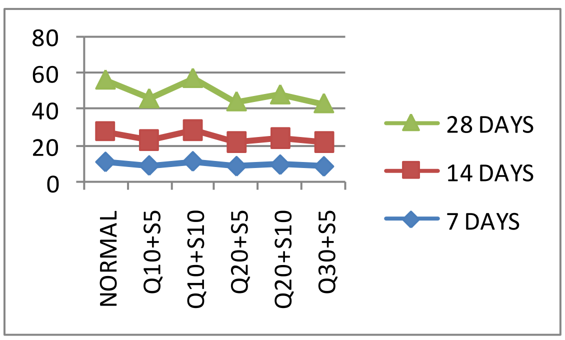












ALL PERCENTAGES WITH FINAL RESULT

V. CONCLUSION

From the above Experimental Study we conclude that the increasing percentage of Quarry Dust and Silica Fume in concrete shows that the increase in percentage of compressive strength.

By replacement of Sand & Cement with Quarry Dust (QD) & Silica Fume(SF) i.e, Q10+S5 and Q10+S10 in concrete shows the increasing in compressive strength by 23 N/mm^2 and 28.66 N/mm^2,slump Value increases for above percentage.

By Seeing the results analysis it is observed that the increasing in Percentage of Quarry Dust Result the decreasing in compressive strength. Therefore the increasing percentage of Silica Fume as partial replacement of cement in concrete for Q10+S10 Which shows higher strength compared to Normal concrete (M20) for 28 days.

Utilization of this product in concrete work would reduce the effect of this industrial waste acting as the agent of environmental pollution.

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