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Study on Strength Development of Concrete with Ceramic Waste Powder and Silica Fume

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ABSTRACT: Due to the high demand of cement in construction. It's required to reduce the production of cement by partially replacement of cement with another material. The aim of this dissertation work is that to reduce the environmental impact, reduce the cement consumption in the concrete by the replacement of ceramic material as a supplementary cementitious material. The study is done in concrete for the ceramic electrical insulator material partial replacement with cement in the concrete and checked its mechanical properties, workability and durability. In the concrete grade M25 cement has been partially replaced in 5%, 10%, 15% and 20% by weight of cement in ceramic waste. Utilization of these ceramic wastes the test performance has been checked by the concrete, here workability test (by slump cone test), mechanical properties test (compressive strength test, flexural strength test, split cylinder tensile strength) and durability test (water absorption and water penetration test) has been tested in the replacement of the ceramic waste material. The process is done in low water cement ratio and fine dense particle because the ceramic has less specific gravity and fill the porous voids.

KEY WORDS: compressive strength test, flexural strength test, split cylinder tensile strength,workability

I.INTRODUCTION

From the past concrete was considered as a widely used construction material. We use concrete structures with interest of development of urban and industrial areas, aggressive marine environments, harmful sub-soil water areas and many other hostile conditions where other materials of construction are found to be uneconomical and durable. Since the use of concrete in recent years have spread to highly harsh and hostile conditions, the earlier impression that concrete is a very durable material is being threatened, particularly on account of premature failures of number of structures.
In the past only strength of concrete was considered in the concrete mix design procedure assuming strength of concrete in all pervading factor for all other desirable properties of concrete including durability. In the recent revision of IS 456: 2000, one of the points discussed, deliberated and revised is the durability aspects of concrete, in line with codes of practice of other countries, which have better experiences in dealing with durability of concrete structures. One of the main reasons for deterioration of concrete in the past is that too much emphasis is placed on concrete compressive strength.As the ceramic waste is piling up every day Use of inorganic industrial residual products in making concrete will need to sustainable concrete design and greener environment. And silica fume is also a waste product obtained during the process of quarrying. In general, a silica fume is used a silica gel materials attempt was made in partial replacement of cement. In addition to this, an alternative source for the potential replacement of natural cement in concrete has gained good attention. As a result, reasonable studies have been conducted to find the suitability of silica fume in conventional concrete.

FUTURE SCOPE OF WORK

There is a vast scope of research in the recycled aggregate usage in concrete especially ceramic wastes in the future.The possible research investigations that can be done are mentioned below

- The usage of marble floor tiles can be studied as it is similar to that of tile waste generation and also it is quite hard compared to the natural crushed stones using in conventional concrete.
- A combination of different tiles (based on their usage) in different proportion sin concrete and their effects on concrete properties like strength, workability etc can be determined.

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- By the use of ceramic waste aggregate in concrete, the physical properties like durability, permeability etc. can be analyzed to prepare a concrete with more advantageous than conventional concrete.
- A study on properties of concrete made with combination of recycled aggregate and tile aggregate in different proportions can be investigated to enhance the concrete properties and also to reduce the pollution or waste generation from construction industry.
- The mechanical properties of concrete with ceramic waste either from manufacturing units or from construction demolition can be investigated to improve the properties like permeability; resistance to sound can also be studied.
- Ceramic tile aggregate in high strength concrete can be studied further to check the possibility of its use in high rise buildings.

II. LITERATURE REVIEW

BatritiMonhun R. Marwein (2016): The ceramic waste adopted is broken tiles. Ceramic waste concrete made with these tiles at 0%, 15%, 20%, 25% and 30%. M20 grade concrete is adopted; a constant water cement ratio of 0.48 is maintained for all the concrete mixes. The characteristics properties of concrete such as workability for fresh concrete, also Compressive Strength, Split Tensile Strength are found at 3, 7 and 28 days. The paper suggests that the replacement of waste tile aggregate should be in the range of 5-30% and also it is suitable to ordinary mixes like M15 and M20.

B. Topçu and M. Canbaz (2010): The amount of tile waste generation is enough to use in concrete as a replacement to coarse aggregate. The use of ceramic tile waste has a positive effect on environment and in the cost aspects too. By the use of tile aggregate, the self weight of concrete is reduced about 4% which makes the structure economical. Coming to the strength aspect, the tile aggregate replacement has a negative effect on both the compressive and split tensile strength of concrete. But this paper studied maximum replacements of tile waste which can be further divided into smaller percentages and can be utilized in concrete with desirable properties.

Azar Hamid Mir: The suitability of quarry dust as a sand replacement material shows that the mechanical properties are enhanced and also elastic modulus. The compressive strength analyzed optimum by replacing fine with quarry in ratio of 60:40

BurakFelekoglu: Identified that the integration of quarry waste and the equal amount of cement content generally reduced the super plasticizer requirement and improved the 28 days compressive strength of SSC (self compacting concrete). Normally the strength mixture of SCC contains nearly 300 to 310 kg of cement by inducing the quarry dust it can be increased a lot per cubic meter. Consumption of quarry dust in concrete is suggested particularly in regions where sand is not easily available.

III. MATERIAL AND PROPERTIES

In this investigation the following materials used

1. Ordinary Portland cement
2. Fine aggregates & coarse aggregates
3. Ceramic waste
4. Quarry dust powder
5. Water

Table 1. Properties of cement

SL.NO	Properties	Test results
1	Normal consistency	28%
2	Initial setting time	35 Minutes
3	Final setting time	10 Hours
4	Specific gravity	3

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Table 2.Properties of coarse aggregate

S. No	Description	Test Results
1	Nominal size used	20mm
2	Specific gravity	2.5 to 3.0
3	Sieve analysis	2.9% to3.3%
4	Aggregate crushing value	<30%

Table3. Properties of fine aggregate

S.No	Description Test	Result
1	Sand zone	Zone- III
2	Specific gravity	2.6 to 2.8
3	Sieve Analysis	2.6 to 2.9

Table 4. Properties of Ceramic waste powder

S.No	Description	Test Results
1	Fineness	**2%**
2	Specific gravity of ceramic material	2.1 to 2.67

Recycled Ceramic Waste powder

Silica fume

IV. MIX DESIGN

Cement	Fine aggregate	Coarse aggregate	water
493	596.73	1128.16	197
1	1.21	2.29	0.4

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V. EXPERIMENTAL STUDY

- Slump cone test
- Compression test
- Split tensile test

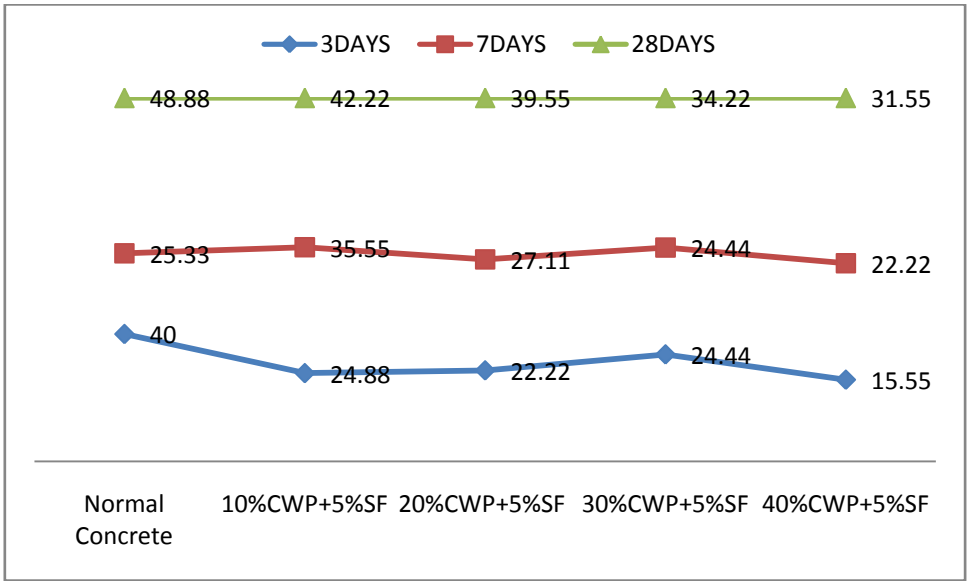
Slump Test- Workability

S.NO	Replacement level	Slump value
1	Normal concrete	98mm
2	40%C. A+40%F.A+10%C.W.P+5%S.F	95mm
3	30%C.A+30%F.A+20%C.W.P+5%S.F	86mm
4	20%C.A+20%F.A+30%C.W.P+5%S.F	76mm
5	10%C.A+10%F.A+40%C.W.P+5%S.F	58mm

COMPRESSIVE STRENGTH TEST

Out of many tests applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not. For cube test two types of specimens either cubes of 15 cm X 15 cm X 15 cm or 10cm X 10 cm x 10 cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15 cm x 15cm x 15 cm are commonly used.

Replacement level	Mix name	Compressive strength (Mpa)		
C.W.P + S.F	M1	3 days	7days	28days
Normal concrete	M2	40	25.33	47.77
10%C.W.P+5%S.F	M3	24.88	35.55	48.88
20%C.W.P+5%S.F	M4	22.22	27.11	50
30%C.W.P+5%S.F	M5	24.44	24.44	46.66
40%C.W.P+5%S.F	M6	15.55	22.22	42.88



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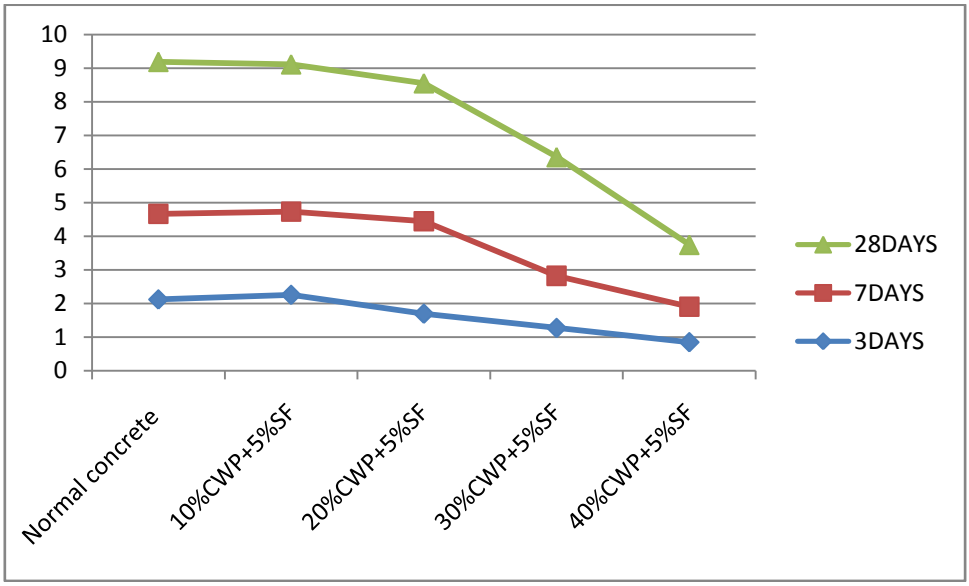
Splitting Tensile Strength:

It is measured by testing cylinders under diametrical compressive test machine.

Replacement level%	Mix name	Split tensile strength (Mpa)		
C.W.P+S.F	M1	3days	7days	28days
NORMAL CONCRETE	M2	2.123	2.54	4.60
10%C.W.P+5%S.F	M3	2.26	2.47	4.24
20%C.W.P+5%S.F	M4	1.6976	2.75	3.60
30%C.W.P+5%S.F	M5	1.2732	1.55	3.18
40%C.W.P+5%S.F	M6	0.848	1.061	3.18



VI. CONCLUSION

- The following conclusions are made based on the experimental investigation some compressive strength, split tensile strength& environmental aspects also the workability of concrete increases with the increase in ceramic waste &quarry dust replacement.
- The properties of concrete increased linearly with the increase in ceramic aggregate up to 20% replacement later it is decreased linearly.
- M40 mix of concrete produced a better concrete in terms of compressive strength, split tensile strength than the other mixes.
- But the mixes up to 20% of ceramic waste & quarry dust can be used.
- Quarry dust powder using as fine aggregate has more influence on the concrete.

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- The addition of quarry powder along with the ceramic waste improves the mechanical properties of concrete
- The split tensile strength of ceramic waste &quarry dust powder is very much in a straighter path compared to the conventional grades of concrete.
- The w/c ratio was kept constant for all the replacement levels of fine aggregate with quarry dust and coarse aggregate with ceramic waste.
- The assumption of consideration of constant w/c ratio helps for understanding the effect of strength parameters due to the change of natural aggregates.
- From the experiments conducted, replacement of ceramic waste as coarse aggregate in concrete can be optimized.
- At 10%, 20%, 30% & 40% replacement of coarse aggregates with ceramic waste the strength properties were decreased linearly were compared with conventional concrete.
- And there is no highly difference of 7, 14- and 28-days strength properties of compressive strength and split tensile strengths.
- So, In the further investigation up to 20 % replacement of ceramic waste as coarse aggregate and quarry dust as fine aggregate (sand) by conventional aggregates content in concrete can be optimized.
- In the further investigation the combined effect of 20% replacement of coarse aggregates with ceramic waste and 30% and 40% replacement of quarry dust with sand the strength properties were decreased linearly were observed.
- In the further study the ceramic waste can be used as additive partial replacement of coarse aggregates and fine aggregate with quarry dust as additive partial replacement to sand.
- From the results it can be concluded that the replacements of ceramic waste of 10% and Quarry dust of 10% gives maximum strength than the remaining percentages (20%, 30%&40%)
- At 20% replacement of coarse aggregates with ceramic waste and with 20% replacement of sand with quarry dust. The observed compressive strengths for M40 grade concrete is 50MPa. And the observed split tensile strength for m40 grade concrete is 2.70MPa.

REFERENCES

[1] Ali Heidari, DavoudTavakoli, A study of the mechanical properties of ground ceramic powder concreteincorporating nano-SiO2 particles, Construction and Building Materials, 38, 2013, 255 - 264.

[2]Amit Kumar Raval D, Dr.Indrajit Patel N, JayeshkumarPitroda, Ceramic waste as effective replacement ofcement for establishing sustainable concrete, International Journal of Engineering Trends and Technology (IJETT), 4(6), 2013, 2324 – 2329.

[3] Amit Kumar Raval D, Dr.Indrajit Patel N, JayeshkumarPitroda, Re-use of ceramic industry wastes for theelaboration of eco-efficient concrete, International Journal of Advanced Engineering Research and Studies, 2(3), 2013, 103 – 105.

[4] Hiroshi Higashiyama, Fumio Yagishita, Masanori Sano, Osamu Takahashi, Compressive strength and resistanceto chloride penetration of mortars using ceramic waste as fine aggregate, Construction and Building Materials, 26, 2012, 96 -101.

[5]Pacheco Torgal F, Shahsavandi A, and Jalali S, Mechanical properties and durability of concrete with partialreplacement of Portland cement by ceramic wastes, Waste solution and treatment, 5, 2013, 625 – 631.

[6]Katherine Kuder, Kasandra Wells and Rob Shogren:Low Portland cements Content SCC Mixtures for Usein Structural Applications

[7]Ismail: Muhannad Jordan Journal of CivilEngineering, Volume 3, No. 1, 2009Effect of MineralAdmixtures on Mechanical Properties of High

Strength Concrete Made with Locally AvailableMaterials.

[8] W.G Moravia, A. G. Gumieri, W. Vasconcelosvolume3, number2 (June, 2010)p.195-204.ISSN1983-4195: Efficiency Factor andModulus of Elasticity of Lightweight Concrete withExpanded Clay Aggregate.