INVESTIGATION ON STONE DUST AND VITRIFIED SCRAP AS AGGREGATE REPLACEMENT IN CONCRETE

T.Mohamed Asik Elahi [1], M.Purushothaman[1] , R. Balaji[1] , G.Premkumar[1]

S.Subathra [2]

[1] Students of Final Year (B.E) Civil Engineering,

[2] Assistant Professor,

New Prince Shri Bhavani College Of Engineering & Technology, Chennai, India

ABSTRACT

Conservation of natural resources and preservation of environment is the essence of development .The problem arising from continuous technological and industrial development is the disposal of waste material. So in the present paper an attempt has been made to assess the suitability of stone dust and vitrified scrap in concrete making. In laboratory stone dust has been tried as fine aggregate in place of sand and vitrified scrap as partial substitute to conventional coarse aggregate in concrete making cubes were cast and tested for compressive strength and spit tensile test after curing period of 7 and 28 days .The result indicated effectiveness of stone dust as fine aggregate and partial replacement of conventional coarse aggregately vitrified scrap up to percent, without affecting the design strength.

In the present study, Ceramic tile waste were used in concrete *as a* replacement for natural coarse aggregate with 0%, 10%, 20% and 30% of the substitution and M30 grade concrete were used. The concrete moulds were casted and tested for Compressive Strength and Split Tensile Strength after a curing period of 28 days. The results indicat*e* that, the maximum compressive strength is obtained for the 30% replacement of ceramic tile aggregate with natural coarse aggregate.

Keywords: Natural and recycled aggregate, ceramic, vitrified scrap, durability, strength

1. INTRODUCTION:

The introduction of waste vitrified tiles which will solve the future problem in solving the waste disposal in future. The world now runs all over with vitrified tiles. Nearly 20 percent of rock is converted into rock flour while crushing rock into stone crushing plants. In vitrified industry there is a mass failure of about 30 to 50 % of total production due to improper mixing of raw material, excess water improper drying and too much of heating. No work has been reported using stone dust and vitrified scrap together in concrete so far.

One such option is the use of stone dust One such option is the use of stone dust a by-product of crushers as replacement of stone dust and ceramic waste as a replacement of coarse aggregate. These materials are easily available at very low monetary value as compared to natural fine and coarse aggregates. So in the present work, an effort has been constituted to evaluate the suitability of stone

dust and ceramic scrap in concrete making hence the present work has been planned to evaluated the suitability of these waste materials in concrete production

2. NEED FOR PRESENT STUDY

Conservation of natural resources and preservation of environment is the essence of any development. The problem arising from continuous technological, industrial development is the disposal of waste material. If some of the waste materials are found suitable in concrete making, not only cost construction can be cut down, but also safe disposal of waste materials can be achieved.

3. EXPERIMENTAL PROGRAM

CEMENT

The cement for the whole work was procured in a single consignment and properly stored. The properties of cement (IS: 12269, 1987) used in the investigation are presented in Table 1.

PROPERTY	VALUE
Specific gravity	3.00
Fineness	97.80
Initial setting time	68min
Final setting time	9hrs28min
Standard consistency	30%
Compressive strength	54.28N/mm^2

FINE AGGREGATE

a) Sand: River sand was used as fine aggregate. The specific gravity of sand was 2.65 and fineness modulus of fineness was 2.54

b) Stone dust: Stone dust used in the laboratory investigations was procured from a local crushing plant. The specific gravity of stone dust was 2.63 and fineness modulus was 2.67

CERAMIC TILE AGGREGATE

CTA are crushed uniformly to about 20mm size manually using hammer and sieved through 20mm IS: Sieve. The various test were conducted on the ceramic tiles are specific gravity, water absorption and impact test.

WATER

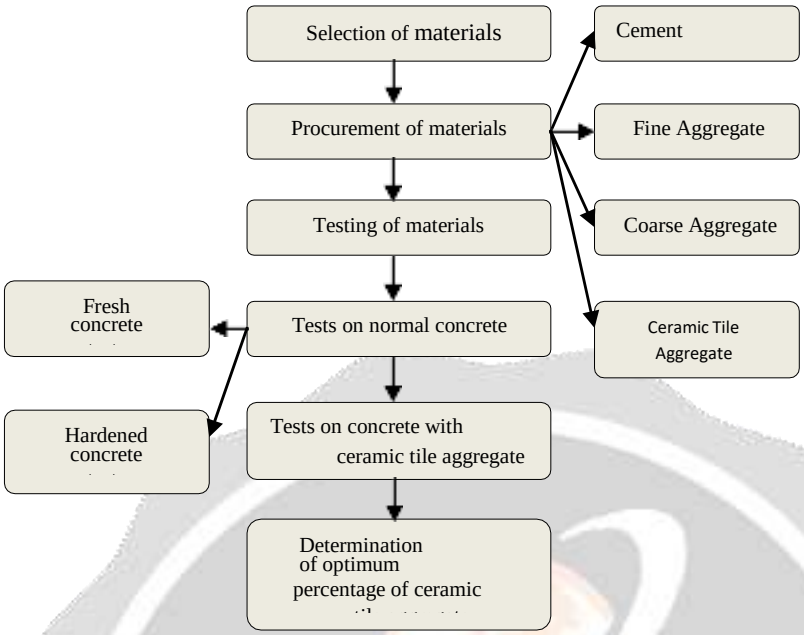
Water available from the local sources conforming to the requirements of water for concreting and curing as per IS: 456-2000.

COMPOSITION OF MATERIALS

Table2. Comparison of properties of ceramic tile aggregates and normal aggregates

PARTICULARS	NORMAL AGGREGATE	CERAMIC TILE AGGREGATE
Shape	angular	flaky
Texture	rough	All sides rough except top face
Specific gravity	2.71	2.27%
Impact value	13.18%	12.83%
Water absorption	0.4%	1.98%

4. METHODOLOGY



Sieve Design-ation	Percentage passing			
	Fine aggregates		Coarse aggregates	
	Natural sand	Rock flour	Natural aggregates	Ceramic scrap
40mm	---	---	100	100
20mm	---	---	93.20	87.20
10mm	100	100	11.20	5.20
4.75mm	100	100	5.20	1.20
2.36mm	98.40	98.20	---	---
1.18mm	77.20	75.60	---	---
600microns	45.50	46.60	---	---
300microns	12.60	8.40	---	---
150microns	8.8	4.20	---	---
Conforming IS 383 - 1970				

TESTS:

For each batch of concrete, three cubes of 150mmX150mmX150mm size were tested to determine compressive strength (IS: 516, 1959). three cylinders of 150mmdia.X300mm height size were tested for split tensile strength (IS: 5816,1999).

Mix Selection

The grade of concrete adopted for investigation was **M30**. The mix proportion of concrete for laboratory investigations was arrived by designing as per Indian standard method. The final mix used was **1: 2.1:3.4** with water cement ratio of **0.48**.

Table 4. THE DETAILS OF MIX DESIGNATIONS AND SPECIMENS USED IN EXPERIMENTAL PROGRAM.

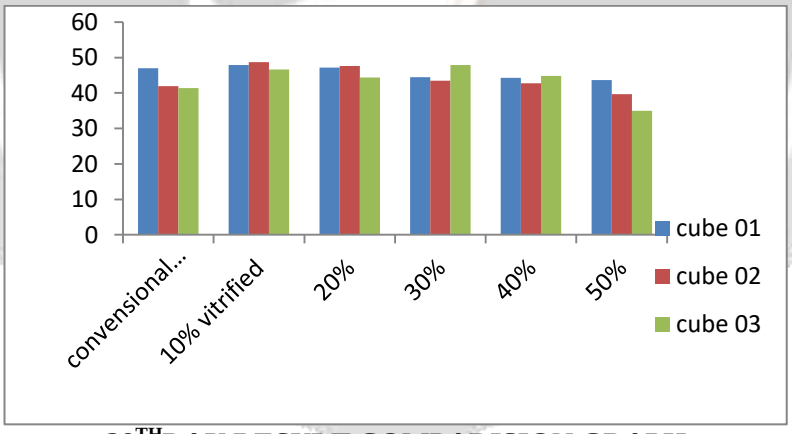
Mix Designation	Fine aggregate	Coarse aggregate		No of specimens	
		Conventi	Ceram	Cube	Cylinder
MC	Sand	100%	--	3	3
M0	Stone dust	100%	--	3	3
M1	Stone dust	90%	10%	3	3
M2	Stone dust	80%	20%	3	3
M3	Stone dust	70%	30%	3	3
M4	Stone dust	60%	40%	3	3
M5	Stone dust	50%	50%	3	3
M6	Stone dust		100%	3	3

5. RESULTS

After comparison properties presented in table 3,it is observed that the stone dust can be used as a conventional fine aggregate By comparing the properties of ceramic scrap and conventional coarse aggregate presented in table2 it can be concluded that ceramic scrap can be used in place of conventional coarse aggregate. The experimental results are presented in Table5.That the strength of concrete is increased due to usage of stone dust as fine aggregate. But strength is reducing due to usage of ceramic scrap as coarse aggregate. And It is clear that replacement of coarse aggregate by ceramic scrap in excess of 20 percent, leads to reduction of strength below conventional mix (MC). Hence in concrete with stone dust as fine aggregate, conventional coarse aggregate can be replaced partially by ceramic scrap upto 20 percent.

Table 5. AVERAGE COMPRESSIVE STRENGTH TEST FOR 28 DAYS

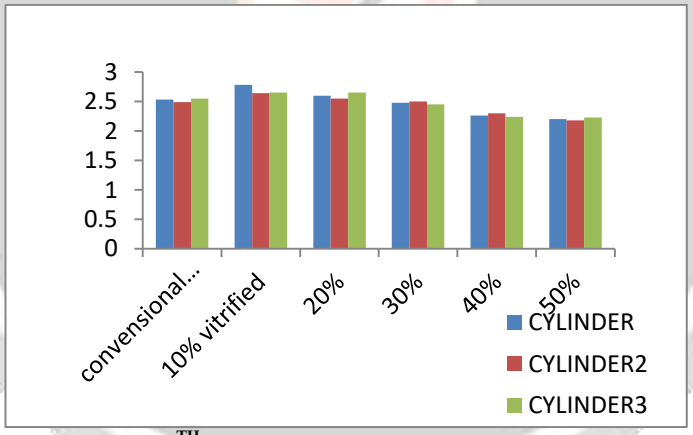
MIX DESIGN	FINE AGGREGATE	COARSE AGGREGATE		AVERAGE
		CONVENTIONAL	CERAMIC SCRAP	
MC	SAND	100%	-	42.14 N/mm^2
M0	STONE DUST	100%	-	43.43 N/mm^2
M1	STONE DUST	90%	10%	47.74 N/mm^2
M2	STONE DUST	80%	20%	46.40 N/mm^2
M3	STONE DUST	70%	30%	45.28 N/mm^2
M4	STONE DUST	60%	40%	43.97 N/mm^2
M5	STONE DUST	50%	50%	36.43 N/mm^2



28THDAY RESULT COMPARISION GRAPH

Table 6. AVERAGE SPLIT TENSILE TEST FOR 28 DAYS

MIX DESIGN	FINE AGGREGATE	COARSE AGGREGATE		AVERAGE
		CONVENTIONAL	CERAMIC SCRAP	
MC	SAND	100%	-	4.50 N/mm^2
M0	STONE DUST	100%	-	4.55 N/mm^2
M1	STONE DUST	90%	10%	4.78 N/mm^2
M2	STONE DUST	80%	20%	4.60 N/mm^2
M3	STONE DUST	70%	30%	4.40 N/mm^2
M4	STONE DUST	60%	40%	4.26 N/mm^2
M5	STONE DUST	50%	50%	4.20 N/mm^2



28TH DAYSPLIT TENSILE RESULT COMPARISION GRAPH

6. CONCLUSION

Research on the usage of waste construction materials is very important since material waste is gradually increasing with the increase in population and increasing of urban development. The main aim of this investigation was the utilization of tiles collected from the demolished buildings and the wastes obtained from the tile industries. The use of these tile aggregates as partial replacement in coarse aggregate in concrete has positive effect on the environment and obtaining lower costs since the tile aggregates are easy to obtain. Their cost is cheaper than the natural aggregates. The ceramic tile aggregate are partial replaced with coarse aggregate because the tile aggregate are easy to obtain and their cost is cheaper than the natural aggregate.

After completions of all experimental, programs are conducted that ceramic tile aggregate can be used in place of coarse aggregate with certain percentage of replacement, Based on the compression strength test, split tensile strength test. The following are the conclusions obtained after performing the above experiments,

- The maximum compression strength is obtained when 10% of ceramic tile aggregate was replaced with coarse aggregate.
- The maximum split tensile strength is obtained when 10% of Ceramic tile aggregate was replaced with coarse aggregate.
- The compressive strength and split tensile strength for 20% and 30% replacement of CTA is not increased. There is little variation in the strength when compared with normal concrete. The optimum result is obtained for 10% replacement of CTA with coarse aggregate.
- By addition of ceramic tile aggregates into coarse aggregate, proper utilization of ceramic tile waste can be achieved.

- In case of combinations, the compressive strength is increasing for all the cases.

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