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A Review on use of Ceramic waste as coarse Aggregate Replacement in Concrete

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Abstract—In today's construction world concrete is largely used construction material all over globe. Concrete consists of cement, aggregates and water. Production of raw material for concrete making emits high amount of carbon and it is not good for environment. So need to use the waste material for concrete Production. Ceramic industry generate million tons of ceramic waste while manufacturing ceramic tiles. Up to 30% of waste is produce per year and huge part of it is used for land filling. Ceramic is non bio degradable waste and required thousands of years for degradation. The reused of ceramic tiles waste as aggregate in concrete has a positive effect on environment and economy.This study deals with reviewing the usage of ceramic waste tiles as coarse aggregate replacement in concrete and its effect on workability, compressive strength, splitting tensile strength and flexural strength of concrete.

Keywords—Ceramic tile waste, compressive strength, split tensile strength, flexural strength, concrete

I. INTRODUCTION

Concrete is one of the major material used in construction industry. Production of concrete needs the raw material like sand, cement, aggregate and water. In concrete aggregate has a part of about 70-75%. Production of these raw material like aggregate needs the very large amount of energy, and huge amount of used of it depletes the natural resources so scarcity of aggregate increased, thus the cost of making concrete is increased. In today's construction world needs to find out another alternative to the aggregates for concrete making. Consequently, to minimize these Researchers concentrate on used of waste material in construction industry mainly in concrete construction. Use of waste material in concrete has a positive approach in construction industry. In this aspect, consumption of waste tiles or broken tiles as coarse aggregates Replacement in concrete making can be a new scientific view in the field of sustainable concrete production. Ceramic industry generate million tons of ceramic waste while manufacturing ceramic tiles. Up to 30% of waste is produce per year and huge part of it is used for land filling. Huge amount of money is being spent for their disposal as well as environmental pollution occurs. Ceramic is non bio degradable waste and require thousands of years for degradation. The reuse of ceramic tiles as aggregate replacement in concrete has a positive effect on environment and economy. The use of ceramic waste as coarse aggregate in the concrete making reduce the concrete making cost. Ceramic tile aggregates are hard having considerable value of specific gravity, rough surface on one side and smooth on other side, are lighter in weight than normal stone aggregates. This review paper focuses on the feasibility of ceramic waste in making of concrete by study of research papers.

II. LITERATURE REVIEW

E. E.Ikponmwosa1, and S. O. Ehikhuenmen2 (2017) The use of ceramic waste in concrete mix resulted in considerable reduction in the workability as replacement level increased ceramic waste

(CW) in concrete resulted in the decrease of its density but was still within the normal concrete range values. If used, this also could result in reduced dead weight of concrete structures. The strength of ceramic waste concrete decreased due to higher flakiness value, weaker bonding of the aggregate with cement paste due to porcelain surface and higher water absorption of the ceramic waste aggregate. Hence, the substitution of coarse aggregate with ceramic waste beyond the 75% replacement level is not recommended for use in structural concrete.

A.M. Mustafa al bakril,a, ,M.N.Norazian2, b,H Kamuarudinl,c, M.A.A Mohd Salleh, and A. Alidal,e This paper presents the results of an investigation of the use of crushed ceramic waste as aggregates replacement in paving block production .The use of ceramic waste as aggregates replacement reduced the density of the concrete. The compressive strength of the concrete decreases as the proportion of crushed ceramic waste in concrete increased. The density of ceramic aggregate concrete reduces between 2000-2150 kg/m^3 compared to 2200-2350 kg/m^3 for conventional concrete. The above conclusions obtained from the study of ceramic waste coarse aggregate concrete.

D. Tavakoli[a] , A. Heidari[b], and M. Karimian[b](2012) In this experimental study, the characteristics and properties of ceramic aggregate are measured and then being crush in the size of coarse aggregate they are used in concrete as the substitute for coarse aggregates with 0 to 40 percent of substitution and also for sand with 0 to 100 percent of substation. Different mixes are casted, waste crushed tiles are used to partially replace the coarse aggregate by 10%, 20%,30%and 40% tiles aggregate is used to partially replacement the conventional aggregate and then parameters of Slump, compressive strength, water absorption, and unit weight were measured. Using ceramic wastage in concrete production causes no remarkable negative effect in the properties of concrete. The optimal percentage of using tile wastage as sand are amounts of 25to 50 percent and the best case of their use as coarse aggregate are as amounts of 10 to 20 percent. The compressive strength of ceramic coarse aggregates concrete increases but also the unit weight of concrete decreases and very low water absorption were noted.

Sunny B. Vachhani1, Y.V. Akbari, Sharad Kondhiya3, (2017) Compressive strength of concrete is reduced than the conventional concrete because of the larger water absorption rate of ceramic tile is reducing the hydration of the cement paste. When replacement of the ceramic tile as a coarse aggregate a compressive strength of concrete give a batter result with the 20% replacement of the ceramic tile. At a 20% replacement Weight of the concrete is reducing compare to the conventional concrete so it is gives a light of the ceramic tile as a coarse aggregate with replacement of the ceramic tile as a fine aggregate a compressive strength of concrete gives a better result in the 30% replacement of the ceramic tile. Split tensile strength and flexure strength of concrete is gives a maximum result at the 30% replacement of the ceramic tile as a coarse aggregate. Split tensile strength of concrete and flexure strength gives a maximum result at a replacement of the 20% as a coarse aggregate and 30% replacement of the fine aggregate. Under water flexure test gives a better result with the 20% replacement of the ceramic tile as a coarse aggregate and gives a better result with the 20% replacement of the ceramic tile as a coarse aggregate and 20% replacement of the fine aggregate.

M. Sekar (2017) ***Civil and Structural Engineering, SCSVMV University***The specific gravity for ceramic waste is 2.65 whereas for crushed stone is 2.70. The maximum size for both, ceramic waste and crushed stone are the same i.e. 20 mm. The water absorption for ceramic waste is 1.76 percent whereas for crushed stone is 1.53 percent. The properties ceramic waste coarse aggregate are within the range of the values of concrete making aggregates. The surface hardness of ceramic waste concrete with 15% replacement of crushed stone aggregate is 6.6 % higher than control concrete. The velocity value of ceramic waste concrete with 15% replacement of crushed stone aggregate is

4.30% higher than control concrete. The compressive strength of ceramic waste concrete with 15% replacement of crushed stone aggregate is 6.4 %higher than control concrete. Thus, the replacement of coarse aggregate with ceramic waste up to 15% replacement reaches optimum level.

Hafiz Waheed-ul Hasan1, Sabahat Alamgir, Humera Ahmed and Sajjad Mubin (2014) Industrial ceramic waste as a partial replacement of fine aggregate in the concrete at the age of 28 days. Four types of concrete mixtures were tested in this research i.e. CC-0, CC-10, CC-15, and CC-20, where CC-0 stands for Reference Concrete and CC-10, CC-15 & CC-20 stand for concretes having 10%, 15% & 20% ceramic waste as sand replacement material respectively. The workability of all the three concrete mixtures increased slightly with the addition of fine aggregate of ceramic waste as partial replacement of sand. The flexural strength of the ceramic waste concrete increased with the increase of quantity of ceramic waste in the concrete. The flexural strength of CC-10 concrete is 7.5% higher than flexural strength of CC-0 concrete. The greatest splitting tensile strength was observed for CC-10 concrete and the lowest for CC-20 concrete. The tensile strength of CC-20 concrete is 3.23% lower than CC-0 concrete Reference Concrete (CC-0) achieved the greatest Modulus of Elasticity (MOE) whereas CC-20 concrete attained the lowest Modulus of Elasticity (MOE).

C. Medina a, M.I. Sánchez de Rojas b, M. Frías b The reuse of these wastes as recycled coarse aggregate in partial substitution (15%, 20% and 25%) of natural coarse aggregates in the manufacture of structural concretes. The results demonstrate that recycled, eco-efficient concretes present superior mechanical behavior compared to conventional concrete and it was moreover appreciated that the recycled ceramic aggregate does not interfere in a negative way during the hydration process. It was also observed that the microstructure in the interfacial transition zone (ITZ) between recycled ceramic aggregate and paste was more compact than in the case of natural aggregate and paste.

Hiroshi Higashiyama a, Fumio Yagishita a, Masanori Sano a, Osamu Takahashi Compression tests of mortars are conducted at 7, 28 and 91 days curing. Moreover, the resistance to chloride ion penetration of mortars has been determined by two methods. Thespraying of a 0.1 N silver nitrate solution and the X-ray fluorescence spectrometry. The compressive strength of the compressive strength of mortar made of the ceramic waste aggregate increases and the resistance to chloride ion penetration is significantly higher in comparison with mortar made of the river sand. It is also confirmed that partial replacement of cement by the ceramic powder up to 20% by weight is effective with respect to the compressive strength and the resistance to chloride ion penetration.

RM. Senthamarai a, P. Devadas Manoharan b, D. Gobinath a Concrete made with ceramic electrical insulator waste as coarse aggregate shows good modulus of elasticity,workability,tensile strength, and flexural strength permeation characteristics are used widely to quantify durability properties of concrete. This paper presents an experimental investigation on the permeation characteristics [volume of voids and water absorption (ASTM C642-06), RCPT (ASTM C1202-10), and sorption] of concrete with ceramic electrical insulator waste coarse aggregate of six different water–cement ratios in comparison with corresponding conventional concrete of same mix proportion. From the results it has been observed that there is no significant change in the basic trend of permeation characteristics of this recycled aggregate concrete when compared to the conventional concrete of same mix proportion. This recycled aggregate concrete possesses higher permeation characteristic values than those of conventional concrete. These values decrease with decrease in water–cement ratio for both the recycled aggregate concrete and the conventional concrete.

Pincha Torkittikul, Arnon Chaipanich (2010) This investigation show that The measured concrete properties demonstrate that while workability was reduced with increasing ceramic waste content for Portland cement concrete and fly ash concrete, the workability of the fly ash concrete with 100% ceramic waste as fine aggregate remained sufficient, in contrast to the Portland cement control concrete with 100% ceramic waste where close to zero slump was measured. The compressive strength of ceramic waste concrete was found to increase with ceramic waste content and was optimum at 50% for the control concrete, dropping when the ceramic waste content was increased beyond 50%. This was a direct consequence of having a less workable concrete. However, the compressive strength.

III. MATERIAL

1. Cement

Cement is important binding material in concrete. The ordinary Portland cement of 53 grade used confirming all standards of IS 12269- 2013 is used.

2. Course aggregate

The coarse aggregate with 20 mm to nominal size is used. Aggregate should be angular in shape flaky and elongated aggregate not be used as per IS 383-1970.

3. Fine aggregate

Fine aggregate is use to feel the voids between course aggregate in concrete. Aggregate have a size less than 4.75mm is used. Fine aggregate should be silt free and well graded as per IS 383-1970. The good quality river sand preferred.

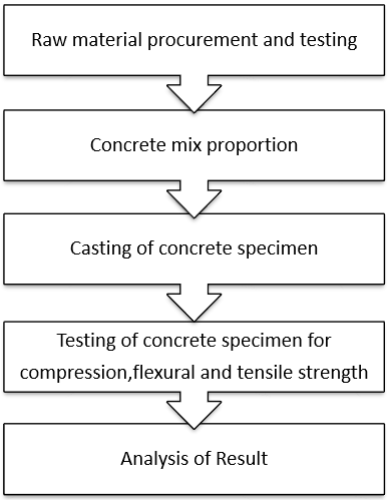
4. Ceramic tile waste as coarse aggregate

Ceramic tile wastes suchas ceramic vitrified floor tile waste were broken into small pieces of about 20 mm in size by a hammer and separated the coarse material to use them as partial replacement to the natural course aggregate.

5. Water

Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement; since it helps to from the strength cement gel, the quantity and quality of water are required to be looked into very carefully the water used for concrete should be potable.

IV. METHODOLOGY



V. CONCLUSION

Replacement of aggregate with ceramic tile waste in cement concrete has a positive effect on environment and economy.In this aspect, consumption of tileswastesorbroken tiles as coarse aggregates in concrete manufacturing can be a new scientific view in the field of sustainable concrete Production. As per literature study the unit weight of ceramic aggregate concrete decreases so it produces light weight concrete.The results demonstrate that ceramic aggregate concrete is eco-efficient concrete, have superior mechanical behavior compared to conventional concrete and it was moreover appreciated that the recycled ceramic aggregate does not interfere in a negative way during the hydration process.Ceramic aggregate concrete has low workability as a percentage of replacement increasesworkability of ceramic aggregate concrete decreases due to more water absortion of ceramic tile aggregate.As per researches Beyond 75% replacement of ceramic aggregate in concrete notadvisable for structural concrete.Upto 40% replacement of ceramic waste aggregate not negatively effect on property of concrete.

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