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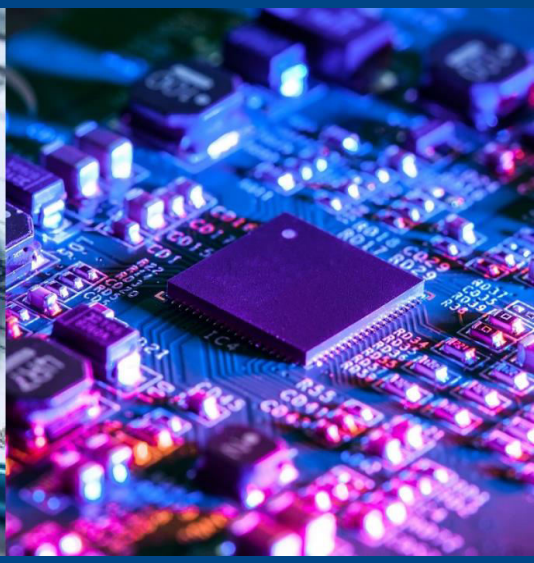

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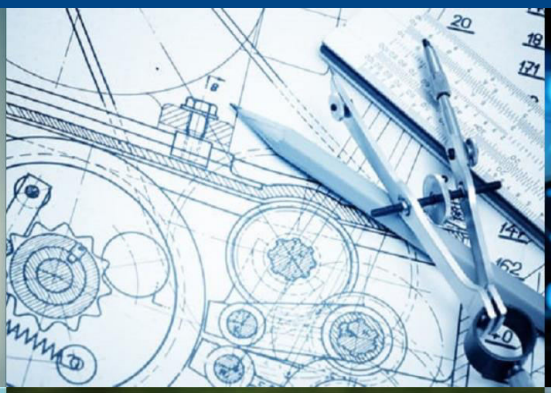

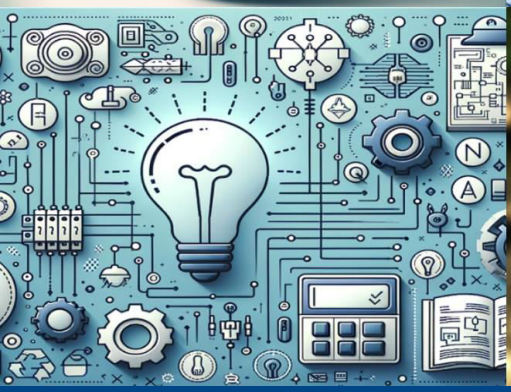

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Experimental Investigation of Coarse Aggregate by Ceramic Wastes as Partial Replacement

R.R.Abinaya, K.Niraikula Sekaran, K.Mangala Roobini, K.Hari Raj, G.Srimu Arasu, N.Saran Kumar

Assistant Professor, Dept. of Civil, Mohamed Sathak Engineering College, Kilakarai, India

Associate Professor, Dept. of Civil, Mohamed Sathak Engineering College, Kilakarai, India

UG Student, Dept. of Civil, Mohamed Sathak Engineering College, Kilakarai, India

UG Student, Dept. of Civil, Mohamed Sathak Engineering College, Kilakarai, India

UG Student, Dept. of Civil, Mohamed Sathak Engineering College, Kilakarai, India

UG Student, Dept. of Civil, Mohamed Sathak Engineering College, Kilakarai, India

ABSTRACT: Due to rapid growth of construction of buildings and other infrastructure the demand of construction materials such as coarse aggregate, fine aggregate increased.

The construction materials are mostly from natural resources. These are sourced from river bed and quarry sites. Simultaneously, the ceramic wastes are also generated from construction site, tile industries, manufacturing units of toilets, wash basins related products .To decrease the exploitation of natural resources and usage of ceramic wastes it is partially replaced in varied proportions Different replacement levels such as 10 percent, 20 percent, 30 percent were adopted. The properties of concrete such as compressive strength, workability, durability are tested to evaluate the behavior of this concrete. The results of this investigation gives that the partial replacement of ceramic wastes to an optimum level is done without affecting the strength of the concrete since ,concrete is primary constituent to build any kind of structure. Among the different proportions the moderate proportions performs well under tests which are conducted to analysis the property of concrete such as compressive strength and workability .This investigation significantly develops sustainable approach and it also reduces environmental pollution of ceramic wastes which are not disposed properly. Often the ceramic wastes are dumped in landfills or sometimes it is left as it is in the construction site. It also promotes the waste management of construction sites and it also helps to reduce the demand on natural aggregates.

KEYWORDS: ceramic waste, coarse aggregate, proportion

I. INTRODUCTION

Concrete is widely used in building of different types of infrastructure. Due to its strength, durability of buildings it exhibits versatile nature. The main components of concrete are fine aggregate, coarse aggregate, water. These components are determines the strength and other properties of concrete. Among these coarse aggregate occupies large volume and plays vital role by filling the gaps in concrete. The coarse aggregate quality and size determines the mechanical properties like strength, workability of the concrete. So the coarse aggregate significantly influence the performance of concrete.However the increased demand on coarse aggregate leads to environmental exploitation of natural resources. India is the second largest tile producer over which 150 metric tons of ceramic wastes are produced in which 15to30 percentage becomes waste on various process of manufacturing ceramics so the same time the ceramic wastes also increased. Ceramic wastes are especially from demolition of site, building new infrastructure, industries which manufactures sanitary ware, tiles etc. The major concern is the ceramic waste are difficult to dispose and they are non-biodegradable in nature. Hence, it leads to land degradation and environmental pollution .The ceramic wastes are hard, durable, resistance to chemical attacks, temperature elevation and abrasion. Due to this advantage the ceramic wastes are utilized as a partial replacement of coarse aggregate .The present investigation focuses on the replacement of coarse aggregate partially and to evaluate the strength, workability and durability characteristics

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Figure 1: Ceramic Wastes From Constuction Site

Fig 1, Shows ceramic wastes dumped near construction site. The ceramic are inorganic non-metallic oxide, nitride or carbide material. Sometimes the carbon or silicon elements are considered as ceramics. Ceramic wastes share some similar characteristics of coarse aggregate. This includes the grading and water absorption quality. Like coarse aggregate ceramics can be graded into different sizes and it also form strong bond with cement paste due its water absorption capacity

II. LITERATURE REVIEW

A critical analysis of the paper has been conducted to assess the use of ceramic waste as a partial replacement of coarse aggregate in concrete and how the present study is related to the previously conducted studies. Due to rapid urban expansion and industrial development, demand for natural aggregates has increased because of which natural sources are depleting. Generating a sizable amount of ceramic waste through demolition activities and the ceramic industry poses a disposal problem in today's world. Reusing ceramic waste in concrete minimizes the environmental impact and helps in conserving natural resources which are outcome of customary practice.

Many investigators have studied the concrete containing ceramic waste. As per study, ceramic aggregates affect both the fresh and hardened properties of concrete in terms of workability, compressive strength, and durability. There has been much work done in this area but it can still be improved to make optimal replacement levels as well as durability parameters related to water absorption.

R. M. Senthamarai and P. “Concrete with Ceramic Waste Aggregate” was proposed by Devadas Manoharan. The natural coarse aggregate was replaced with ceramic industrial waste in the study. Based on experimental results, the compressive strength, tensile strength and flexural strength of concrete with ceramic aggregates are comparable to that of conventional concrete. The research also showed that ceramic aggregates have good performance despite theirdifferent physical properties, such as their water absorption.

Relevance to current Research

The study above is a basic strength characteristic of ceramic aggregate concrete. But, it only focuses on mechanical properties and there is no extensive analysis on workability and water absorption, which is considered in present work. J. D. García - González, A. Rodríguez -Robles, J. Juan-Valdés J. M. Morán - del Pozo , and M. I. The Experimental Study on Ceramic Waste as Coarse Aggregate in Concrete was proposed by I. Guerra-Romero. The feasibility of using ceramic waste as total or partial coarse aggregate was studied by them. The findings of the study evidenced that ceramic waste can be incorporated in structural concrete and that waste can be reused to achieve sustainability.

This research shows that ceramic waste can be used in structural application. The current research adds to this by experimentally analyzing partial replacement levels and other parameters like workability and water absorption. Another research reported in the journal Construction and Building Materials on the mechanical properties of cement

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concrete using waste ceramic as coarse aggregate [3] showed that replacement levels till even higher percentages can be used with minimum effect on mechanical properties. There were variations in workability and durability at different replacement levels.

Relevance to current Research

This study emphasizes the need to assess the characteristics of the concrete in its fresh and hardened state.

The paper titled "Study on Strength Properties of Concrete with Ceramic Waste Aggregate and Silica Fume Admixture" was suggested by S. G. Suresh and S. Harishankar [4]. According to their findings, the use of ceramic waste as a substitute for some part of the coarse aggregate is environmentally friendly, but the concrete still maintains adequate strength.

Relevance to current Research

The current study draws attention to the potential for enhanced performance of ceramic concrete through the use of admixtures. The effects of reduction of workability caused by ceramic waste are investigated in this research, and possible approaches to improve it may be considered.

The reuse of ceramic waste as coarse aggregate in concrete was discussed in H. G. Shruthi, M. E. Gowtham Prasad, Samreen Taj, and Syed Ruman Pasha's paper [5]. It was proven that ceramic wastes generated from discarded tiles and construction rubble can effectively function as coarse aggregate.

This research helps confirm the environmental advantages of using ceramic waste. The current research further tests the effectiveness of this material with an inclusion of factors like water absorption and workability.

Relation to Contemporary Research

Based on the information presented in the literature review above, it can be seen that ceramic waste can be successfully utilized as a replacement material for coarse aggregate in concrete production. The majority of current research focuses on investigating the mechanical properties of concrete, with very little effort devoted to its workability and water absorption characteristics.

In this contemporary research paper, an experimental study is performed to explore the impact of ceramic waste used as coarse aggregate replacement material on the workability (slump test) and water absorption capability of the resulting concrete.

No.	Paper Title	Author Name	Key Points	Remark
1	Concrete with ceramic waste aggregate	R.M.Senthamarai , P.Devadas Manoharan(2005)	Ceramic waste used as coarse aggregate showed comparable compressive , tensile and flexural strength to traditional concrete	Suitable for partial replacement of coarse aggregate
2	Ceramic ware waste as coarse aggregate for structural concrete protection	J.Garaia – Gonzalez et al. (2015)	Demonstrated feasibility of using ceramic waste as partial and full replacement of coarse aggregate	Support sustainable construction practices
3	Mechanical properties of concrete utilizing waste ceramic as coarse aggregate	Various researches (2016)	Strength maintain upto optimum replacement level	Optimum replacement required for best performance
4	Study on strength properties of concrete with ceramic waste aggregate and silica fume admixture	S. G. Suresh , S.Harishanker (2018)	Addition of ceramic waste with admixtures improved strength and performance	Admixture can enhance ceramic concrete properties
5	Reuse of ceramic waste as aggregate in concrete	H. G. Shruthi et al (2016)	Conformed usability of ceramic waste from tiles in concrete promotes waste recycling	Eco friendly and cost effective solution. Promotes environmental sustainable

Table 1: Literature Review Summery

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In summary, the work presented in this paper is based on previous research to evaluate the use of ceramic waste as a partial replacement for coarse aggregate in concrete. While earlier studies focused on mechanical properties of concrete. In the present study discusses about a workability, water absorption and overall performance of concrete.

III. METHODOLOGY OF PROPOSED SURVEY

Concrete Mix Design

In the present study, M30 grade with nominal mix as per IS 456 – 2000 was used. Concrete mix proportion by weight for 1m3 and water cement ratio of 0.45. Table 2**.** Gives the mix used for study

S .No	Mix Type	Cement	Water	Fine Aggregate	Coarse Aggregate
1	Normal Concrete	1	o.45	1.6	2.8
2	Ceramic concrete	1	o.45	1.6	2.2

Table 2: Concrete Mix Proportion

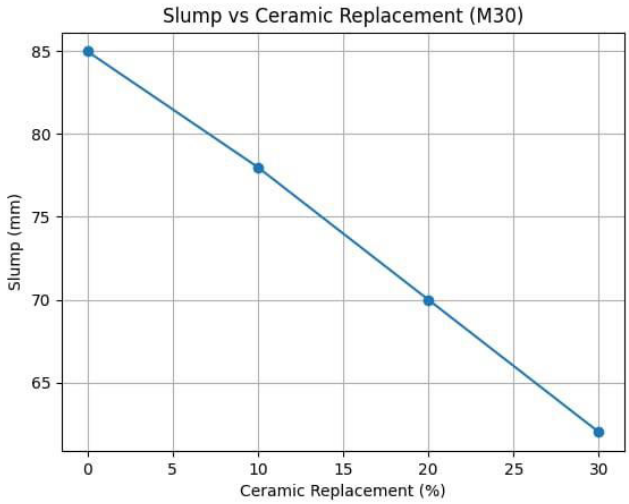
Casting and Testing

Ceramic waste was added in concrete in step of (10%, 20%, 30%). The percentage of partially replacement are arrived with trial study using ceramic wasted. For each percent of ceramic waste partially replacement as coarse aggregate, cube was casted. Final comprehensive strength of cubes are tested for 7days, 14days and 28 days curing. The average compressive strength, workablity, and water absorption are then determined for each mix proportion are discussed.

A. **Workability** – The workability determined by slump cone test. The result are as follows ,

S. No	Ceramic Replacement (%)	Slump (mm)
1	0	85
2	10	78
3	20	70
4	30	62

Table 3: Slump cone test



B. **Compressive strength –** Compressive strength of concrete cube specimens was tested. It was tested at interval of 7 , 14 and 28 days

$$fc = P/A \text{ N/mm2}$$

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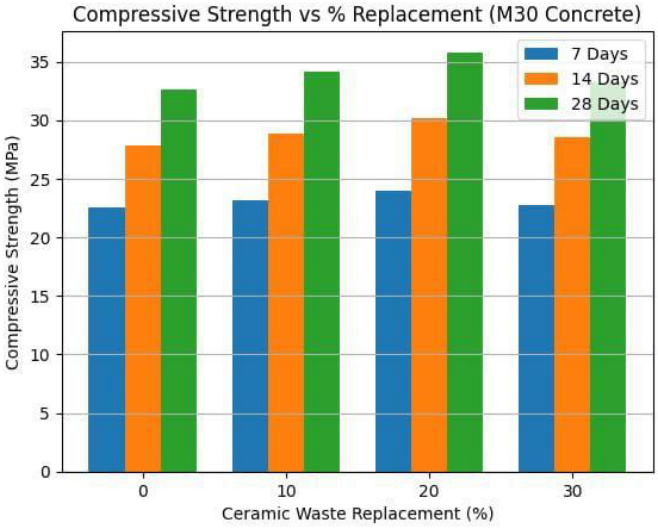
S. No	Ceramic Replacement (%)	Average Compressive strength (N/mm2)		
		7 Days	14 Days	28 Days
1	0	22.50	27.80	32.40
2	10	23.80	29.10	34.20
3	20	25.10	30.50	36.00
4	30	21.90	26.70	31.10

Table 4: Compressive strength test

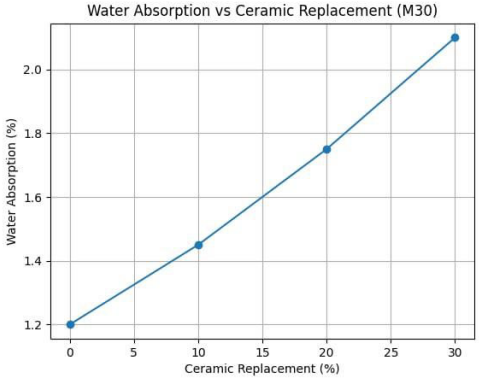


C. **Water Absorption** – Water absorption test is conducted to know about the durability of the concrete. It is calculated by ,

Water Absorption =((wed weight – dry weight)/ dry weight)*100

S. No	Ceramic replacement (%)	Water Absorption (%)
1	0	1.20
2	10	1.45
3	20	1.75
4	30	2.10

Table 5: Water absorption test



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IV. CONCLUSION AND FUTURE WORK

This research presents an experimental approach to investigate how partial substitution of coarse aggregate with ceramic waste affects performance characteristics of concrete. Important properties evaluated were workability, compressive strength and water absorption in order to determine viability of using ceramic waste for concrete production. Results showed that using ceramic waste influenced both fresh and hardened characteristics of concrete, with optimum performance being achieved by moderate level of replacement. Use of ceramic waste would support sustainable practices in construction by minimizing the adverse effects on the environment and conserving valuable natural resources. Future investigations will include studying long-term durability, enhancing workability through use of chemical admixtures and analysing the performance of ceramic concrete in structural applications.

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