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Review Paper On Experimental Study On Partially Replacement Of Sand With Ceramic Waste In Concrete.

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Abstract:- Rapid urbanization and industrial growth have resulted in a large amount of ceramic waste, which creates serious environmental problems. At the same time, the excessive use of natural sand in concrete has led to the depletion of natural resources. This experimental study focuses on the utilization of ceramic waste as a partial replacement of fine aggregate (sand) in concrete.1] In this study, sand is replaced with ceramic waste/ceramic powder at proportions of 0%, 5%, 10%, 15%, 20%, and 25% by weight. Concrete specimens are prepared for each replacement level and are subjected to curing for 7 days and 28 days. After curing, the concrete is tested to evaluate its performance and strength characteristics.2] The main objective of this research is to study the effect of ceramic waste on the properties of concrete and to determine the optimum replacement percentage of sand with ceramic waste. The use of ceramic waste in concrete not only helps in waste management but also promotes sustainable and eco-friendly construction practices.3]

Keywords:-Ceramic Waste, Ceramic Powder, Concrete, Fine Aggregate(sand) Replacement, Compressive Strength, Sustainable Construction, Curing Period.

1.Introduction

Concrete is one of the most widely used construction materials due to its high strength, durability, and versatility. It is mainly composed of cement, fine aggregate (sand), coarse aggregate, and water. With the rapid growth of the construction industry, the demand for natural sand has increased significantly, leading to the depletion of natural resources and environmental imbalance.1] At the same time, the ceramic industry produces a large amount of ceramic waste in the form of broken tiles, sanitary ware, and rejected ceramic products. 2] Disposal of this ceramic waste is a major environmental problem, as it occupies

landfill space and causes pollution. Therefore, effective utilization of ceramic waste has become an important area of research in sustainable construction.3] Ceramic waste has good hardness, strength, and chemical stability, which makes it suitable for use as a construction material. When processed into ceramic powder or crushed ceramic waste, it can be used as partial replacement of fine aggregate in concrete. This helps in reducing the consumption of natural sand and promotes eco-friendly construction practices.4] The present experimental study focuses on replacing sand with ceramic waste/ceramic powder in concrete at various percentages of 0%, 5%, 10%, 15%, 20%, and 25%. The concrete specimens are cured for 7 days and 28 days to study the effect of ceramic waste on the strength properties of concrete. The results of this study will help in identifying the optimum replacement level of sand with ceramic waste for better performance and sustainability.5]

2.Objective

- To investigate the viability of replacing some of the traditional concrete ingredients (cement, fine aggregate, and coarse aggregate) with ceramic waste.
- To assess how ceramic waste affects the concrete's flexural, split tensile, and compressive strengths, among other strength characteristics.
- To ascertain the ideal proportion of ceramic waste replacement that provides the best strength and functionality.
- To evaluate and contrast the mechanical characteristics of ceramic waste concrete with regular concrete.
- To efficiently use waste from the ceramics sector in order to lessen environmental damage.
- To recycle ceramic waste into concrete in order to encourage environmentally beneficial and sustainable building methods.

3.Literarture review

1] R. Johnson Daniel and S.P. Sangeetha focus on “Experimental study on concrete using waste ceramic as partial replacement of aggregate”.

In an effort to lessen pollution in the environment and preserve natural resources, earlier research has looked into using leftover ceramic material in place of some of the aggregate in concrete. According to research, ceramic waste can be substituted for fine aggregate in various ratios and evaluated for curing times of seven and twenty-eight days.

The findings demonstrated that while greater replacement levels decreased workability because of the angular shape and water absorption of ceramic particles, concrete with low to moderate replacement levels of ceramic waste obtained strength values comparable to ordinary concrete. Overall, the study found that waste ceramic may be successfully incorporated into concrete, promoting environmentally friendly and sustainable building practices.

2] R. Johnson Daniel and S.P. Sangeetha focus on “Experimental Study of the Effect of Ceramic Waste Powder on the Mechanical and Structural Properties of Concrete: A Sustainable Approach”.

The use of ceramic waste powder as a partial substitute for fine aggregate in concrete is the subject of the study "Experimental Study of the Effect of Ceramic Waste Powder on the Mechanical and Structural Properties of Concrete: A Sustainable Approach." The study's primary goal was to assess concrete's mechanical and structural characteristics while encouraging environmentally friendly building techniques.

In this study, concrete specimens were tested for compressive strength, split tensile strength, and structural performance following conventional curing times using varying replacement percentages of ceramic waste powder.

3] Manuel M. Jordán Vidal focus on " Experiments Using Different Types of Waste to Manufacture Ceramic Materials".

The use of different industrial wastes as secondary raw materials to make ceramic and glass-ceramic goods is highlighted in the MDPI paper "Experiments Using Different Types of Waste to Manufacture Ceramic Materials." The study demonstrated that a variety of waste materials, including non-toxic elements like Li, Ca, and Mn as well as extremely hazardous wastes like Cr(VI), may be transformed into valuable materials including refractories, glass-ceramics, and building ceramics through sintering and vitrification procedures. This method helps immobilize hazardous waste and make it inert while also lowering production costs and the use of natural resources.

4]G. Sivaprakash,V. Saravana Kumar, Lakhi Jyoti Saikia focus on "Experimental Study on Partial Replacement of Sand by Ceramic Waste in Concrete"

Researchers have looked into using industrial wastes as substitute fine aggregates in concrete due to the scarcity of natural river sand and environmental concerns. The tile and sanitary ware industries produce huge amounts of ceramic waste, which presents disposal challenges. According to studies, it is possible to substitute some of the sand in concrete with crushed ceramic waste.

5]Mr. Dharmendra Choudhary, Mr. Geeteshwar Prasad focus on "Sustainable Concrete: Ceramic Tile Waste as Partial Aggregate Replacement ".

Large volumes of raw materials are used in the manufacturing of concrete, which pollutes the environment and depletes resources. Reducing waste disposal and conserving natural resources can be achieved by partially substituting ceramic tile waste for natural aggregate. Concrete containing ceramic waste can retain sufficient mechanical qualities, according to earlier research (Correia et al., for example), however increased water absorption may have an impact on durability. Senthamarai and Manharan demonstrated similar strength and high workability when coarse aggregate was substituted with ceramic waste.

6] Al-Bakri et al. (2008) and Awoyera et al. (2021) focus on "Upcycling Ceramic Waste Experiment: Integration of Sustainability and the Value of Khalifah Fil Ardh".

The use of recycled materials in concrete has been extensively researched as a way to lower construction costs and environmental impact. According to Pacheco-Torgal and Jalali (2010), ceramic waste has pozzolanic qualities and can be used to improve sustainability by partially replacing cement or aggregates. Recycled coarse aggregate (RCA) can be utilized in concrete with acceptable strength performance, according to studies by Bektas et al. (2009) and Peter et al. (2019), despite minor mechanical property decreases when compared to natural aggregates.

7]R. Johnson Daniel, S.P. Sangeetha focus on "Experimental study on concrete using waste ceramic as partialreplacement of aggregate".

Research into sustainable alternatives is driven by the fact that the manufacture of concrete uses a lot of natural resources and contributes significantly to carbon emissions. According to earlier research, recycling trash from construction and demolition projects, such as crushed ceramic and recovered aggregates, can lessen the impact on the environment without sacrificing mechanical performance. Reviews of sustainable concrete manufacturing, for instance, found that using ceramic waste in place of cementitious materials or aggregates enhances long-term durability and particle packing, which helps to conserve resources and reduce CO2 emissions in concrete mixtures.

8]G. Sivaprakash,V. Saravana kumar and Lakhi jyotisaikia focus on "Experimental study on partial replacement of sand by ceramic waste in concrete".

To lessen the impact on the environment and preserve natural aggregates, a number of researchers have investigated the use of ceramic waste as a substitute material in concrete. According to Veera Reddy's (2010) investigation into the usage of stone dust and ceramic scrap as aggregate replacement, ceramic waste can be utilized in concrete at optimal levels without significantly reducing its strength. The use of ceramic materials in environmentally friendly concrete and precast goods was examined by Medina et al. (2010), who came to the conclusion that ceramic waste enhances sustainability while preserving acceptable mechanical qualities.

9]Mustafa Batikha, Ali Rostami focus on "Using recycled coarse aggregate and ceramic waste to produce sustainable economic concrete".

Because of the production of cement and the extraction of aggregate, the production of concrete is highly dependent on natural resources and leads to environmental deterioration. Researchers like Pacheco-Torgal& Jalali (2010) and Bektas et al. (2009) have investigated the use of industrial wastes like ceramic materials as partial substitutes for cement or aggregates to address these sustainability challenges, demonstrating improved sustainability and decreased waste disposal issues. Because of its high silica and alumina content, ceramic waste has been recognized as a possible pozzolanic material that, when used properly, can enhance the mechanical and durability performance of concrete.

10] Mohamed Guendouz, Djamila Boukhelkhal, Alexandra Bourdot, Oussama Babachikh and Amine Hamadouche focus on "The Effect of Ceramic Wastes on Physical and Mechanical Properties of Eco-Friendly Flowable Sand Concrete"

Large amounts of ceramic waste, such as broken wall tiles, are produced by the building sector and could be hazardous to the environment if dumped in landfills. In order to lessen dependency on natural resources while enhancing sustainability and performance, researchers have looked into the viability of recycling ceramic waste as a partial substitute for natural sand in concrete, especially in flowable sand concrete (FSC).

Density: Because ceramic waste differs from natural sand in terms of particle packing and porosity, it frequently modifies bulk density. Optimal doses can preserve or improve compactness, despite some studies showing modest losses in density.

Mechanical strengths: Due to the ceramic's capacity to enhance internal particle packing and microstructure, numerous investigations claim enhanced or equivalent compressive and flexural strengths up to a specific replacement level (often around 15–25%). Excess waste may dilute the cementitious matrix and reduce performance if it exceeds that range.

4.Conclusion

Waste ceramic material can be successfully utilized as a partial substitute for fine aggregate in concrete, according to the experimental inquiry. As the amount of ceramic waste in concrete increased, its workability somewhat declined, but it was still within reasonable bounds for real-world uses. Concrete's compressive strength increased up to an ideal replacement level, after which a decline in strength was noted. The angular form and improved interlocking of ceramic particles within the cement matrix are responsible for this improvement.

The findings show that concrete with equivalent or better mechanical qualities than conventional concrete can be made by partially substituting fine aggregate with ceramic waste up to an ideal percentage. By lowering environmental pollution and preserving natural resources, the use of ceramic waste in concrete

not only improves material efficiency but also supports sustainable building. As a result, waste ceramic material can be regarded as a practical and environmentally responsible substitute for concrete.

5.References

1] R. Johnson Daniel and S.P. Sangeetha , "Experimental study on concrete using waste ceramic as partial replacement of aggregate".

2] R. Johnson Daniel and S.P. Sangeetha , "Experimental Study of the Effect of Ceramic Waste Powder on the Mechanical and Structural Properties of Concrete: A Sustainable Approach".

3]] Manuel M. Jordán Vidal, " Experiments Using Different Types of Waste to Manufacture Ceramic Materials".

4] G. Sivaprakash,V. Saravana Kumar, Lakhi Jyoti Saikia "Experimental Study on Partial Replacement of Sand by Ceramic Waste in Concrete"

5]Mr. Dharmendra Choudhary, Mr. Geeteshwar Prasad, "Sustainable Concrete: Ceramic Tile Waste as Partial Aggregate Replacement ".

6] Al-Bakri et al. (2008) and Awoyera et al. (2021) "Upcycling Ceramic Waste Experiment: Integration of Sustainability and the Value of Khalifah Fil Ardh".

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9] Mustafa Batikha, Ali Rostami ,"Using recycled coarse aggregate and ceramic waste to produce sustainable economic concrete".

10] Mohamed Guendouz, Djamila Boukhelkhal, Alexandra Bourdot, Oussama Babachikh and Amine Hamadouche , "The Effect of Ceramic Wastes on Physical and Mechanical Properties of Eco-Friendly Flowable Sand Concrete".