IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

To Enhance the Strength of Concrete by Partial Replacement of Coarse Aggregate with Tile Waste

Prof.Akshay B. Rahane, Vrushali S. Jagtap, Papiha R. Wade, Mohammad Ismail

Abstract:

Growth in construction industry is linked to the growth of infrastructure sector and the building industry. Construction industry has been growth @10-12% per annum. Concrete is widely used as a construction material due to inherent advantages. The demand for granite aggregates only expected to grow as the demand for infrastructure is ever increasing. Hence, there is a pertinent need to look for alternate materials to granite aggregates. This study explores use of ceramic tile waste as an option to the replacement of granite aggregates in terms of suitability. In this study the ceramic tile waste is being used to replace the granite aggregate i.e., coarse aggregate (CA). The ceramic coarse aggregate (CCA) is used in concrete by replacing CA by 25%,35% and 45%. To compare the results of conventional concrete (CC) with CCA concrete a concrete design mix of M20 is produced with various proportion of CCA material. Due to the good bounding nature of ceramic material with cement it increases the strength of concrete. From the study it is found that the percentage of replacement of CA with CCA material is 45%, within which the performance of concrete is better, and all the results attained within the designed limit.

1. Introduction:

The ceramic waste will help to increase the high compressive strength of the concrete when compared to the other materials. Considering the environmental factors, we can recycle the construction and debris waste used in the concrete. Concrete is an essential element in the construction material which is usually associated with coarse aggregate henceforth coarse aggregate acts as an essential element in the construction field. In the present condition the demand of coarse aggregate is going increased, and it leads to the gradual cost increment of aggregates. Thus, the introducing new ceramic tiles from waste ceramic tiles by crushing it to get the required size. The 30% of ceramic products are being waste daily so there is a small cost of this waste or sometimes it has no cost because the ceramic products are not recycled and reused. The utilization of concrete in Indian construction is the rate of about 400 million tons per year and if this continues it may reach a billion tons in less than a decade. Concrete is made up of various aggregates present in the earth's crust, in this manner its assets are consistently drained causing ecological strain. Environment deliver solid has also been affected by various human actions which deliver solid waste in significant amounts i.e., more than 2500 million tons per year, inclusive of all the industrial, medical, agricultural, and other forms of waste from the rural and urban areas. Clearance of all these solid wastes causes various issues and complication there by affecting ecology.

The utilization of concrete in Indian construction is the rate of about 400 million tons per year and if this continues it may reach a billion tons in less than a decade. Concrete is made up of various aggregates present in the earth's crust, in this manner its assets are consistently drained causing ecological strain. Environment deliver solid has also been affected by various human actions which deliver solid waste in significant amounts i.e., more than 2500 million tons per year, inclusive of all the industrial, medical, agricultural, and other forms of waste from the rural and urban areas. Clearance of all these solid wastes causes various issues and complication there by affecting ecology.Presently large amounts of ceramic wastes are generated in ceramic industry which would have an important impact on environment and humans. But now a days the awareness regarding the use of ceramic waste in construction field has increased. Even this type of usage products solid waste but the disposal of them is not much complicated compared to the waste and pollution by the source industries. The non-biodegradable ceramic materials used for floor tiles, wall tiles and weather course tiles, sanitary ceramic products, electrical ceramic insulators, and ceramic utensils etc. can be conveniently recycled into concrete elements for various services and locations. This replacement has numerous advantages such as the economy using as sustainable material and reduction solid waste disposal and minimize the environmental hazardous.

Keywords: Infrastructure sector, Granite, Ceramic material, Conventional concrete, Mix design, Compressive strength, solid waste, ecology, sustainable material, construction industry, Coarse aggregate.

2. Objective of study:

1) To analyze the potential application of tile waste in concrete production which would reduce the usage of coarse aggregate in concrete and preserve the clean environment.

2) To reduce the cost of construction and evaluate the significance of waste material for manufacturing of sustainable concrete for construction.

3. LITERATURE REVIEW

1. "The effect of ceramic waste aggregate on strength properties of concrete", E.E. Ikponwosa and S.O Ehikhuenmen, Nigerian Journal of Technology (NIJOTECH) July 2017:

This paper states that the use of ceramic waste in concrete mix resulted in considerable reduction in the workability as replacement level increased. The use of 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 pastes 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. The use of ceramic waste in concrete is an effective way to reducing the costs of concrete and keeping the environment clean through efficient management of waste and decrease in the use of normal coarse aggregate in concrete production.

2. "An Experimental analysis of partial replacement of coarse aggregate by waste ceramic tiles in concrete", N. Sivachandiran, A. Magesh, International Journal of pure and applied mathematics,2015:

The purpose 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 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 aggregates are partial replaced with coarse aggregate because the tile aggregate is 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.

3. "Effect of Partial replacement of fine and coarse aggregate with ceramic waste on the properties of concrete", Vikas Rajora1, Gurtej Singh Sidhu, International Journal of science and research (IJSR), August 2016:
According to this paper ceramic waste initially there is decrease of 23.32% in compressive strength of 7days when partially replacement of 10%, but after that while replacing 20% there is increase of 5.48% and with 30% there is increase of 14.56% increases respectively in initial compressive strength with respect to normal concrete mix. The reason behind this is that the ceramic waste (sand) behaves as micro filler in concrete. When the ceramic waste replaced as 10% the amount of micro filler is not enough to exhibit required strength but further increase in amount of ceramic waste (sand) fill more voids in concrete mix due to which the compressive strength increased. Ceramic waste initially there is decrease 16.20% in compressive strength of 28days when partially replacement of 10%, but after that while replacing 20% there is increase of 4.2% and with 30% there is increase of 14.42% increases respectively in final compressive strength with respect to normal concrete. Initially there is decrease by 39.49% in flexural strength (28days) when partially replacement of 10%, but after that while replacing 20% there is increase of 8.57% and with 30% there is increase of 33.40% increases respectively in flexural strength with respect to normal concrete.

4.Material and methodology:

4.1) Material:

A. **Ceramic Tile waste**
B. **Coarse Aggregate** - Size 10 mm.
C. **Fine Aggregate**
D. **Cement –** OPC 43 grade
E. **Water**

4.2) Methodology:

The Methodology starts with the procedure of carrying out test on the broken tile waste around 10mm size. The result of all the tests taken on the broken tile waste and coarse aggregate were compared to the standard given in texts. The test includes specific gravity, water absorption, sieve analysis. Cubes of size (150mm×150mm×150mm) with mix proportion 1:1:5:3 were casted with constant water cement ratio of 0.50.

The coarse aggregate was partially replaced with tile waste by 25%, 35% and 45%. The cubes were casted and after 24 hours, they were remoulded and cured in water.

4.2.1) Water absorption Test:

From the previous research paper, we have found that tile waste absorbs water. We have dried the tile waste in an oven at the temperature of about 105°C to 110°C and then cool and weigh. After cooling, we have immersed the dry specimens in clean water at 27° + 2° for 24 hours.

Fig.1: Water absorption Test

4.2.2) Specific Gravity Test:

We have used pycnometer method for this test and results obtained are as follows:

- ✓ Specific gravity of Coarse-grained aggregate =3
- ✓ Specific gravity of Fine-grained aggregate = 2.61
- ✓ Specific gravity of waste ceramic tiles = 2.76
- ✓ Specific gravity of cement = 3

4.2.3) Sieve analysis:

a. Test result of sieve analysis of cement:
Sieve size=90µm.
Weight of cement:1000gm
Weight retained on 90 µm sieve =38gm.
Percentage of fineness = {(1000-38)/1000} *100
= 96.2%.

b. Results for sieve analysis of coarse aggregate:

Total weight = 3000gm.
Average size of coarse aggregate = 10mm.

c. Result of sieve analysis of fine aggregate:

Fineness modulus =3.05.

d. Sieve Analysis for tile waste:
For partial replacement of coarse aggregate by ceramic tile wastes we are using average size of tile waste i.e., 10 mm Because average size of aggregate is 10 mm.

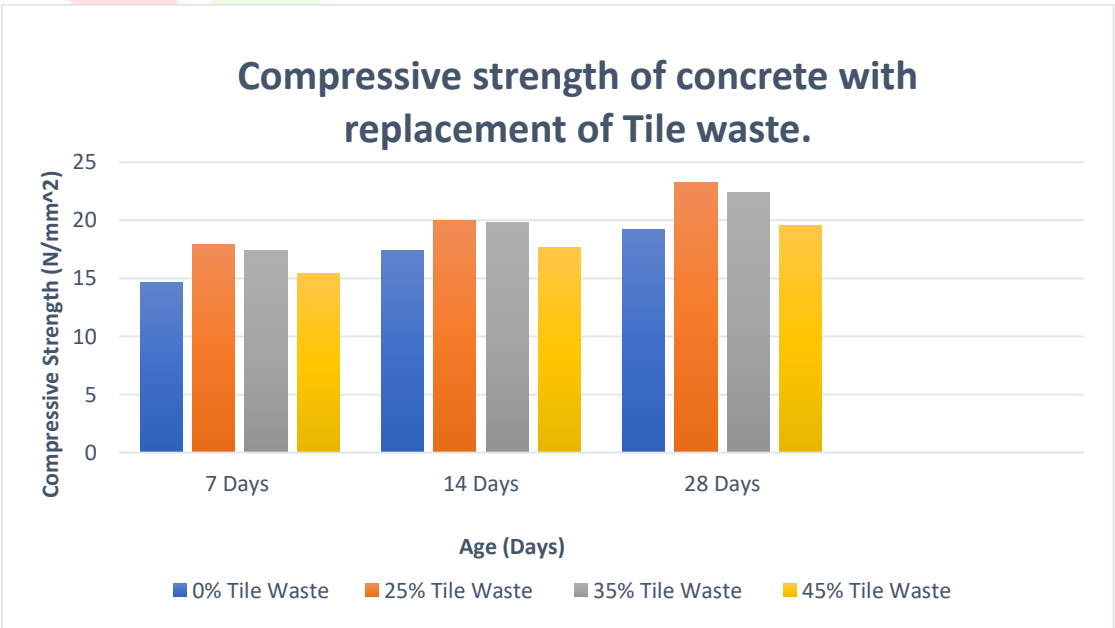
4.2.4) Compressive strength:

The compressive strength test was conducted on UTM (Universal Testing Machine). The test was conducted on concrete cubes for different percentage of waste tiles. The cubes were crushed under UTM and its strength was recorded.

Fig 2: Compression test on UTM

5. Conclusion:

From the experimental study on plain cement concrete and the ceramic coarse aggregate concrete, the compressive strength of concrete with the addition of tile waste increases with the increase in percentage up to 25% and it gives 23.26n/mm^2 beyond which strength to decrease with further addition of tile waste.



Graph no 1: Compressive strength of concrete with replacement of tile waste.

6.References:

1) Adeniran Jolaade Adeala and Lawrence Ademola Omisande yop "Structural Performance of Broken Ceramic Tiles as Partial Replacement of Coarse Aggregates in Concrete" International Journal of Research and Scientific Innovation (IJRSI) (2021).
2) N.Sivachandiran,A.Magesh, "An Experimental analysis of partial replacement of coarse aggregate by waste ceramic tiles in concrete",International Journal of pure and applied mathematics,2015 International Journal of Pure and Applied Mathematics Special Issue (2018) .
3) S.0 Ajamu, J.R . Oluremi and E.S ogunyemi "Impact of replacement of coarse aggregate with ceramic tile waste on the strength characteristic of concrete" Journal of research information in civil engineering (2018).
4) E.E. Ikponwosa and S.O Ehikhuenmen "Effect of ceramic waste as coarse aggregate on strength of properties of concrete" Nigerian Journal of technology (NIJOTECH) (2017).