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PARTIAL REPLACEMENT OF CEMENT WITH CERAMIC WASTE ALONG WITH COARSE AGGREGATE BY BROKEN TILES

[#]*Department of Civil Engineering, Buddha Institute of Technology, CL-1, Sector 7, GIDA, Gorakhpur (India)*

[1]**ASHISH KUMAR VERMA**
Assistant professor
Buddha Institute of technology,
Gorakhpur.
ashish278@bit.ac.in

[2]**SHAMSUR RAHMAN**
UG student
Buddha Institute of technology,
Gorakhpur.
shaimrahman234@gmail.com

[3]**VISHAL KUSHWAHA**
UG student
Buddha Institute of technology,
Gorakhpur
kushwahavishal865@gmail.com

[4]SANKET SINGH
UG student
Buddha Institute of technology,
Gorakhpur.
sanketsingh.gkp@gmail.com

[5]SATISH KUMAR
UG student
Buddha Institute of technology,
Gorakhpur.
satishkumar172839@gmail.com

[6]PRIYESH KUMAR TRIPATHI
UG student
Buddha Institute of technology,
Gorakhpur.
priyeshtripathi1998@gmail.com

ABSTRACT

Ceramic waste powder is discovered by sedimentation, and shattered tiles are readily available at demolition sites; these are subsequently thrown in open areas, causing pollution and dust in the summer, endangering both agricultural and public health. Thus, the use of ceramic waste powder and broken tiles in various industrial sectors, particularly in the construction, repair, and maintenance of buildings and industries, will aid in environmental protection. By weight of M-25 grade concrete, we will partially replace (OPC) cement with ceramic waste powder in the range of 0 percent, 8 percent, 16 percent, 24 percent, 32 percent. Concrete mixtures will be produced, tested, and compared to standard concrete in terms of compressive strength.

These tests will examine the mechanical properties of concrete for 7, 14, and 28 days, respectively.

Keywords— Broken tiles, Ceramic, infrastructure, aggregate, concrete.

I. *INTRODUCTION*

The increasing growth of non-biodegradable garbage has emerged as a major source of current pollution. The only method to prevent pollution is to reduce or reuse these non-biodegradable compounds.
Ceramic and broken tiles are examples of non-biodegradable materials.
To lessen the quantity of these ceramic trash and broken tiles, we will use them in concrete

Cement:
Cement is a binding material that sets, hardens, and adheres to other materials to bond them together in building. Geopolymer cement and Portland cement are the two most common types of cement. Cement is occasionally used on its own, although it is mostly utilised to bond sand and aggregate together. Masonry mortar is made from cement mixed with fine aggregate, while concrete is made from sand and gravel. Cement is the most frequently used material on the globe, coming in second only to water as the most widely consumed resource.

Fig. 1.1 cement

2- FineAggregate:

Particles that pass through a 4.75 mm sieve but remain on a 0.075 mm sieve are considered fine aggregates. Fine aggregates in concrete include sand, surkhi, stone screens, cinders, fly ash, and other materials.Fine aggregate, which is made up of natural sand or crushed stone, is a key component of concrete. The hardened properties of the concrete were heavily influenced by the fine aggregate density and quality.

Fig. 1.2 Fine Aggregate

3- CoarseAggregate:

Aggregates are often obtained by blasting in stone quarries or breaking them down by hand or with crusher machines . Coarse aggregates are materials that pass through a 3-inch screen and are kept on a 4.75mm sieve. In a combination, coarse aggregate is more cost effective. When compared to the volume of small bits, larger pieces allow for less surface area of the particles.

Fig. 1.3 Coarse Aggregate

4- Broken solidwaste:

The building sector benefits from replacing coarse aggregate with broken solid waste in terms of cost and pollution reduction. By adding tile aggregate and granite powder to ordinary concrete, the manufacturing cost will be significantly lower, lowering construction pollution and allowing for more efficient use of building waste.
Overall, trash production, such as ceramic waste broken tiles, is over 2 to 3 billion tonnes per year, with concrete accounting for about 30-40%. Solid waste issues are particularly critical for developing countries that are entering or have already entered the construction boom

5- BrokenTiles:

Broken tiles were recovered from a ceramic manufacturing plant's solid refuse and a demolished structure. Broken tile aggregate was divided into different sizes in order to use them as a partial replacement for natural coarse aggregate. The broken tile aggregate was retained after passing through a 16.5mm filter. Broken tiles were partially replaced with coarse aggregate in percentages ranging from 10% to 30%.

Fig. 1.4 Broken Tiles

2. LITERATURE REVIEW:

The strength and abrasion characteristics of Fly Ash Concrete were investigated by B. Tripathi et al. (2012). He evaluated the potential of Fly Ash as sand in concrete in their paper, taking into account the presence of hazardous metals (lead and zinc) and their impact on early cement hydration. FLY ASH was used to replace the equivalent volume of sand in various proportions.

In the Indian Concrete Journal, Shashidhara and Vyas (2010) reported on the outcomes of replacing sand in cement concrete using imperial smelting furnace Fly Ash. The fine aggregate fraction so obtained met both fine aggregate and all in aggregate grading standards. Although the packing 7 density of the dry all-in aggregate decreased as the replacement level increased, the workability of concrete improved. Although substituting sand with fly ash had no effect on compressive strength, complete replacement led in Lead (Pb) setting leaching above the allowed amount in a leaching test. produced with various water-to-cement ratios Abrasion resistance, as well as compressive, flexural, and pull off strength, were tested The results were positive because no signs of setting delay were found. The possibility in upcoming time is to use of Fly Ash as sand in concrete was assured by improvements in compressive and pull-off strength, equivalent flexural strength and abrasion resistance, and leaching of toxic components within safe levels.

R. Hooper et al., (2002) centered on Fly Ash setting characteristics, the effect of fly ash in decreasing set retardation, and European regulations for additional material reuse. According to them, the UK Ten Year Transport Plan, which includes highway infrastructure development, provides possibilities to successfully demonstrate the utilization of modest volume sources of secondary materials, such as Fly Ash, within the local economy. Pavement assembly provides numerous options for consumption, the most believable of which is the substitution of slag for sand fractions in bonded mixtures, cement, and bituminous. The study was limited to cementitious mixes. The existence of zinc and lead ions in fly ash has been shown to affect the setting properties.
The slag's leaching properties revealed that the slowdown is not proportional to the amount of zinc or lead leached. Furthermore, leaching tests using pulverized fuel ash (fly ash) and powdered granulated blast furnace slag suggested that include these elements in the concrete mixture could reduce set-in time.

Morrison and Richardson (2004) investigated environmental risks related with the reusing of slag in concrete due to the prevalence of toxic metals such as zinc and leads in their study of Re-use of zinc producing furnace fly ash in concrete. They came to the conclusion that fly ash is physically adequate to be used as an aggregate, but that it must overcome various obstacles before it can be utilised in concrete. The glassy form of the slag first prompted worries about the possibility of alkali–silica reaction (ASR) in concrete, according to the study.

METHODS & METHODOLOGY:

3.1- Testing of Cement:

ConsistencyTest:

This is a test to determine the amount of adding water required to make a paste of normal consistency, the percentage of water required to make a homogeneous cement paste, and the viscosity of cement paste such that the vicat's plunger pierces the bottom of the vicat mould up to 5-7mm. The amount of water required for various cement tests is determined by the cement's usual consistency, which is determined by the basic composition and granularity of the cement

Fig.3.1 (a) Vicat plunger

b) Soundness Test:

The cement concrete must not vary volume after setting in order to pass the soundness testing. It is confirmed by restricting the amount of free lime and magnesia in the cement, which slake slowly and cause a change in volume (called unsound). The Le-Chatelier process for free lime and the autoclave method for magnesia can both be used to determine the soundness of cement. It exhibits unsound up to 10 mm for OPC, RHC, LHC, and PPC, but not more than 5 mm for HAC and SSC.

It is a critical test to enhance the integrity of cement since a weak cement would fracture, distort, and disintegrate, eventually leading to failure.

Fig.3.1 (b) Le-Chatelier

c) Compressive Strength: Compressive strength measurements are needed to determine mix proportion. This tes controls the quality and quantity, as well as the percentage of adulteration.

d) Tensile Strength: Tensile Strength: Briquette test and split tensile methods are used to determine tensile strength.

e) The tensile modulus of cement indicates faults in the cement more quickly than any other test. In comparison to compressive strength testing, this test too is fairly simple to execute. Furthermore, because flexural strength is proportional to tensile strength, this test is well suited to provide knowledge on both tensile and compressive strengths when the supply of substance for testing is limited.

2- Testing of Aggregates:

a) Crushing Test: Crushing under compression load is one of the ways in which pavement substance fails. A test is used to determine the crushing strength of aggregates and is specified by IS: 2386 part-IV. Under a step-by-step provided crushing load, the mixtures crushing price gives a relative life of resistant to crushing.

b) Abrasion Test: An abrasion test is used to determine the toughness of aggregates and whether or not they are suitable for certain pavement construction projects. The Los Angeles abrasion test is the primary method for determining hardness, and it has been standardised in India.

c) ImpactTest:

The aggregate impact measurement value is a measure of strength to abrupt impact or shock, that might differ from resistance to a progressive compressive force.

d) Shape Tests:

The percentage of flaky and elongated particles in the mixed mass determines the particle morphology. Flaky or elongated particles are detrimental to the workability and consistency of mixes.

CONCLUSION:

- Following outcomes were examined after several combination of ceramic waste and broken tiles used in concrete.
- When compared to traditional cube strength, the strength of the cube after replacing 8 percent, 16 percent, 24 percent, and 32 percent increased at initially, then decreased as replacement increases
- We get the finest results when 8 percent of the cement is replaced with ceramic.
- After replacing 16 percent of the cement with ceramic waste, tensile strength increased, then decreased.
- It is a viable choice for disposing of ceramic waste safely. The construction sector benefits from the usage of ceramic waste.

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