STUDY ON STRENGTH ASPECTS OF CONCRETE WITH TILE POWDER AS PARTIAL REPLACEMENT OF CEMENT

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ABSTRACT

Ceramic waste deposit causes different types of environmental pollution like air, water and soil pollution. Tile powder is a fine residue after manufacturing of tiles. Chemical composition tests conducted on the ceramic tile proved that it contains 64.56% silica, which is a predominent feature of pozzolans. The use of waste products produced by tile industries has been focused to reduce it for industries and economical reasons. The usage of more cement in concrete becomes uneconomical which is partially replaced with tile powder in cement concrete. For this purpose, the concrete specimens are prepared by partially replacing the cement with tile powder at different percentages like 10%, 20%, 30%, 40% and 50% (by weight). These specimens are tested for compressive strength, split tensile strength and flexural strength after 7, 28 and 56 days of curing. These values are compared with the test values of conventional concrete. The test results proves that the average compressive strength, split-tensile strength and flexural strength of the concrete are achieved up to 30 % replacement of cement with tile powder without affecting the characteristics of M40 grade concrete

1. INTRODUCTION

CONCRETE

Concrete is a composite material consist of mainly water, aggregate, and cement. The physical properties desired for the finished material can be attained by adding additives and reinforcements to the concrete mixture. A solid mass that can be easily molded into desired shape can be formed by mixing these ingredients in certain proportions. Over the time, a hard matrix formed by cement binds the rest of the ingredients together into a single hard (rigid) durable material with many uses such as buildings, pavements etc., The technology of using concrete was adopted earlier on large-scale by the ancient Romans, and the major part of concrete technology was highly used in the Roman Empire. The coliseum in Rome was built largely of concrete and the dome of the pantheon is the World's largest unreinforced concrete structure. After the collapse of Roman Empire in the mid-18th century, the technology was re-pioneered as the usage of concrete has become rare. Today, the widely used man made material is concrete in terms of tonnage.

HISTORICALBACKGROUND

Although high strength concrete is considered as relatively a new material, its development has been gradually increasing over years. In 1950s, USA considered the concrete with a compressive strength of 34mpa as high strength. In 1960's, the concrete with compressive strength 41mpa to 52mpa was used commercially. In the early 1970's, 62mpa concrete was been made. With in the world state of affairs, however, within the last fifteen years, concrete of terribly high strength entered into the construction sector of high-rise buildings and long span bridges. The compressive strength over 110mpa has been thought-about by IS 456-2000 for the applications in pre-stressed concrete members

and cast-in-place buildings.

However, recently reactive concrete could be the one that having a compressive strength of nearly 250mpa. It is fully supported by pozzolanic materials. The first distinction between high-strength concrete and nominal-strength concrete refers to the relation of utmost resistance offered by compressive strength of the concrete sample fortheapplicationofanytypeofload.Thoughthere isnocorrectseparationbetween

High-strength concrete and normal-strength concrete, the Yankee Concrete Institute defined the compressive strength greater than 42mpa as high strength concrete.

PROPERTIES OFCONCRETE

Generally the Concrete is a material having high compressive strength than to tensile strength. As it has lower tensile stress it is generally reinforced with some materials that are strong in tension like steel. The elastic behavior of concrete at low stress levels is relatively constant but at higher stress levels start decreasing as matrix cracking develops. Concrete has a low coefficient of thermal expansion and its maturity leads toshrinkage.

Due to the shrinkage and tension, all concrete structures crack to some extent. Concrete prone to creep when it is subjected to long-duration forces. For the applications various tests be performed to ensure the properties of concrete correspond to the specifications. Different strengths of concrete are attained by different mixes of concrete ingredients, which are measured in psi or Mpa. Different strengths of concrete are used for different purposes of constructions. If the concrete must be light weight a very low-strength concrete may be used. The Lightweight concrete is achieved by the addition of lightweight aggregates, air or foam, the side effect is that the strength of concrete will get reduced. The concrete with 3000-psi to 4000-psi is oftenly used for routine works. Although the concrete with 5000-psi is more expensive option is commercially available as a more durable one. For larger civil projects the concrete with 5000-psi is oftenly used. The concrete strength above 5000 psi was often used for specific building elements. For example, the high-rise concrete buildings composed of the lower floor columns may use 12,000 psi or more strength concrete, to keep the columns sizes small.

Bridges may use concrete of strength 10,000 psi in long beams to minimize the number of spans required. The other structural needs may occasionally require high- strength concrete. The concrete of very high strength may be specified if the structure must be very rigid, even much stronger than required to bear the service loads. For these commercial reasons the concrete of strength as high as 19000-psi has been used.

2.LITERATUREREVIEW

GENERAL:

studied the replacement of 0%,20%,50% and 100 % of total natural aggregate volume with recycled aggregate (recycle brick and sanitary ware aggregate) for determination of its mechanical properties i.e. workability, Fresh density, compressive strength , split tensile strength, modulus of elasticity, abrasion resistance and influence of superplasticizers. Wioletta et al. [7] Studied about the properties of cement matrix modified with ceramic waste by the addition of

ceramic filler (10%, 15% and 20% of cement mass) with Mortar and tested its consistency retention, workability retention, shrinkage test, freeze-thaw resistance test, flexural and compressive test (2,7,14,28 and 56 days) .Jiménez et al. [8] tested the replacement of natural fine aggregate with ceramic waste in masonry mortar with the replacement of fine aggregate (0%, 5%, 10%, 20% and 40%) of natural sand with ceramic recycled fine aggregate in a ratio of 1:7 volumetric cement-to-aggregate. Katzer [9]did the strength performance comparison of mortar made with waste fine aggregate and ceramic fume with exchange of cement by ceramic

fumeLots of researcher has been done a research on concrete. This paper covers some of the paper based on partial replacement of cement.

Wen-Ten Kuoet al. [1] has investigate an effect of ground granulated blast furnace slag (GGBFS). He has tested the mechanical and electricity properties to assess the correlations among flow, compressive strength, water absorption, and electricity at 50 V and 100 V. At the curing age of28 days, the compressive strength of the control group was in the range of 29.1–1.7 MPa, whereas the compressive strength of PZT was in the range of 26.8–30.0 MPa. The control group exhibited higher results (1786–2075 X) in the electricity property test under 50 V, whereas PZT exhibited lower results (1368–1562 X). The compressive strength and results of the electricity property tests demonstrated that the compressive strength and electrical resistance decreased as the replacement of GGBFS increased. The strength of the control group was higher than the strength of PZT because 5% of the fine aggregate was replaced by the piezoelectric material and the piezoelectric material was water-resistant. Thus, the piezoelectric material could not be effectively combined with fine aggregate and cement.

F. Baeza et al.[2] has done a research on Blending of industrial waste from different sources as partial substitution of Portland cement in pastes and mortars. He has done Binary and ternary combinations of sewage sludge ash (SSA) with marble dust (MD), fly ash (FA) and rice husk ash (RHA) as replacement in Portland cement pastes, were assessed. He has carried

Md Daniyal and Shakeel Ahmad (2015) [5]: A large quantity of ceramic materials goes into wastage during processing, transporting and fixing due to its brittle nature. The crushed waste ceramic tiles were used in concrete as a replacement for natural coarse aggregates with 10%, 20%, 30%, 40% and 50% of substitution in concrete. The study states that the use of ceramic tile aggregate in concrete enhances its properties and it has been observed an increase in both compression and flexural strength.

N.Naveen Prasad (2016) [6]: Crushed waste tiles and Granite powder were used as a replacement to the coarse aggregates and fine aggregate. The combustion of waste crushed tiles were replaced in place of cement by 10%, 20%, 30% and 40% and Granite powder was replaced in place of fine aggregate by 10%, 20%, 30% and 40% without changing the mix design. M30 grade of concrete was designed to prepare the conventional mix. Without changing the mix design different types of mixes were prepared by replacing the coarse aggregates and fine aggregate at different percentages of crushed tiles and granite powder. Experimental investigation is carried out. The out Several tests were carried out at different curing ages: thermo gravimetry, density, water absorption, ultrasonic pulse velocity and mechanical strengths. Pozzolanic effects of the mineral admixtures, densities similar to control sample and improved absorptions when combining waste materials were identified. In general, the compressive strength reaches or exceeds the cement strength class, and blending SSA, FA and RHA (30% cement replacement) increase of strength by 9%, compared to the control sample, was achieved.

W.W.J. Chan et al.[3] has conducted a study on the durability of concrete made from various non-reactive waste materials, i.e. carbon black, silts and clays, and with various water contents were investigated. He has studied different types of test like compressive strength; workability, sorptivity, and water permeability of the concrete. He has also done a detail investigation based on the resulting change in the microstructure and cement hydration in these concrete by X-ray diffraction(XRD), scanning electron microscopy (SEM) and energy dispersive X-ray (EDX) spectroscopy. Workability can be increased by increasing the specific surface area or using super plasticizer. So in present study he has used silt and clay for research in

varying proportion and he has found that 25 vol.% of cement replaced with silts and clay using a water/cement (w/c) ratio of 0.5 gives durable concrete. That is, the cement and water contents were less than those in OPC. Also, the cost ofconcrete will be lowered.

important role in manufacturing of concrete. By varying the properties and amount of these materials, the properties of concrete will changes. The main raw materials used in this experimental work are Cement, fine aggregate, Coarse aggregate.

CEMENT:

Ordinary Portland cement is the most common type of cement in general use around the world as a basic ingredient of concrete, mortar, stucco, and most non- specialty grout. Cement is the main ingredient in manufacturing of concrete. The characteristics of concrete will be greatly affected by changing the Cement content. The Cement used in this project is Ordinary Portland Cement of 53 grade confirming to IS 12269 – 1987.

It developed from other types of hydraulic lime in England in mid 19th century and usually originates from limestone. It is a fine powder produced by heating materials to form clinker. After grinding the clinker we will add small amounts of remaining ingredients. Many types of cements are available in market. When it comes to different grades of cement, the 53 Grade OPC Cement provides consistently higher strength compared to others. As per the Bureau of Indian Standards (BIS), the grade number of

3. MATERIALS ANDPROPERTIES

DESCRIPTION OF MATERIALS

Concrete is a composition of three raw materials. Cement, Fine aggregate and Coarse aggregate. These three raw materials play an a cement highlights the minimum compressive strength that the cement is expected to attain within 28 days. For 53 Grade OPC Cement, the minimum compressive strength achieved by the cement at the end of the 28th day shouldn't be less than 53MPa or 530 kg/cm^2. The color of OPC is grey color and by eliminating ferrous oxide during manufacturing process of cement we will get white cement also.

Ordinary Portland Cement of 53 Grade of brand name Ultra Tech Company, available in the local market was used for the investigation. Care has been taken to see that the procurement was made from single batching in air tight containers to prevent it from being effected by atmospheric conditions. The cement thus procured was tested for physical requirements in accordance with IS: 169-1989 and for chemical requirement in accordance IS: 4032-1988. The physical properties of the cement are listed in Aggregates of size ranges between 0.075mm – 4.75mm are generally considered as fine aggregate. In this experimental work two types of Fine aggregate were used. They are River sand and (Bottom ash). The Fine aggregate are selected as per IS-383 specifications.

River sand:

It is also called as natural sand. In this work a good quality of natural sand was used. The sand is medium sand and is confirming to Zone-II as per standard specifications.

3.2.3 Coarse Aggregate

Aggregate of size more than 4.75mm are generally considered as Coarse aggregate. The maximum size of Coarse aggregate used in this experimental work are 20 mm and 12 mm. A good quality of Coarse aggregate is obtained from nearest crusher unit. The Coarse aggregate are selected as per IS-383 specifications.

3.3 PROPERTIES OF MATERIALS:

Various tests have conducted on the Raw materials to obtain the physical and mechanical properties. The detailed test results are given below.

3.3.1 Tests on Cement:

3.3.1.1 Specific Gravity of Cement

The method used to calculate specific gravity of Cement is Le-chatlier's Flask method. In this Cement is tested by using Kerosene. The tested Cement specific gravity is of 3.15

3.3.1.2 Normal Consistency of Cement

Normal consistency test is conducted as per IS 4031 (part 4) – 1988. The main purpose of conducting Normal consistency is to find the amount of water to be added for producing Cement paste of standard consistency. Vicat apparatus is generally used for this test and is confirming to IS 5513 – 1976.

Result: The Normal consistency of Cement paste = 31.22

Fig 3.1 Vicat Apparatus for Normal consistency

3.3.1.3 Fineness of Cement

The Fineness of Cement is calculated by the 90 micron sieve method. In this the retained amount of Cement on the sieve should not be more than 10 % for ordinary Cement.

Observations:

Retained weight on sieve = 3gm

Result: The fineness of Cement = 97 %

CONCLUSIONS:

In the elite plan of the solid blend, the water-bond proportion is received low. It is important to keep super plasticizers for the required usefulness. At the point when the level of mineral added substances in the blend builds, the level of super plasticizer additionally increments to acquire the required opposition.

On account of various mixes of level of substitution of mineral added substances, most extreme compressive quality is acquired for cement of evaluation M30 at 45.77 Mpa at 90 days with supplanting of bond with 20% ceramic waste powder. high resistance

Reason The field of use of elite cement in our development exercises is wide, to be specific pre-assembled, prestressed spans, multi-story structures, scaffolds and structures in beach front zones and so forth. To impact this change, we should reactivate the plan of the structures by empowering the utilization of high-quality cement.

When the smaller scale split shows up, an abrupt disappointment is seen in the high-quality solid shapes.

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