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ABSTRACT

The concrete is a cement-based material which has become most popular and widely used in construction field such as highways, flyovers, buildings, damsetc. Now a days the consumption of concrete increased exponentially and structure without concrete cannot be imagined. Durability of concrete mainly depends upon the climatic condition which may likely to damage the concrete structures. To enhance the life against such problems it is necessary to improve the mechanical properties of the concrete. The use of pozzolanic in concrete and mortar was started with a view to reduce the cost, overcome the adverse effects of OPC and utilize waste products and by products of industrial activities which were providing harmful to environment, natural resources etc. Also, the use of pozzolanas improves several properties of mortar and concrete viz. workability, strength, resistance to cracks permeability and durability. Further the use of pozzolanas has resulted in the production of high- performance concrete. Owing to globalization, privatization and liberalization, the construction of important infrastructure projects are increasing in developing countries like India. Such development activities require large quantities of natural resources. This leads to faster depletion of natural resources on one side and manifold increase in cost of construction of structures on the other side, which is a major problem in construction sector today. In view of this people have started searching for suitable alternate materials which can be used either as an additive or as a partial replacement to conventional ingredients of concrete. Use of tile dust as partial replacement for cement in concrete is one such economical method. In the laboratory tests were conducted by partially replacing cement in concrete by tile dust as 0%, 10%, 20%, 30%, 40% & 50%. The development of compressive strength, split tensile strength and flexural strength of concrete at the age of 7, 28, 56 days are investigated. These strengths are compared with conventional concrete of the same mix proportions.

Key words: Tile dust, super plasticizer, ceramic waste, strength, concrete

1 Introduction

The use of pozzolanas in concrete and mortar was started with a view to reduce the cost, overcome the adverse effects of OPC and utilize waste materials and by products of industrial activities which were providing harmful to environment, natural resources etc. Also, the use of pozzolanas improves/modifies several properties of mortar and concrete viz. workability,



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strength, resistance to cracks, permeability and durability. Further, the use of pozzolonas has resulted in the production of high-performance concrete. Now a days, the properties of concrete are modified with the use of several additives like plasticizers/super plasticizers and pozzolonas improve the microstructure of the concrete matrix resulting in stronger and more durable concrete. The pozzolonas contribute to the strength development by utilizing the whole or part of the calcium hydroxide generated during hydration process of OPC. This action improves the several undesirable properties associated with OPC used. Also, the pozzolonic materials act as a filler in the microstructures of the concrete. A more homogeneous matrix is obtained as the pozzolanas because of their very small size provide very large number of nucleation sites for the precipitation of hydrated products. The subsequent modification of the microstructure of cement composites improves the mechanical properties, durability and increases the service-life properties. When fine pozzolana particles are dissipated in the paste, they generate a large number of nucleation sites for the precipitation of the hydration products. Therefore, this mechanism makes paste more homogeneous. This is due to the reaction between the amorphous silica of the pozzolanic and calcium hydroxide, produced during the cement hydration reactions.

Silica fume is a by-product resulting from the reduction of high – purity quartz with coal or coke and wood chips in an electric arc furnace during the production of silicon metal or silicon alloys. Silica fume is known to improve both the mechanical characteristics and durability of concrete. The principle physical effect of silica fume in concrete is that of filler, which because of its fineness can fit into space between cement grains in the same way that sand fills the space between particles of coarse aggregates or the cement grains fill the space between the sand grains. As for chemical reaction of silica fume, because of high surface area and high content of amorphous silica in silica fume, this highly active pozzolana reacts more quickly than ordinary pozzolanas. The use of silica fume in concrete has both engineering potential and economic advantage. This paper presents a review of silica fume and its effect on fresh and hardened concrete. Concrete is one of the most widely used construction materials in the world. The production of Portland cement as the essential constituent of concrete requires a considerable energy level and also releases a significant amount of chemical carbon dioxide emissions and other greenhouse gases (GHGs) into the Atmosphere. Thus, seeking an eco-efficient and sustainable concrete may be one of the main roles that construction industry should play in sustainable construction. To make the concrete more eco-efficient, different life cycle phases of concrete products can be brought to bear such as extraction of raw material, production of constituents, production of concrete, transportation, erection, maintenance, demolition and recycling.

Portland cement can be partially replaced by cementitious and pozzolanic materials especially those of industry by-products such as fly ash, GGBS, silica fume, ceramic waste powder and metamorphic rock dust from stone cutting industry. The aggregates are also conserved by



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replacing them with recycled or waste materials among which recycled concrete, ceramic waste, post-consumer glass, and recycled tires are the most used. Waste ceramic materials may become a cheaper but almost equivalent alternative to metakaolin or ground granulated blast furnace slag, fly ash and other materials as supplementary binder in concrete. The ceramic industry often produces calcined clays that result from burning little-group clays which are commonly used in the production of red-clay ceramic products. A portion of these products is discarded as scrap, thus constitutes industrial waste. The residues of ceramic bricks, floor and roof tiles ground to a suitable fineness can though become active pozzolans. So, they have a potential to be used in mortar and concrete.

2 Literature Review

Literature Review in the form of a comprehensive summary of a specific topic from the previous research. Those research are of article research, journal research, book, and other sources. The purpose of a literature review is to survey the journals, articles, scholarly books to prevent duplication of the research paper and also provide the credit of the original researcher of that journals, articles or books. Literature review is an evaluation of the article research, journal research, book and other sources literature in specific topic area. It mainly document the specific writings for the acknowledgement of writings.

2.1 Collection of Materials

The Materials Collection is a growing collection of a wide-selection of samples of interesting materials. The materials range from the frequently used, like concrete and types of wood, to the high-tech, such as geo synthetics. The collection is centered on sustainable, innovative materials used in construction, architecture and design. It is curated to provide tactile information, allowing design, engineering and applied science students to explore materials used in construction and the built environment.

2.2 Testing of Materials

Materials testing, measurement of the characteristics and behavior of such substances as metals, ceramics, or plastics under various conditions. The data thus obtained can be used in specifying the suitability of materials for various applications—e.g., building or aircraft construction, machinery, or packaging. Materials testing breaks down into five major categories: mechanical testing; testing for thermal properties; testing for electrical properties; testing for resistance to corrosion, radiation, and biological deterioration; and nondestructive testing. Standard test methods have been established by such national and international bodies as the International Organization for Standardization (ISO), with headquarters in Geneva, and the American Society for Testing and Materials (ASTM), Philadelphia.



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2.3 Mix Design

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. As per IS456:2000, Different grades of concrete are classified into M5, M7.5, M10, M15 etc., whereas M stands for Mix and the number behind M stands for Characteristic Compressive strength (fck) of the concrete in N/mm² @28 days when checked with 15cm×15cm×15cm cube Concrete Mixes are generally divided into two different types:

Nominal Mix

Nominal Mix is generally adopted for small scale constructions.

Design Mix

Quantity of various ingredients of concrete can be calculated by mix design method.

2.4 Casting of Specimen

Casting is a manufacturing process in which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the mold to complete the process. Casting materials are usually metals or various time setting materials that cure after mixing two or more components together; examples are epoxy concrete, plaster and clay.

Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods. Heavy equipment like machine tool beds, ships' propellers, etc. can be cast easily in the required size, rather than fabricating by joining several small pieces.

2.5 Testing of Specimen

Concrete test specimens (concrete cylinders, beams, or cubes) are used for a variety of purposes on construction projects. Although all are intended to represent the strength of concrete used on the project, the break-result can be indicative of very different performance parameters depending on how each test specimen was cured.

3 Experimental Methodology and Investigations

Concrete mix constituents Concrete is a composite material, made by mixing Coarse aggregate (CA) & Fine aggregate (FA), Cement & Water. The Significance of Partial replacement of Cement with Waste Marble Powder. They found that the effect of using marble powder as constituents of fines in mortar or concrete by partially reducing quantities of cement has been studied in terms of the relative compressive, tensile as well as flexural strengths. Partial replacement of cement by varying percentage of marble powder reveals that increased waste marble powder (WMP) ratio result in increased strengths of the mortar and concrete .Leaving



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the waste materials to the environment directly can cause environmental problem. Hence the result, The Compressive strength of Concrete are increased with addition of waste marble Powder up to 12.5 % replace by weight of cement and further any addition of WMP the compressive strength decreases. The Tensile strength of Concrete are increased with addition of waste marble powder up to 12.5 % replace by weight of cement and further any addition of WMP the Tensile strength decreases. Thus they found out the optimum percentage for replacement of MDP with cement and it is almost 12.5 % cement for both compressive & tensile strength.

3.1 Tile dust Replacement as Cement

Vejmelková et al. (2012) checked the characteristics of concrete having fine-ground ceramics as SCM. The varied series of parameters of concrete containing ceramic industry waste as a partial substitute of Ordinary Portland was studied. In this investigation, CWP partially replaced OPC with 10, 20, 40, and 60 % by mass was examined by X-ray spectrometer where its specific surface area was 336 m²/kg. The research findings confirmed on CWP might be used as the partial replacement of OPC material in the concrete making as SCM. The open porosity rise with increase of the CWP content; as well as bulk density increased a little bit in the same manner. Above 20% CWP by cement mass showed a very fast decrease in the compressive strength after 7 & 28 days, though, fracture-mechanics properties drop gradually when x level of replacement was 40% CWP. The liquid water transport parameter of concrete mixture was satisfactory at the replacement level of 20%. Increasing the amount of CWP exchanged by OPC, decreased the thermal conductivity properties. [8] A research conducted about the utilization of ceramic waste as an effective replacement of cement for establishing sustainable concrete was carried out by Raval et al. (2013). In this investigation, OPC was partially replaced by CWP with 10, 20, 30 40 and 50 % by mass in 20 MPa concrete mixtures. The concrete specimens were tested for compressive strength at 7, 14 and 28 days. In conclusion, replacing cement with CWP up to 30% showed a rise in compressive strength of M20 mixtures after 28 days of age and any further replacement reduced the compressive strength values. Also, the cost of M 20 concrete mixture decreased by 12.67% therefore, it turned to economical concrete without compromising concrete strength compared to the conventional concrete. [4] Fatima et al. (2013) examined the ceramic powder as a construction material in rigid pavement. Up to 30% of the OPC was replaced by CWP in this investigation to evaluate the feasibility of the use of CWP <75µm as partial substitution of the cement in concrete of paving quality (PQC) & dry lean concrete (DLC). Several tests were used in the determination of the M 35 grade mixture workability, elastic modulus, compressive strength at 7 and 28 days, split tensile strength and flexural strength of mixtures. The water to cement ratio used was 0.45. Four mixtures with CWP replacing cement with 0, 10, 20 and 30 % were prepared. The conclusions drawn from this investigation showed that the reported slump values



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of CWP concrete were in the range of 75 and 100 mm. The increase in the compressive strength results by 3.9% at the substitution level of 20% CWP and 0.46 w/c ratio was observed. The outcomes from the flexural strength & split tensile strength were a little decreased to all W/C ratio with 2-3 % relative to the control concrete. Finally, CWP material might be used in road construction in the PQC and DLC. [2] Prajapati et al. (2014) concluded the study of examination of strength & durability of the concrete made by replacing waste ceramic powder. The grade of concrete M25 was made by replacing Ordinary Portland Cement 53 grade by 0% - 30% of ceramic waste in the powdered form sieved with 90 microns. After this, they run the various tests regarding the flexural strength, compressive strength & water absorption of concrete at W/C ratio 0.48. The results shown that concrete's compressive strength reduced with adding of ceramic powdered wastes & was less compared to the concrete made conventionally. Water absorption readings shows an inclined nature with increase of ceramic waste in powdered form; though, with replacement of 10% rise in water absorption has been less. [9] Jay Patel et.al. (2014), conducted study on waste ceramic powder as the replacement of cement partially in concrete. From the study, they determined that waste ceramic powder as a 17 cementitious material has been good for the environment as well as economy. Optimum %age of waste ceramic powder as a cement replacement was in range of 20% - 30%. The strength of compression of concrete inclined up to 30% - 40% based on pozzolanic activity of waste ceramic powder. Adding the ceramic waste powder greater than 30% to 40% reduced the compressive strength of made concrete. [23] Sadek et al. (2014) concentrated on the use of waste ceramic wall tiles in cement. The aim of the investigation was to look for effect of using ground CWP on the fresh & hardened characteristics of concrete. Natural fine & coarse aggregates beside tap water and the incorporation of OPC cement type were used in the experiment. Two experimental phases were set to achieve the previous aim as follows, phase one focused on the determination of the characteristics of cement pastes that involved CWP. Phase two concern was the determination of the compressive and flexure strengths after 2 & 28 days of age. Numerous replacement ratios of CWP weight by cement were used in the study as 0, 5, 10, 15, 20, 25, 30 and 35%. After study, it was determined that cement pastes used fired waste ceramic tiles showed enough conformity especially through investigating soundness, setting time with initial and standard compressive strength. Also, as the replacement level of CWP increased in both mortars and pastes, water absorption property increased too while bulk density decreased slightly. [5] Zimbili et.al. (2014) taken an analysis of the utilization of the ceramic industry wastes in the production of concrete. Best methods, they found for ecological growth is waste recycling.

International Journal of Engineering Research ISSN: 2319-6890 (online), 2347-5013(print) Volume No.8, Issue Special 5, pp: 189-193 18-19 Feb. 2019 EPIC@2019 Page 192 As per them, the utilization of ceramic industry wastes are appropriate for use as the partial replacement of F.A. & C.A. and replacement of cement in the concrete partially. The concrete



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made using the ceramic industry wastes have numerous benefits over the normal concrete in characteristics of the compressive strength, durability & density. [11] S. Keerthipriyan et al. (2015) conducted a study on analysis to strength features of the concrete by adding ceramic industry waste in the place of the cement indicate that, split tensile strength, compressive strength, & the flexural strength of the concrete decrease with increase in the %age of the ceramic industry waste. Although, the compressive strength is finest at 20% replacement at M25 grade of concrete. Strength had been optimal at 10% replacement with ceramic industry waste powder for the mortar cubes. [24] Dr. M. Swaroopa Rani et al. (2016) investigated partially replacement of OPC by CWP with 10%, 20%, 30%, 40% & 50 % by mass in 40MPa concrete mixtures. The concrete specimens were tested for compressive strength at 7, 14, 28 and 56 days. In conclusion, replacing cement with CWP up to 10% showed an increase in the compressive strength of M 40 mixtures after 28 days of age and any further replacement reduced the compressive strength values. Also, the cost of M 40 concrete mixture decreased, therefore it turned to technically feasible and economically viable concrete without compromising concrete strength compared to the conventional concrete. [22] The following table 1 shows the literature review papers based on cement replacement by ceramic waste powder and its Comparison.

4 Conclusion

This project deals with the Experimental Investigation on The Partial Replacement of Cement with Silica Fumes and Tile dust. Various literature reviews are studied based on this. Material study was carried out and initial test for those materials were done which is helpful to calculate the mix design. Experimental investigations were carried out in the laboratory. The Ceramic waste can be the replacement of any prime constituents of the concrete like cement coarse aggregate and fine aggregate/sand. [2] The compressive strength test is mostly adopted and widely used test for checking the concrete parameter. [3] The workability and the compaction of fresh concrete gets the lower as the dosage of ceramic powder gets increased most likely due to the high absorption rate of fine ceramic particles. [4] The durability ceramic waste cement concretes would be improved in comparison to OPC concretes due to a reduction in water absorption capacity. [5] The range effective replacement of cement with ceramic waste powder in concrete lies between 20-30% and it gets decreases as the grade of concrete increases. [6] The utilization of ceramic tile powder & its application for ecological development of construction industry is the most feasible solution, possible another solution of disposal of Ceramic waste and also addresses the better application of such waste

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