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USE OF WASTE MATERIAL TO ENHANCE ENGINEERING PROPERTY OF CONCRETE

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Abstract— concrete is widely use material in construction industry. Construction activities generates large amounts of waste materials. In addition, at the end of a building's life, it may be demolished or deconstructed and generates significant amounts of waste. Construction waste includes waste that is generated during construction activities and materials that are surplus to requirements. Increasingly, there are options available in terms of recycling and reusing materials, and reducing the amount of waste produced, but despite this, a large amount of construction waste is still disposed of in landfill. 32% of the waste comes from the construction and demolition of buildings and 13% of products delivered to construction sites are sent directly to landfill without having being used. To sustain the environment, it is crucial to find solutions to deal with waste, pollution, depletion and degradation resources. By using the waste material as a supplement in the concrete can increase the strength as well as durability. As these products are waste from the construction industry we can make the environment green and more sustainable.

Keywords— concrete, waste material, sustainable development, mechanical properties, durability properties

I. INTRODUCTION

Concrete is basically made of a cementitious paste and aggregate. Each one of those concrete primary constituents, to a distinct extent, has different environmental impact and sustainability issues. The current concrete construction practice is unsustainable because, it is consumes large quantity of virgin material like stone, sand, and drinking water and Portland cement which is not an environment friendly material. Cement consume lot of energy and release of green-house gases which leads to global warming.

Since global warming is most serious environmental issue for sustainability and is becoming an important issue of economic environment. So concrete industry needs to develop new types of concrete, manufactured with expensive materials, special methods and has low cost and highly durable concrete mixtures containing largest amounts of urban and industrial by-products that are suitable for partial replacement of Portland cement, aggregate, and drinking water.

Polymer concrete is composed of polymeric resins that act as binder materials of aggregates and micro fillers. The mechanical strengths of polymer concrete can reach 4 - 5 times higher than cement-based concrete. Ceramic waste also contributes large amount of waste in construction and demolition waste. Ceramic waste is hard, durable and high chemical and physical degradation resistant. In fact, many by-products and industrial waste materials can be used in concrete mixtures as partial replacement of aggregates depending on their chemical and physical properties. For ecological sustainability, we must achieve continuous improvements in our resource productivity by reducing wasteful consumption of materials.

II. OBJECTIVES

To study the various researches conducted on usage of waste material (Industrial by-products and Waste) in concrete.

III. LITERATURE REVIEW

Paul O. Awoyera[1] conducted study on ceramic aggregate as partial/full replacement of virgin aggregate materials for construction. His study focuses on the mechanical characterization of waste ceramic wall and floor tiles aggregate concrete. Ceramic wastes generated from construction and demolition wastes and it will be separated from other debris and crushed using a quarry metal hammer. After that ceramic tiles were sieved into fine and coarse aggregates. Other materials used were river sand, gravel, cement and water. He performed Workability test on fresh concrete and compressive strength and split-tensile strengths of the hardened concrete after curing of 3, 7, 14 and 28 days. The highest split tensile strength and compressive strength were achieved by replacing 100% of the natural aggregate with ceramic coarse aggregate and ceramic fine aggregate individually. *Fig 1* and *Fig 2* shows the graphical representation of compressive strength for 3, 7, 14 and 28 days concrete cube.

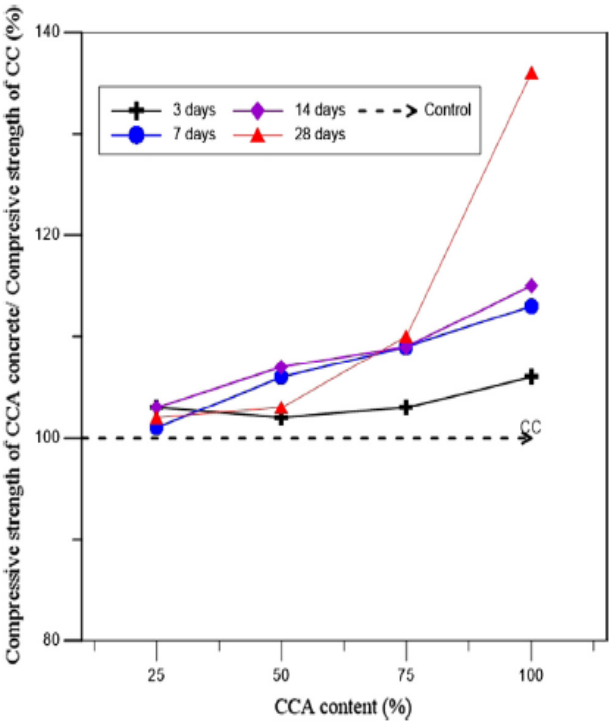

Fig 1 Relative compressive strength for CCA concrete

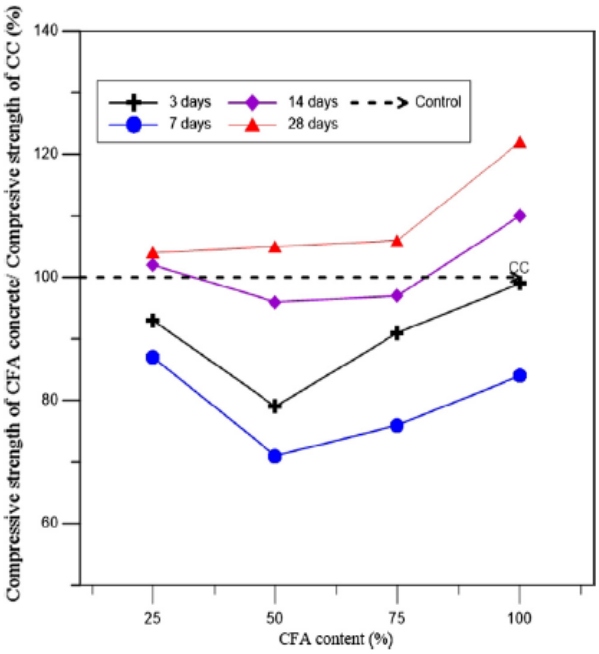

Fig 2 Relative compressive strength for CFA concrete

Dr. Awham M. Hameed, Mohammad T. Hamza [2] investigated the research to produce polymer concrete has high physical and mechanical characteristics. This Polymer concrete was prepared by using the waste of aggregates from construction and demolitions materials with low cost. These waste were used as replacement of aggregates as well as river and natural sand. Unsaturated polyester resin was used as replacement of cement. The percentages weight of resin were changed with 20%, 25% and 30% to manufacture this polymer concrete. Physical test such as compressive strength, flexural strength, Splitting tensile strength and Schmidt hammer were performed. He has found that the polymer concrete produced from unsaturated polyester has better properties than the normal concrete which is made of ordinary Portland cement. He found that bulk density decreases as the percentage of the added polymer resin increases for all types of aggregates. Also he found that with increasing the percentage of polymer resin, the value of mechanical properties increases.

Gulden Cagin Ulubeyli, Turhan Bilir, Recep Artir [3] presented some results regarding effects of waste marble on durability properties such as permeability and water absorption, sulphate attack and abrasion resistance , chloride

penetration and carbonation and also he has investigated the performance of conventional and self-compacting concrete at high temperature and freezing and thawing cycles. As a result, he found out that the use of waste marble in the conventional or self-compacting concrete mix as an aggregate can improve durability properties of the concrete. The properties of water absorption & permeability and resistance of sulphate attack and chloride penetration were improved by incorporation of waste marble in concrete.

Marineal et al [4] investigated experimental research on eco-concrete that included scrap of waste tires. In that they have prepared the concrete with different dosage of tire waste. In cement concrete, the tire scrap was added in dosages of 25%, 30%, 40%, and 50% and in case of polymer concrete it is 6.4%, 12.4%, 17%, 20% and 23%. The compressive and tension test ware investigated. In case of cement concrete the best result ware obtain with admixture with 25% of scrap tires.
In case of polymer concrete best result for compressive strength obtain by the mix with 23% epoxy resin and 17% tires powder. The density of all mix of concrete were obtain below 2000kg/m^3, so it is also consider as a light weight concrete.

Ashwini Manjunath B T [5] shows experimental study made on E-waste particles that utilised as fine and coarse aggregates in concrete with a partial replacement of 0 %, 10%, 20% and 30% on M20 Concrete. Compressive strength (*Fig 3)*, Tensile strength (*Fig 4*) and Flexural strength (*Fig 5*) Concrete with and without E- waste plastic as aggregates was observed which shows a better strength. For 10% replacement of E-plastic waste shows better result in compressive strength test for 53 grade cement. When coarse aggregate is replaced by 20% of E-waste, the results of compressive strength, split tensile strength and flexure strength of concrete reduced by 52.98% as compare with conventional concrete.

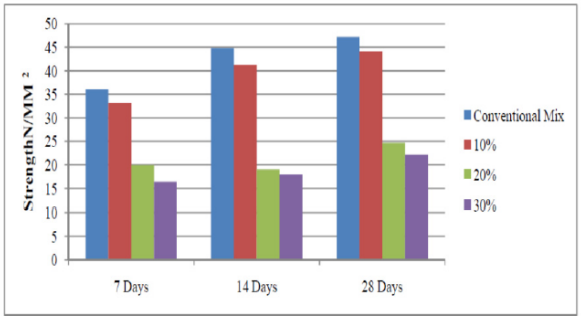

Fig 3 Compressive strength for concrete

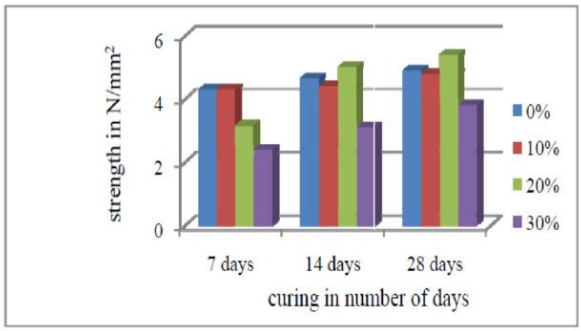

Fig 4 Split tensile strength

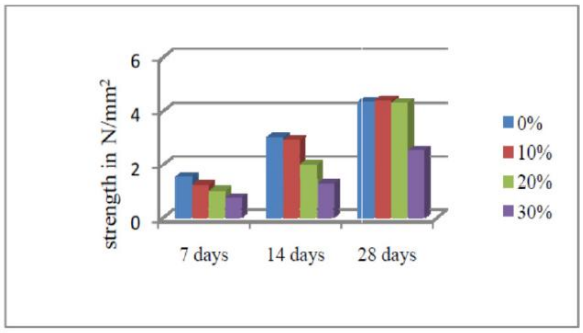

Fig 5 Flexural strength test

Sheelan M. Hama ,Nahla N. Hilal [6] investigate effective use of plastic waste as partial replacement of fine aggregate on the fresh properties of self-compacting concrete. They have design the concrete mix with water to binder ratio of 0.32 and 520kg/m^3 of binder content. 30% replacement of cement by weight, fly ash (class F) was used in mix. The plastic waste sizes are used for the mix were fine plastic waste passing through 1mm sieve and coarse plastic waste retaining on 1mm sieve and passing from 4mm sieve. By mixing 40% fine plastic waste of and 60% coarse plastic waste for obtain new mixed plastic waste. They did the experimental study of plastic waste contents of 0%, 2.5%, 5%, 7.5%, 10%, and

12.5% and three different sized Plastic wastes i.e. fine plastic wastes, coarse plastic wastes and mixed plastic waste. The different workability test were conducted. They found that as the increasing the plastic content in concrete resulted in reduction of slump flow. They found that for self-compacting concrete incorporate with plastic waste having more than 35 Mpa compressive strength can be produced easily.

IV. CONCLUSIONS

In this study, effects of waste material on mechanical and durability properties such as compression test, split tensile test, water absorption and permeability, chloride penetration and carbonation, sulphate attack and abrasion resistance were investigated.

- The compressive strength and split tensile strength can be increase by replacing ceramic waste.
- It is found that the polymer concrete with waste of aggregates from construction and demolitions can increase the value of mechanical properties with low cost.
- use of waste marble in the conventional or self-compacting concrete mix as an aggregate can improve durability properties of the concrete.
- For replacement of E-plastic waste within a certain limit shows better result in compressive strength test and can produced lightweight concrete.
- Introducing plastic waste in concrete can increase the ductility in concrete.
- self-compacting concrete incorporate with plastic waste having more than 35 Mpa compressive strength can be produced easily

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