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Different wastes can be used as replacement of cement or aggregates in polymer concrete

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ABSTRACT
The quantities of wastes, generated in industry are increasing every year. Their utilization became a priority for solving pollution problem and save energy and resources. The wastes are investigated as materials for obtaining new concrete with different applications. Polymer concrete is a composite material, in which the aggregates of different sorts are bound together by a resin. As in the case of cement concrete, different types of wastes (slag, glass, marble, etc).Consuming of wastes helps to clean the Environment; preservation of natural resources which are replaced by wastes; etc.In the experimental study, marble waste is used for obtaining epoxy polymer concrete. The effects of this of waste on the mechanical properties of polymer concrete were investigated. The mechanical properties (compressive strength, flexural strength, split tensile strength) were experimentally determined and compared with the characteristics of epoxy polymer concrete (considered as reference mix).

I. INTRODUCTION

Various Researches are going on in the field of construction heading towards the modern sustainable materials for replacement of cement as binder in traditional concrete in order to reduce the carbon dioxide. (Concrete made of cement, water and aggregates is the mostcommon material for construction of various structures. It has good mechanical properties and it is widely used in buildings, bridges, airports, dams and marine structures. Unfortunately, construction of concrete structures due to the weak properties of cement concrete such as low wear resistance, high permeability, low chemical resistance and phenomena such as cavitation and chlorine-induced corrosion.

The solution used in recent years to address these problems is the use of polymer concretes. In general, over 75-80% of a PC is occupied by fine and coarse aggregates. Epoxy and polyester resins are two common polymers used as matrix. In addition to aggregates and matrix, micro fillers are sometimes added to the composition to fill the air void.

The advantages of PC are: a) easy application in thin cross section, b) saving concrete from carbonation, c) loss of alkalinity, d) very good resistance against corrosion and chemical reactivity and weathering effect, e) set very quickly, f) useful for repairing of existing structures. The disadvantages of PC are: a) it is very expensive than a conventional concrete, needing high skill and precise work, c) the chemicals or resins used in the polymer concrete can be risky.

Experimental studies show that the tensile strength and fracture toughness of PC are 3.5-4.5 times the common plain cement concrete materials and hence it can be a good replacement for cement concretes.

History of Polymer concrete

Since the early research and development of polymer concrete in the late 1950s to the early 1960s, their research and development has actively been carried out. As a result, polymer concrete is one of the most common construction materials at present in advanced countries such as the United States, Germany and Japan. Standardization work on the quality requirements, test methods and execution for the polymer concrete has been in progress in such advanced countries.

II. LITERATURE REVIEW

Marinela Barbutaet. al. (2016) [1]:

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The use of marble waste in polymer concrete as filler or as aggregate, the compressive strength value is smaller than the reference mix. Reference mix compressive strength is 60 MPa. Increase of the resin dosage from 8% to 12%. The mix with aggregates of marble waste (PCMA6) had the best results of compressive strength is 47.22 MPa. Now in the case of split tensile test value is decreases as compare to reference mix.

Gavril Sosoi et. al.(2017) [2]:

The experimental test was done on epoxy resin concrete with fly ash and two types of waste (saw dust and chopped PET). 25% and 50% saw dust and 50% and 75% chopped PET the polymer concrete with waste substitution presented higher values PET presented higher values of compressive strength than control mix.

C. Kiruthika et. al. (2020) [3]:

In this paper, authors developed a mix for polymer concrete using isophthalic resin of more than 60 MPa compressive strength for manufacturing inspection covers and frames.

T. Jaya Krishna et. al. (2021) [4]:

Base on the experimental work in the study, consider 70:30 (fly ash: ggbs), 4% of super plasticizers, and 0.1%,0.2%,…0.5% of polypropylene fibre, basalt fibre, and ar glass fibre were considered.

There is an increment in compressive strength, flexural strength is noticed with the percentage of above fibres 0% and0.4% and at 0.5% there is a decrease in compressive strength, flexural strength, split tensile strength test was observed respectively with 0.1% and 0.4% of fibres the strength of geo polymer concrete is increased when compared to 0% of fibre.

M. Padmakar et. Al. (2020) [5]:

In this study, replacing entire cement content with GGBS (70%) and silica fumes (30%). Geopolymer dense additions with the development in sodium silicate fixation and most extreme happened at 40% of na2sio3. Frome the results of study two different mix proportion 1:1.5:3 and 1:1:2, and got higher compressive strength values for 1:1:2. The compressive strength value of cubes & cylinders 13M of NaOH and 40% of Na2siO2 gave better results than all other considered mixes.

III. METHODOLOGY

Research paper 1:

Collection of materials which are required for preparation of polymer concrete with epoxy resin and marble waste. And mix according to different percentages use for test. For determining the mechanical characteristics: for compressive strength were poured cube of 70mm sizes; for determining flexural strength were poured of 70x70x210mm sizes and for determining splint tensile strength were poured cubes of 70 mm sizes, the tests on samples were effectuated at 14 days according to standards.

Research paper 2:

The two mixes with wastes were prepared with the same dosage of epoxy resin, fly ash and sort 4-8 mm, only the sort 0-4 mm were replaced by saw dust and chopped PET bottle. In the first mix the aggregate sort 0-4 mm was replaced with saw dust in dosages of 25%,50%,75% and 100% by volume. In the second mix the aggregate sort 0-4 mm wase replaced with chopped PET bottle in dosages of 25%,50%,75% and 100% by volume. According to European Standard the samples type cubes of 70mm sizes were poured and were demoulded after 24 hours. At the age of 14 days. The density of hardened concrete mixes and compressive strength were determined on three sample for each test.

Research paper 3:

For the developed mix, 14% isophthalic resin. 15% fly ash as filler, aggregate mixture ratio of 71% having packing density of about 0.5 were taken. 0.5% by total weight of the concrete were added to improve the mechanical properties of developed polymer concrete. specimens are cast as per standards, developed mix tested with addition of polypropylene fibre and the results obtained was, compressive strength 66 MPa, Flexural strength 12 MPa, and Tensile strength 11.6 MPa.

Research paper 4:

Prepare the sodium hydroxide solution by adding pellets into water for 24 hours before the mixing the geo-polymer concrete. Then after 24 hours the sodium hydroxide solution is mixed up with sodium silicate to form the desirable alkaline solution. Then the material of geo polymer concrete was dry mixed for the sometime. Then the alkaline solution and superplasticizer were mixed to form a geo-polymer concrete mix. Then after as the requirement of fibres content will be added to the mix. Later on, casting the cubes, cylinders and beams were done. And get the results,there is an increment in compressive strength, flexural strength is noticed with the percentage of above fibres 0 % and 4%, and at 0.5% there is decrease in the value.

Research paper 5:

Collect the materials required for preparation of geopolymer concrete and calculate the mix proportion for binder materials. Using the 9 M and 13 M molarities of NaOH and considered 20% and 40% of Na2Sio3 for preparation of geopolymer concrete. Grease should be applied to

the moulds and required proportion geopolymer concrete should be placed in to the moulds. The moulds are left for curing and demoulded after 48 hours. The moulds are tested after 28 days using universal testing machine. Frome the compressive strength values of cubes and cylinders we come to know that 13 M of NaOH and 40% of Na2Sio3 gave better results than all other considered mixes.

IV. CONCLUSION

From the experimental research had resulted those different types of wastes (slag, glass, marble, etc). used as filler in polymer concrete. The proper Dosages was bigger or similar value of compressive strength, flexural strength, tensile strength as compare to control mix.

The research study had demonstrated that different wastes can be used as replacement of cement or aggregates in polymer concrete, saving in this way the natural resources and consuming the wastes.

V. FUTURE WORK

Waste materials such as marble dust, waste glass powder as filler, copper slag as fine aggregates can also be tried in future to get the sustainable polymer concrete with different combination. The developed polymer concrete can be varied with different resin types and various other fibres to improvise the developed mix. Also, coupling agents can be recommended in future work to increase the bond strength and the mechanical properties of developed polymer concrete.

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