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An experimental study on concrete with PET (plastic waste)

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ABSTRACT
Concrete is the most used material in the construction industry due to its unique properties like compressive strength, durability, fire resistance, thermal resistance and impact resistance. With the population increase and migration of people to the urban cities the demand of cement, sand, aggregate is rapidly increasing. Now in the era of scientific experiments there is many research going on using the environmental wastes as the replacement of the materials in concrete. PET plastic waste bottle can be used as an alternate material used for increasing the strength of concrete. The requirement of today construction is to make better quality of concrete with less cost and higher strength than the normal concrete. The main aim of this research is to find the compressive strength, tensile strength of PET plastic waste concrete. Concrete mixes of M30 grades are prepared with substitution of 5% to 25 % of PET plastic waste by the volume of cement in the mixer.

I. INTRODUCTION

Today concrete is the world most used material in the construction industry due to this the globalCo^2emission are increasing daily. The main component of concrete is cement which contributes to 8% of the total global Co^2 emission. The main components of concrete are cement,water, sand, aggregate and air. When we mix cement, water and air it is called paste, but when the aggregate is added in paste it is known as mortar.

Sometimes artificial stones such as crushed glass bottles and parts of crushed marbles are also added to the concrete surfaces to give a good aesthetic appearance. Concrete is used in construction of almost all the structures like bridges, dams,roads,sidewalks,high rises, houses. Concrete has problems which are generally caused by improper construction methods and supervision. Problems like segregation, honeycombing, cracks, spalling. Some defects like efflorescence is caused due to excess amount of alumina.

So admixtures are added to concrete to improve the properties of fresh and hardened concrete. They are also used to make the reaction time of concrete fast, slow and to accelerate the rate of strength development of concrete, superplasticizers are also known as water reducers, by adding it the concrete can produced with 15 % less water content.

History of concrete

The predecessor of concrete was found in 1300 BC. It was accidentally found when the middle eastern builders found that when the surfaced the outer wall of fortress and home walls with a thin, moist coating of burned limestone it chemically reacted with the gasses in air and a hard layer was formed. This was the first use of cement.

The concrete was first used by Romans between300 BC to 476 AD. The romans knew that concrete was a revolutionary material so the perform experiments by placing it inside the moulds of arches and domes and it quickly hardened reducing the troubles of builders, but as the roman empire collapsed the use of concrete became rare ,than in the 18thcentury it was redeveloped. Today the usage of concrete is more than steel worldwide.

History of PET plastic waste.

Plastic is the main environmental problem nowadays. PET is plastic bottle which is largely use in food industry for water, oil, and for other ingredients. It was in 1862 that Alexander parkes made plastic at the London. Plastic reputation feel further in the 1970s and 1980s as anxiety about waste increased. Plastic become a special target because so many plastic waste.

II. LITERATURE REVIEW

MAZIAR FAKOORMAHDI NEMATZADEH [1]

In this research paper post-fire pull-out behaviour of steel rebars in high-strength concrete

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containing waste PET and steel fibers: experimental and theoretical study. In this paper PET as the fine particles degraded the concrete steel bar bond. In this regard the substitution of fine aggregate with PET 5 and 10 % decreased the bond strength by 4 and 26 % compared to the reference sample respectively.

REBECCA J. GRAVINA, TIANYU XIE, BREE BENNETT. [2]:

This paper report on a comprehensive research program and practical application of concrete made from HDPE and PET as aggregate replacement in concrete for municipal pavement use. In the case study, it is shown that the developed concrete containing PET and HDPE is as aggregates replacement can be successfully applied in engineering practical for pavement application.

, ABBAS O. DAWOOD, HAYDER AL-KHAZRAJI RAAD S. FALIH (2021) [3]:

In this study, physical and mechanical properties of concrete containing PET waste as partialreplacement for fine aggregates. When researchers replacing 7.5% aggregates than PET concrete gives best results.

AZAD A, MOHMMAD, Aso FAQE RAHIM (4)

In this study compressive strength loss was observed for high strength concrete with the addition of PET fiber. There is direct tensile strength loss as a result of PET fiber addition to concrete. There is an improvement in cracking load of high strength concrete beams when PET fibersis added to concrete.

HAMSA M. ADNAN, ABBAS O.DAWOOD [5]:

The workability of fresh concrete decrease with increase with increased content of PET fibers for all mixtures. In this study all beams containing PET waste had lower secant stiffness than that of reference beam. The initial stiffness rise with the rising percentage of PET fibers in the concrete mixture of the beam.

From the above literature the comparative analysis of effectof Oyster Shell Concreate is presented in Table - 1.

Table 1: Comparative analysis of effect of PET plastic waste in Concreate and research gaps.

Paper Id	Research gaps (Problem statement)	Objective	Approach used	Strength
1	In this research paper post-fire pull-out behaviour of steel rebars with PET and steel fibers is checked but researchers not using only PET in concrete Researchers using PET and Steel fibers.	Add PET and steel fibers in concrete	Evaluate of post-fire pull-out behaviour with PET fibers in concrete,	Using PET waste and steel fibers in concrete.
2	In this research paper researchers using HDPE and PET waste in concrete and use in municipal concrete work but not specified any use in any building construction use.	It is done to find the various engineering properties of concrete with HDPE and PET waste using in concrete pavement in municipal work.	HDPE and PET use in concrete for pavement use	Using PET and HDPE in pavement construction to reducing the cost of pavement construction. And re-cycle the plastic

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3	In this paper physical and mechanical properties of concrete with PET waste as partial replacement of fine aggregates with OPC cement only and not using other any type of concrete and not using any kind of admixture.	To check the sustainability of using of PET fibers in concrete, compressive strength, tensile strength, slump properties and workability.	PET gives positive result in concrete for various properties of concrete.	• Reduced cost efficiency and improved eco-efficiency compare to normal concrete.
4	To find experimental behavior and analysis of high strength concrete beams reinforced with PET waste fiber. The compressive strength was loss on addition of PET waste.	To check the various engineering properties of concrete beams with PET fibers.	Dry mix method was used for concrete constituent before the addition of water	• Increased initial setting time and final setting time • Decreases split tensile strength at 3,7,14,28 days
5	In this research paper PET wastes is use as synthetic fibersbut not specified nominal amount of PET fiberfor making concrete. The workability of concrete decrease.	To find cube strengths, water penetration resistance, cyclic wetting and drying chloride resistance.	Nominal mixing of M35 grade PET concrete is used. Workability is decrease as increase the PET.	PET waste using in concrete and reducing pollution level for good environment.

Description of material testing:

The different materials used are concrete, sand, coarse aggregate and PET , the motive of material testing is to find the best material from the all classes of material. The aim is to get maximum strength and durabilityin construction.

Cement

Cement is a made up of calcium silicate sand aluminate sand alumina ferrite. It is obtained by combining fixed proportions limestone, clay and other minerals in, which is mixed and heated at temperature range of 1500˚C. This process gives out clinker where a small amountof gypsum is added and a fine powder is produced called ordinary Portland cement. The cement when mixed with sand and water forms a paste and slowly sets to form a concrete mass. 43 Grade cement was used for this experiment. The specific gravity, initial setting time and fineness were determined by carrying out the test in the lab. Specific gravity was 3.25.

Fine aggregate

If the aggregate passes through IS Sieve 4.75 than it is classified as fine aggregate. These are added to concrete to increase workability and to give a homogenous mix. Normally the sand obtained naturally from river is preferred and used as fine aggregate. For the study, locally available river sand was used. Various physical properties were determined by conducting a test as per IS 383(part-III)- 1970. Specific gravity 3.2

Coarse aggregate

The aggregate of size between 20mm to **4.75mm is considered as coarse aggregate.** For the study the test was carried out on 20mm size aggregate. Specific gravity 2.68.

PET (plastic waste)

Because of specific gravity of PET plastic waste is 1.297 is near to fine aggregates of concrete it is good to using PET as partial replacement of fine aggregate. Plastic waste is the main environmental problem facing worldwide so it is very good to use PET in concrete and also reduce the cost of construction.

Marble powder

Re-using the wastes from industries has environmental, economic and technical advantage. These benefits can be seen from two different perspectives, one from the point of waste producer and the other from the user part. Marble powder being one of the basic pollutants, reusing thesewasten in some parts as replacement with cement, contributes in lowering the pollution risk.

Water

The most essential ingredients of concrete mix is water as it actively hydrates in reaction with cement. It contributes to the strength such that giving cement a paste. The amount and type of water requires proper care. Water used should be free from impurities. Sea water shall not be used. Ordinary portable water available in university campus was used.

III. CONCLUSION

The study is done to find the replacement of fine aggregate as PET plastic waste in concrete.The water/cement ratio is 0.45.The concrete with 7.5% show better result than normal cement concrete. The compressive strength was 4-19% higher than the normal cement concrete, and the split tensile strength 2-11% higher than the normal cement concrete. The flexural strength is also higher than normal cement concrete.Thus it is found that the PET plastic wastealong with HDPE and behaves same as normal concrete made with normal river sand. And workability gradually decreases.

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