

An Experimental Investigation of Utilization of Bottle Cap in Concrete

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ABSTRACT: Concrete is mostly used for construction in the world and its properties have been undergoing changes through technological advancement. Generally, concrete having four components materials namely cement, sand, coarse aggregate and water. Advancement in technology enhances human comforts and at the same time it causes damages to environment. Waste plastic bottles are major cause of solid waste disposal and also disposal of metal caps of soft drink bottles are headache to environmental engineers and involves either recycling or reusing. There we are going to add metal caps and PET bottles caps in concrete to increase the strength. This project represents the results to study the behavior of concrete by adding of bottle caps and PET with dosage of 0.5% of weight of cement as fiber to reduce the cement content to achieve IS10262:2019 requirements. PET bottles and metal bottle caps are added to the concrete at 0%, 1%, and 2% by volume of total mixture and also analysis of the compressive strength, split tensile strength, flexural strength and then mechanical properties are compared with the conventional concrete. Grade of concrete used in the project is M20. Mix ratio is 1:1.8:3.

I.INTRODUCTION

Concrete is a major building material which is been used in construction industry throughout the world. It is an extremely versatile material and can be used for all types of concrete structures. Concrete is a composite construction material composed mainly of cement, water and aggregates.

The cement materials are serves as a binder for the aggregates. The coarse aggregate and fine aggregate are used in concrete. Water is mixed in concrete so that the concrete gets its shape and then gets hardened through the process called hydration.

Concrete as a construction material is widely used in India with annual consumption exceeding 100 million cubic meters. Conventional Ordinary Concrete which is designed on the basis of compressive strength does not meet many functional requirements since it is found deficit in aggressive environmental conditions, time of construction, energy absorption capacity, repair and retrofitting jobs etc. Hence some alternatives need to be find which can replace either fully or partially any of the concrete composite without affecting the properties of concrete which gives better strength to concrete. The use of such materials not only results in good strength and improved properties in concrete but also helps in maintaining good environmental conditions by effective utilization of these by products which will otherwise remain as a waste material.

Metal caps of soft drink bottles and PET can be used as a partial replacement of cement.

II.CONCRETE MATERIALS

The concrete mixture consists of the following ingredients,

1. Cement
2. Coarse aggregate
3. Sand
4. Water

CEMENT

Cement is a well-known building material and has occupied an indispensable place in construction works. There are variety cements available in the market and each type is used under certain conditions due to its special properties. Cement in a general sense is adhesive and cohesive materials are capable of bonding together particle of solid matter into a compact durable mass.

COARSE AGGREGATE

The aggregate which passes through 75mm IS sieve and entirely retain on 4.75mm IS sieve is known as coarse aggregate. It may be crushed gravel or stone, uncrushed gravel or stone or partially crushed gravel stone. The minimum particle size of coarse aggregate is 4.75mm and the maximum particle size is 75mm. If the size is more than 75mm then the aggregate is called cyclopean aggregate.

SAND

The aggregate which passes through 4.75mm IS sieve and entirely retain on 75 micron IS sieve is called fine aggregate. It may be crushed stone sand or crushed gravel sand. The minimum particle size of fine aggregate is 0.075mm and the maximum particle size is 4.75mm. The material having particle size varying from 0.002 to 0.06mm is termed as silt and smaller particle are called clay.

WATER

It is the most important and least expensive ingredient of concrete. The water is used for the mixing and curing of concrete should be from deleterious materials. As per using IS: 456-2000.

III.LITERATURE REVIEW

Sina Safinia, Amani Alkalbani at (2016) “Use of recycled plastic water bottles in concrete blocks”

The primary objective of this investigation to study the experimentally properties of concrete is due to containing wastage of PET bottles. The method of study designed for this research included tests for 8 concrete blocks, 7 concrete cylinders and 6 hollow concrete blocks from Oman’s market. The study of utilized 500ml plastic bottles is placed inside the concrete masonry units and analyzed the compressive strength. The test results of concrete cylinders between 7 to 14 days around 13 Mpa and 14 to 28 days around 1.2Mpa. The concrete blocks with plastic bottles were tested after 1 week, the 2 after 14 days and the last 1 after 28 days. The compressive strength of concrete block between 7 to 14 days is about 2.5 Mpa and 14 to 28 days is around 0.57 Mpa. The hollow concrete blocks from Oman’s construction market of compressive strength is about 3.64 Mpa. These results shows that PET bottle which gives the compressive strength shows 57% difference in the strength by using plastic bottles compared to local concrete blocks.

Nabajyoti Saikia, Jorge de Brito at (2013) “Mechanical properties and abrasion behavior of concrete containing shredded PET bottle waste as a partial substitution of natural aggregate”

The incorporation of materials like waste PET bottles fibers in cementations matrix improves the mechanical response of the resulting product ,commonly the effects size and shape of recycled polyethylene terephthalate (PET) aggregate of fresh and hardened properties ,including abrasion resistance of concrete. The concrete mixes for 5%, 10% and 15% of natural aggregate were replaced by an equal volume of 3 differentially shaped and sized PET aggregates. The test results of fresh concrete properties due to water cement ratio are 0.53.The density of fresh concrete declines as the content of PET aggregates increases. The compressive strength of concrete with increasing the ratios of PET aggregates to replace natural aggregates at different ages. The higher strength of concrete containing PP of water cement ratios is lower than of concrete with the other two types of PET aggregates. The abrasion behavior of PF and PC.

PC is observed for 10% replacement of concrete. Compressive strength exceeds a critical value, around 40 Mpa. The highest abrasion resistance is observed for concrete with 15% PP. The type of PET aggregates and curing time, strengths (compressive, split tensile and flexural) and modulus of elasticity of concrete containing PET aggregate are lower than those of the reference concrete. These properties decrease the content of PET aggregates increases. The decreasing trend of properties can be arranged as PP > PF > PC.

Sana Gul, Sohaib Naseer at (2019) “concrete containing recycled rubber steel fiber”

It is learnt that Recycled Rubber Steel Fiber (RRSF) has it superior resistance to cracking and crack propagation. Hence an attempt is made to study the influence of recycled rubber steel fiber concrete as partial replacement for coarse aggregate and studying the parameters like compressive strength, split tensile strength and steel fiber reinforced concrete. The various percentage of material 1% Ordinary Portland cement, 2% Fine Aggregate, 4% Coarse Aggregate, 1% replacement SRSF,Volume of concrete 12 x 6 inches, its ACI mix design methods. Therefore it can be test for after 28 days curing to determine the compressive strength of hydraulic range 20 to 50 psi/s, split tensile strength test for universal testing machine. This results show for compressive strength and split tensile strength are reduces.

Boksum Kim, Josef Wisniewski at (2018) “Behavior of sand-filled plastic bottled clay panels for sustainable homes”

In this paper, he used sand filled PET bottles, plastic bottled clay panels, sustainable homes are the materials. Which were added to the concrete and found a clear impact on its mechanical properties. It was clearly revealed that the

specimens of cubes and cylinders test for compression strength. From the experimental result it was also test for 500ml PET bottles, 8 set of test and 4 sets of empty bottles and 4 Sets of filled dry sand. sands. The empty bottle weight average 25g about 855g filled with fine dry sands. Thickness of plastic bottle is 0.5mm. Therefore 5% cement, 2.5% water, CEMI. Approximately 20mm compacted for each panels and dry area testing 28 days after casting and mixture with 5% cement for 7, 14, 21, 28, 84, 119 days after casting and then for testing of cubes and cylinders. The experimental results of the panels with bottles failed in a ductile manner, while the panels in a brittle manner. After testing, the bottles are found intact and hence they could be reused.

Zhi Ge, Renjuan Sun at (2013) “Physical and mechanical properties of mortar using waste polyethylene terephthalate bottles”

Polyethylene Terephthalate (PET) bottle are synthetic fiber, fiber reinforced concrete between 0.3% and 1.5%, natural river sand, limestone powder, maximum size of sand 4.75mm, limestone powder smaller than 0.075mm, total aggregate of limestone powder 7.5% are used. Test results due to type of aggregate gradation, sand to PET ratio, curing time, curing temperature, 2 single sized (1.18mm and 2.36mm), demolded at 3h, 6h, 18h, 24h and 7 day. Curing temperature for 100° c, 140° c, 180° c and room temperature for total curing time of 24h. The infrared spectrum analysis and differential scanning calorimetric analysis to the flow of rate at 50ml/min and heating rate 10°c/min, sample mass 4.5mg. The universal testing machine rate 0.5kN/sand its acting on the loading at the rate 0.04kN/s. These results of sand to PET ratio increased and the density and water absorption of the recycled PET mortar increased. All the recycled PET mortars had a relatively low level of water absorption.

Pablo Resende Oliveira, Aline Maria Silva Bonaccorsi at (2017) “Sustainable sandwich composite structures made from aluminum sheets and disposed bottle caps”

The effect of using waste bottle caps increase the Maximum resistance of the panel and aluminum skins epoxy resin, stainless steel, aluminum. The angles for the orthotropic, hexagonal and cubic geometries 45%, 60% and 90%. The PET material for 9% PP, 25% PET and plastic caps. Therefore the position of the bottle caps due to bonding between the adjacent caps and bulk density and flexural stiffness, elastic modulus, skin stress and core shear modulus, epoxy resin, aluminum sheets (0.5mm thickness). The polypropylene bottle caps and soft drink bottles, room temperature for 24 hr of composite materials due to skin stress and the equivalent core shear modulus and the interval confidence for 95%. The results shows for the elastic and shear modulus appeared to be independent of the geometry and the connection methods are used.

IV. CONCLUSION

Compressive strength of the concrete can be stepped up with the prominent from the different waste materials which are hazardous from the view of solid waste disposal. These materials can be plastic bottles and steel caps which give fiber properties to the concrete and reliable fiber reinforced concrete can be made. They are plastic and steel bottles are used in the concrete. Therefore we are used to plastic and steel bottle caps in the concrete it's due to comparison of strength in concrete.

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