A STUDY ON USE OF RECYCLED PLASTIC (HDPE, LDPE & AMP; VHDPE) IN CONCRETE AS A PARTIAL REPLACEMENT OF COARSE AGGREGATE TO OBTAIN LIGHT WEIGHT CONCRETE

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Abstract:

The project aims at use of recycled plastic i.e. High density poly Ethylene (HDPE), Low density poly Ethylene (LDPE), Virgin High density poly Ethylene (VHDPE), in concrete as a partial replacement of Coarse aggregate to obtain light weight concrete. The waste plastic of HDPE, LDPE, and VHDPE is collected from Hyderabad and mixed with PPC and sand in varying proportions (0%, 10%, 20%, and 30%). The compressive strength for each variant is to be determined in laboratory. The rapid industrialization and urbanization in the country leads lot of infrastructure development. This process leads to several problems like shortage of construction materials, increased productivity of wastes and other products. As disastrous effects of waste plastic on the environment is noticed by the authors as its huge quantity pollutes the environment, therefore authors have taken up this study.

This study deals with the reuse of waste plastics as partial replacement of coarse aggregate in M20 concrete. Usually M20 concrete is used for most constructional works. Waste Plastics were incrementally added 0%, 10%, 20%, 30%, to replace the same amount of Aggregate. Tests were conducted on coarse aggregates, fine aggregates, cement and waste plastics to determine their physical properties. Cubes of concrete were cast and tested after curing them for 3, 7, 14 and 28 days for compressive strength. The result shows that the compressive strength of M20 concrete with waste plastics HDPE, LDPE, VHDPE is highest at the replacement of 20% for cube strength but still it is less than the normal concrete. Hereafter increment in percentage of it is decreasing the strength.

Introduction

Since the civilization started in this world, man has always been involved in some form of the construction activities, which also directly involves the use of cement concrete. In this present day world, the technical modifications have revolutionized the construction industry and construction activities. Construction industry, consist of vertical construction and horizontal construction. Vertical construction refers to the building construction and horizontal constructions refer to the heavy construction.

Construction of building structure like public and private buildings residential and not-residential building structure like public and private buildings residential and non- residential building structures comes under the building construction. Many of the largest and spectacular structures comes under the heavy construction which includes structures like railways, airports, harbours, dams canals, bridges and many other major public works. Other miscellaneous spatiality structures of the construction industry includes industrial construction, marine construction etc. Thus in construction of these major and spectacular structures, large and heavy amount of cement concrete is required.

Cement Concrete is one of the world's most versatile and widely used construction materials. Concrete is the primary construction material which is widely used in all the construction activities around the world.

Day by day construction activities are increasing which is resulting in the excessive utilization of cement concrete. And the cement concrete material requires excessive amount of extraction of natural resources or naturally available materials like natural river sand, stones, lime, clay, water etc. Cement concrete is the second largest consumed material on earth. The attractive properties of cement concrete include economy, efficiency, durability, strength, mould ability, flexibility and rigidity. These properties give the cement concrete a wide range of structural applications.

What is Cement Concrete

Cement concrete is a man-made composite material and is most widely and extensively used building material in the construction industry. Cement concrete consist if mixture of building materials that is lime or cement, well graded fine aggregates and coarse aggregates, water and admixtures to prepare cement concrete with special properties. In cement concrete, the fine aggregates assist in producing workability and uniformity in the mixture. The river deposits are the main source of fine aggregates in cement concrete.

Requirements of a Good Cement Concrete:

1. The cement used in the preparation of cement concrete should comply with all standards and specifications.
2. A good cement concrete essentially should be a homogenous mixture of cement, fine aggregates, coarse aggregates and water, which later gets consolidated into a hard mass due to the chemical action taking place between the cement and water.
3. The coarse aggregates which are used in the preparation of cement concrete should be well graded coarse aggregates.
4. Flaky and elongated coarse aggregates in cement concrete should be avoided.
5. Using angular and cuboidal coarse aggregates in cement concrete.

Problems Facing by the Utilization of Cement Concrete:

The primary problems faced by the use of cement concrete is that the ever increasing demand of cement concrete, cost of cement and concrete, pollution due to the cement production, excessive utilization of natural resources in cement production and in construction activities, excessive use of sand and aggregates and potable water, carbon emissions during concrete production etc.

Natural river sand is one of the important constituent in the cement concrete production. Now days the sand is being extensively utilized in almost all around the world in the construction activities. Throughout the world at all places, construction industries are developing at a faster rate which in – turn is resulting into the higher demand for concrete, sand and other concrete making materials. Natural river sand is highly expensive and is also depleting at a faster rate.

The main function of sand in concrete is to improve the workability and uniformity of the concrete mixture. The main source of sand is the river bed deposits, because of the expensive sand and its increasing depletion, it has become very important to protect and preserve the environment and its natural resources which is an important step towards any development.

Waste Plastic Granules:

There is a acute problem of disposal of wastes and it has become expansive due to over loaded landfills in present scenario. The threat due to non-biodegradable materials like waste plastics, scrap tyres etc. ma contaminates the soil and ground water. The problem of disposal can be

solved to some extent by reusing these wastes after recycling and it will also give a solution to environmental pollution as well. Re- use of waste plastic after recycling is economical as it is available at lower cost for mixing with other variants like bitumen, concrete etc. In order to modify the properties of concrete with the use of waste plastic materials such as Low density polythene (LDPE), high density polythene (HDPE).

Virgin High density polythene (VHDPE) and other plastic materials have been investigated to be used in concrete in order to modify it and to improve the properties of it and reduce the cost. This will give a way for green construction and a eco-friendly environment. In this research work recycled plastic aggregates were used as a partial replacement to natural coarse aggregate (NCA) of concrete. Intended percentages of recycled plastic coarse aggregates (RPCA) were in varying percentages from 0% to 30% with a increment of 10%. (0%,10%, 20% and 30%). The compressive strength of each sample was determined and compared with conventional
concrete mix.

MATERIALS AND METHODOLOGY

Materials Used for the Preparation of Cement Concrete:

a) Cement:

In this work, cement used is ultra tech Cement which is PPC (Portland Pozzolana Cement) confirming to IS:1489 part-1 (1991). This cement is Fly Ash based cement.

Physical Properties of Cement

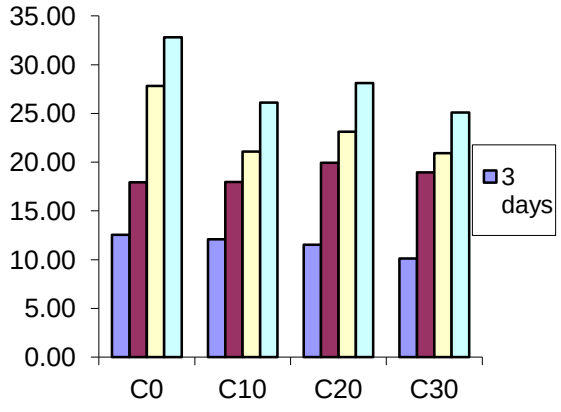
Sl. No.	Material Properties	Cement Test Results
1.	Initial Setting Time	47 minutes
2.	Final Setting Time	330 minutes
3.	Standard Consistency Test	40%
4.	Specific Gravity	2.69
5.	Fineness	5%

RESULT AND DISCUSSION

I. Recycled Plastic Coarse Aggregate with High Density Polythene (RPCA-HDPE) Results.

Table-5.1 Compressive Strength of Cubes of Different Proportions

Sample Series	Compressive Strength (N/Mm^2)			
	3 days	7 days	14 days	28 days
C0	12.56	17.95	27.82	32.82
C10	12.10	17.96	21.10	26.11
C20	11.55	19.93	23.12	28.10
C30	10.11	18.96	20.92	25.10



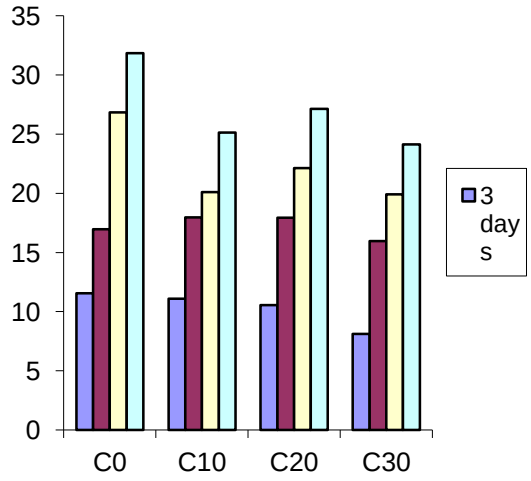
The compressive strength of concrete cubes of various proportions cured for

3,7,14 and 28 days are shown in table no-5.1.

II. Recycled Plastic Coarse Aggregate with low Density Polythene (RPCA-LDPE) Results.

Table-5.2 Compressive Strength of Cubes of Different Proportions

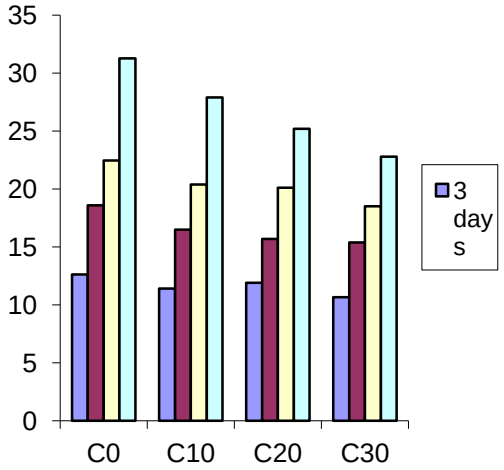
Sample Series	Compressive Strength (N/Mm^2)			
	3 days	7 days	14 days	28 days
C0	11.56	16.95	26.82	31.84
C10	11.10	17.96	20.10	25.12
C20	10.55	17.93	22.12	27.14
C30	8.11	15.96	19.92	24.12



The compressive strength of concrete cubes of various proportions cured for 3,7,14 and 28 days are shown in table no-5.2.Virgin Plastic Coarse Aggregate High Density Polythene (VPCA-HDPE) Results.

Table-5.3 Compressive Strength of Cubes of Different Proportions

Sample Series	Compressive Strength (N/Mm^2)			
	3 days	7 days	14 days	28 days
C0	12.63	18.60	22.45	31.27
C10	11.40	16.50	20.40	27.90
C20	11.91	15.70	20.10	25.20
C30	10.66	15.40	18.50	22.80



The compressive strength of concrete cubes of various proportions cured for 3,7,14 and 28 days are shown in table no-5.3.The results of experimental investigations on use of recycled plastic aggregates as a partial replacement to natural coarse aggregate (NCA) in concrete were analyzed. Result as follows-

- **Use as Constructional Material:** It was confirmed that plastic waste can be disposed of by using it as constructional materials. It can be used as a coarse aggregate replacement in cement concrete.

Compressive strength: The compressive strength of modified concrete with recycled plastic coarse aggregates High density polythene (RPCA-HDPE) was compared with conventional concrete and it was observed that the compressive strength in comparison with conventional concrete was achieved up to 79.55%,

85.61%, 76.47% for mix of waste plastic of 10%, 20%, 30% respectively. It shows that recycled plastic coarse aggregate High density polythene (RPCA-HDPE) up to 30% as a replacement for natural coarse aggregate (NCA) can be used in light weight concrete structure successfully. However higher percentage more than 30% is not acceptable as the compressive strength is considerably reduced.

Cost Economy: By producing light weight concrete with use of recycled plastic coarse aggregate Hifg density polythene (RPCA-HDPE) there will be reduction in cost of raw materials and minimization of disposal of polymer waste.

Thermal conductivity: It was observed that thermal conductivity of concrete was reduced by use of plastic aggregates in concrete. This indicates that recycled plastics can be used for thermal insulation of buildings.

CONCLUSION

- To compare the compressive strength and Density of Recycled Plastics used as coarse Aggregate for Constructional concrete with the conventional concrete.
- To know its applications in construction industry.
- To reduce the pressure on naturally availability materials by replacing it with recycled plastic aggregate.
- To compare the physical characteristics of natural aggregate with Plastic recycled aggregate.
- To study the behavior of fresh and hardened concrete with polymer waste coarse aggregate and compare its properties to those of conventional concrete.
- Within this study the maximum compressive strength is obtained at 10% replacement, but still it is less than the controlled concrete strength but strength is sufficient enough to be useful as M20 grade.
- For given water content, the use of plastics in the mix lowers the density, compressive strength.
- Virgin plastics can be used to replace some of the aggregates in concrete mixture. This contributes to reducing the unit weight of the concrete this can be very applicable when requiring light weight concrete.
- To produce lightweight polymer concrete for multi-purpose use.

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