USE OF WASTE PLASTIC AS FINE AGGREGATE SUBSTITUTE IN CONCRETE

Amalu.R.G, Azeef Ashraf, Muhammad Hashim, Rejith.K.U, Vijitha.V.

Under graduate Civil Engineering Students, UKF College of Engineering and Technology, Kollam, Kerala

NITHYA KURUP

Asst. Professor, Dept. of Civil Engineering, UKF College of Engineering and Technology,India

ABSTRACT

Due to rapid growth of population in countries like India the disposing of solid waste is a major problem in our daily life. Solid waste management is one of the major environmental concerns. Among the waste material, plastic is the material that is the major concern to most of the environmental effects. There are different types of plastic which are classified on the basis of the physical property. As the plastic waste is non degradable, it must be recycled or reused. The objective of study is to study the behavior of the concrete which is made of the recycled plastic materials along with the study of the some of the physical properties that are related. Usually M20 grade of the concrete is the most commonly used in the constructional works, hence in this study M20 cement concrete is considered in which the recycled plastic waste is used as the replacement of fine aggregate in the concrete. Concrete cube and beam were casted taking 10% to 25% of plastic as partial replacement of fine aggregate and tested for 28 days of compressive strength and flexural strength of concrete.

1. INTRODUCTION

The research in to new and innovative waste materials being under taken world-wide and innovative ideas that are expressed are worthy of this important subject. Much organization had started a large number of research project concerning the feasibility, environmental suitability and performance of using waste plastic in concrete. These studies try to match societal need for safe and economic disposal of waste materials with the help of environmentally friendly highway industries, which needs better and cost effective construction materials.

The usage of the materials is increasing as a result the waste producing by the usage is also increasing. The waste that is produced is containing more amounts of plastic material, which is very commonly used material by common person. As the plastic is not a biodegradable material it cannot be decomposed. As the waste producing is increasing the disposal of the waste is one of the major problems. The waste is sent for the landfills which cause the land to pollute as the waste material is contacting plastic which is non-

biodegradable which causes many problems. So there must be a method for the reuse of the plastic or the replacement of the plastic material with any other materials. Big attention is being focused on the environmental and safeguarding of natural resources and recycling of waste materials. Actually many industries are producing a significant number of products which is incorporate scrap (residues). In the last 20 years, a lot of works concerning the use of several kinds of urban waste in building materials industrial process have been published. Many researchers have been extended to study new kinds of waste to investigate deeply particular aspects. The addition of waste, apart from the environmental benefits, also produces good effects on the properties of final products.

Many of the new waste materials used in the concrete industry is recycled plastic. For solving the disposal of large amount of recycled plastic material, reuse of plastic in concrete industry is considered as the most feasible application. Recycled plastic can be used as fine aggregate in concrete. However, it is the important to underline that re-using of waste is not yet economically advantageous, due to the high costs of transport and its effect on the total costs.

PLASTIC

The word “plastic” means substances which have plasticity, and accordingly, anything that is formed in a soft state and used in a solid state can be called a plastic. Therefore the origin of plastic forming can be traced back to the processing methods of natural high polymers such as lacquer, shellac, amber, horns, tusks, tortoiseshell. As well as inorganic substances such as clay, glass, and metals. Because the natural high polymer materials are not uniform in quality and lack mass productivity in many cases, from early times it has been demanded in particular to process them easily and into better quality and to substitute artificial materials for natural high polymers. Celluloid, synthetic rubber, ebonite, and rayon are these artificial materials. Presently, it is defined that the plastic are synthesized high polymers which have plasticity, and consequently substances made of these natural materials are precluded.

METHODOLOGY

The main theme of this project is to utilize recycled materials for the production of concrete. As disposal of plastic waste is not possible easily, they create adverse impact on environment. Reuse of plastic waste in concrete industry is considered as the most feasible application. It decreases the pollution of the environment and reduces the cost of materials.

MATERIALS

1. Aggregates (Coarse and fine aggregates)

Various properties of aggregates can influence the performance of concrete; therefore various considerations have to be kept in mind while selecting the material.

2. Cement

Ordinary Portland cement of 53Grade was used as it satisfied the requirements of IS: 269-1969.

3. Water

IS: 456-2000 water, used for mixing and curing of concrete. Permissible limits for solids in water are as per IS: 456-2009. The maximum permissible limits of chloride content in water for RCC work has been reduced from 1000 milligrams per liter in IS: 456-1978 to 500 milligram per liter in IS: 456-2000

4. Plastics

Plastics that cannot be degraded further been powdered into fine particles. These plastics consist mainly of high density polyethylene (HDPE).

PRELIMINARY TEST CONDUCTED VALUES OF CONCRETE

PROPERTIES	**OBTAINED RESULT**	**REQUIRMENT OF IRC AS PER IS (12269:1987)**
Fineness of cement	6.2%	Not more than 10%
Standard consistency	31%	b/w 26%-33%
Initial setting time	42 min	Not less than 30 min
Final setting time	480 min	Not greater than 600 min
Fineness modulus of C.A	7.57	Range 2.8-3.2
Specific gravity of C.A	2.62	Range 2.6-2.8
Fineness modulus of F.A	2.48	Range 2.2-2.6
Specific gravity of F.A	2.46	Range 2.4-2.6
Water absorption of F.A	6.7%	
Specific gravity of cement	3.15	
Water cement ratio	0.48	0.5
Water absorption of C.A	2.99%	

WORKABILITY TESTS FOR CONCRETE

1. **SLUMP TEST**

Slump test is most commonly used method of measuring consistency of concrete. This can be either in laboratory or in site of work. It is not a suitable method of very wet or very dry concrete. It does not measure all factors contributing to workability, nor is it always representative of the playability of the concrete. It indicates the characteristics of concrete in addition to the slump value. The test specimen should be formed in a mold made of metal not thinner than number 16 gauges and

impervious to cement paste. The tamping rod should be a round, straight steel rod with a diameter of 16mm and a length 600mm, with the tamping end rounded to a hemispherical tip diameter of 16mm. the research specimen is formed in a mold made of metal not thinner than number 16 gauge and impervious to cement paste and test specimen is obtained from concrete. The curve 1.1 shows that the percentage of plastic verses slump value. Workability description of slump is always plastic state.

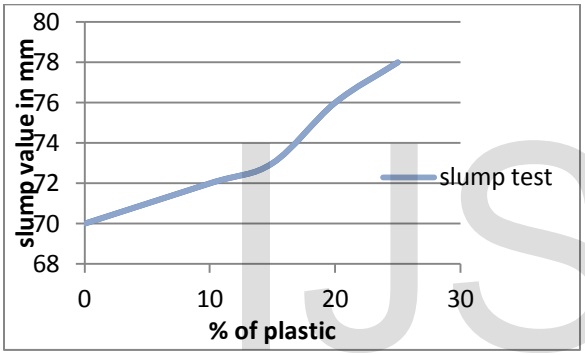


Fig: 1.1, %of plastic Vs slump value

2. COMPACTING FACTOR TEST

Compacting factor test is designed primarily for use in the laboratory but in can also in the field. It is more precise and sensitive than the slump test and is particularity useful for concrete mixes of very low workability as are normally used when concrete is to be compacted by vibration. This test work on the principle of determining the degree of compaction achieved by a standard amount of work done by allowing to concrete to fall through a standard height. The sample of concrete to be tested is placed in the upper hopper up to the brim. The trap door is open so that the concrete falls in to the lower hopper. Then the trap door of the second door is open and the concrete is allowed to fall in to the cylinder. This weight of the cylinder is also known as "weight of partially compacted concrete". The concrete is filled up exactly up to the top level of the cylinder. This weight is known as a ".weight of fully compacted concrete". Also the curve 2.1 shows that the percentage of plastic verses compactor factor. Workability description compacting factor is plastic state.

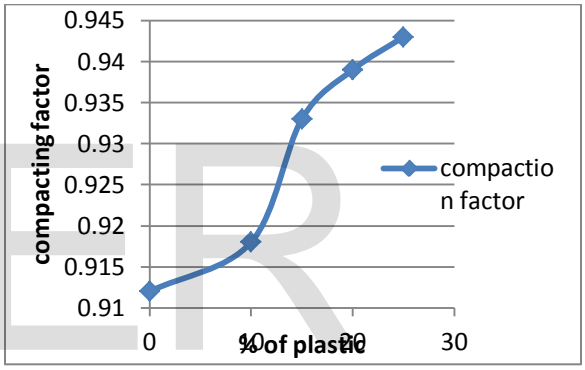


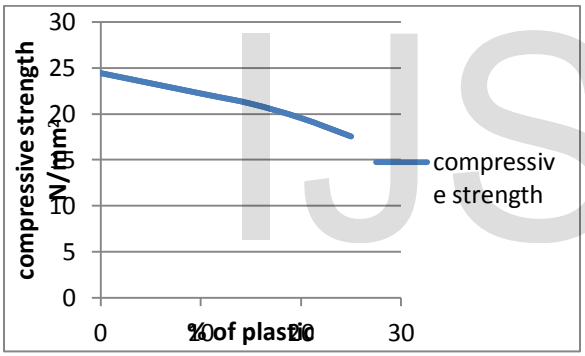
Fig: 2.1 % of plastic Vs compacting factor

COMPRESSIVE STRENGTH TEST

Compressive strength test is the most common test conducted on hardened concrete, partly because it is an easy to perform, and partly because most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. Compressive strength test is carried out on specimen cubical in shape. The cube specimen is of the size 15x15x15cm. it is used to determine the compressive strength of the concrete specimens as molded in concrete cube.

Table shows that as the 28 days of compressive strength and different percentage of plastic added in concrete. Also shows the graph for percentage of plastic to compressive strength.

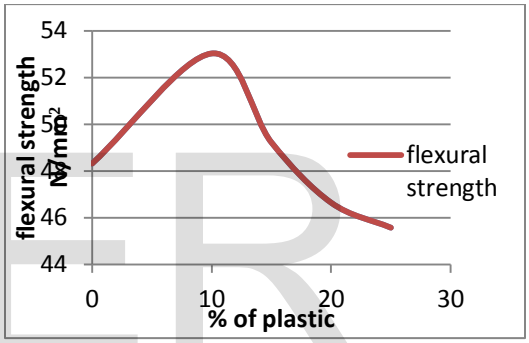
Percentage of plastic	Compressive strength(N/mm²)
0%	24.44
10%	22.22
15%	21.11
20%	19.55
25%	17.55



FLEXURAL STRENGTH TEST

Concrete as we know is relatively strong in compression and weak in tension. Flexural strength test to conform to the ASTM standards. Table shows that percentage of plastic added in concrete and flexural strength. The curve shows that the flexural strength values of waste plastic concrete mixture tends to decreases with increases the waste plastic ratio. A concrete mixture made of 25% waste plastic has the lowest value of flexural strength at 28 days curing age.

Percentage of plastic	Flexural strength(N/mm²)
0%	48.32
10%	53.03
15%	49.23
20%	46.65
25%	45.58



RESULTS AND DISCUSSION

From the test results it was observed that the compressive strength and flexural strength value of concrete mix is decreased with the addition of waste plastics. But workability of the concrete mixture is increasing because of the less absorption of water. Due to this advantage, we can add waste plastic in concrete so that workability of concrete increases and helps in the reuse of plastic and also reduce the scarcity of fine aggregate.

CONCLUSION

The test conducted on materials like cement, sand, aggregate having all the results within permissible limits as per IS codes. The

compressive strength values of all waste plastic concrete mixture tend to decrease below the values for the references concrete mixtures with increasing the waste plastic ratio at all curing ages. The flexural strength at each curing age is prone to decrease with the increase of the waste plastic and aggregate ratio. This trend can be attributed to the decrease in adhesive strength between the surface of waste plastic particles and the cement paste. Main benefit of this project is workability it will be increased because the plastic have been less absorbing water content. And reduce the pollution of environment, scarcity of fine aggregate and also reduce the cost of material.

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