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PERFORMANCE OF CONCRETE WITH PARTIAL REPLACEMENT OF COURSE AGGREAGATES WITH PLASTIC AGGREAGATES

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Abstract : An important problem we are facing in today's scenario is dumping of plastic materials it causes lot of problems to environment. In order to reduce the plastic waste, it can be used in construction field by partially replaced with plastics, plastic is inorganic in nature so it does not alter the chemical properties of concrete and also it does not affect the quality and consistency of concrete. The plastic can be as a filler material in concrete as well as it can be used to improve the mechanical properties of concrete. The rapid industrialization and urbanization in the country leads to a lot of infrastructure development. This process leads to several problems like shortage of construction materials, increased productivity of wastes and other products. This paper deals with the reuse of waste plastics as partial replacement of coarse aggregate in M20 concrete. Waste Plastics were incrementally added in 0%, 5%, 10% and 15% to replace the same amount of Aggregate. Tests were conducted on coarse aggregates, fine aggregates, cement and waste plastics to determine their physical properties.

IndexTerms - Concrete, plastic, aggregate, cement, compressive strength

I. INTRODUCTION

Plastics currently play a massive role in our daily lives. Plastics are utilized in virtually all areas of manufacturing. Tons and tons of plastic products are moulded on a daily basis, even as the waste continues to build up. Due to the fact that most plastics are not biodegradable, an enormous sum of plastic waste continues to build up worldwide, with industrialized nations contributing the largest amount of plastic waste. More specifically, the majority of plastic waste comes from packaging and containers. The amount of land required for landfills is of increasing concern everywhere in the world.

From the 1950 up to 2018, an estimated 6.3 billion tons of plastic has been produced worldwide, of which an estimated 9% has been recycled and another 12% has been incinerated. India alone, produces more than 5 million tons of plastic are consumed each year, of which only an estimated one-quarter is recycled, with their main dyer going to landfills. This large amount of plastic waste inevitably enters the environment, with studies suggesting that the bodies of 90% of seabirds contain plastic debris.

It is possibility of disposal of these wastages in mass concrete such as in heavy mass concreting in PCC in pavements where the strength of concrete is not a major criterion under consideration. The waste plastic is one component of Municipal Solid Waste (MSW). Since the plastic is very low biodegradable material the disposal of the waste plastic causes big problems to the environment. As from many years the research concern that the use of byproducts from industry may augment the properties of concrete. In the modern decades, the use of by-products such as silica fume, glass culvert, fly ash, ground granulated blast furnace slag (GGBS) etc.,

efforts have been made to use in civil construction. The application of the industrial by-productsin concrete is as partial replacement of cement or partial replacement of aggregate. The use ofthese waste plastic in concrete can control the environmental problems or constraints if safe disposal of these products. In the present study the waste plastic used to prepare the paved Tilesby replacing cement with heated plastic waste gel.

1. Cement

Ordinary Portland cement of 43 – grade was used as it satisfied the requirements of IS: 269 –1969 and results have been tabulated

2. Water

IS: 456 – 2000 (Cl. 2.20) water, used for mixing and curing of concrete. Permissible limits forsolids in water are as per IS: 456 – 2009. The maximum permissible limit of chloride content in water for RCC work has been reduced from 1000mg per litre in IS: 456 – 1978 to 500mg per litre in IS: 456 – 2000. In addition to these requirements acidity and alkalinity for water hasto be considered.

3. Plastics

Plastics that cannot be degraded further is been powdered into fine particles. These plastics consist mainly of High-Density Polyethylene (HDPE)

4. Casting and Curing

Usually, M20 concrete is used for most constructional works, hence in this project M20 concrete was selected and waste plastics were used as replacement of aggregate. Aggregates such as 0%, 5%, 10% and 15% was added in percentage, in order to replace the same amount of Aggregate. Tests were conducted on coarse aggregates, fine aggregates, cement andwaste plastics to determine their physical properties.

Table 1. Physical Properties of Aggregate

Type of Aggregate	Coarse	Fine
Specific Gravity	2.6	2.7
Water Absorption	0.50%	1.0%
Free (Surface) Absorption	Nil	2.0%
Aggregate Impact Value	18.57%	-
Aggregate Crushing Value	17.88%	-
Los-Angeles Abrasion Value	23.60%	-

Table 2. Physical Properties of Cement

Specific Gravity	3.15
Initial Setting Time	36 Minutes
Final Setting Time	10 Hours
Soundness (by Autoclave methods)	0.6

Table 3. Physical Properties of Plastics

Specific Gravity	1.04

Figure 1. Plastic Aggregates

Figure 2. Crushing of aggregate

Figure 3. Casted Concrete Blocks

Figure 4. Testing of Blocks

III. METHODOLOGY

The methodology adopted for this study is given below:

1.Literature study was done on the available data on use of plastic in concrete

2. Plastic was collected from the waste material.

3. Plastic was cleaned for the removal of any foreign material, dust etc.

4. It was then sundried for a few hours and then melted in a container.

5. The melted plastic was then drawn into sheets by pouring it on a flat surface, and then allowed to cool down and get hard.

6. Cooled and hard plastic sheets were then broken into smaller particles by hammering the sheets.

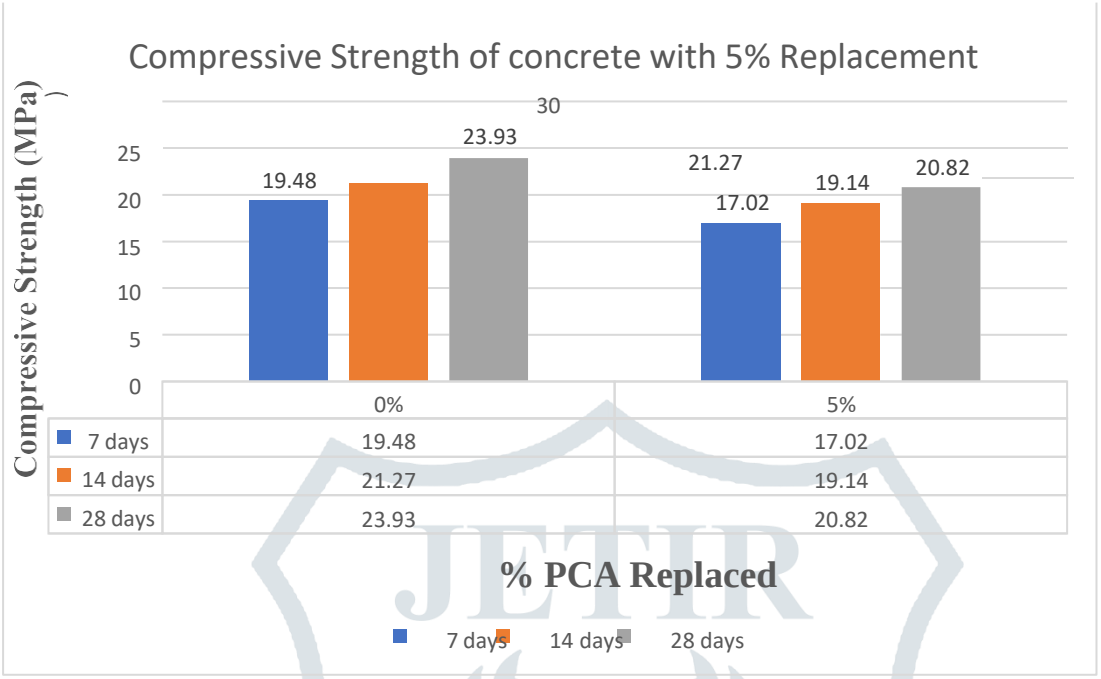
7. Test related to properties of cement and aggregates were performed.

8. Proportion of plastic coarse aggregates (PCA) in different mixes was selected.

9. Mix design for different proportions of concrete was decided and tests were performed to obtain the mechanical properties of different mixes.

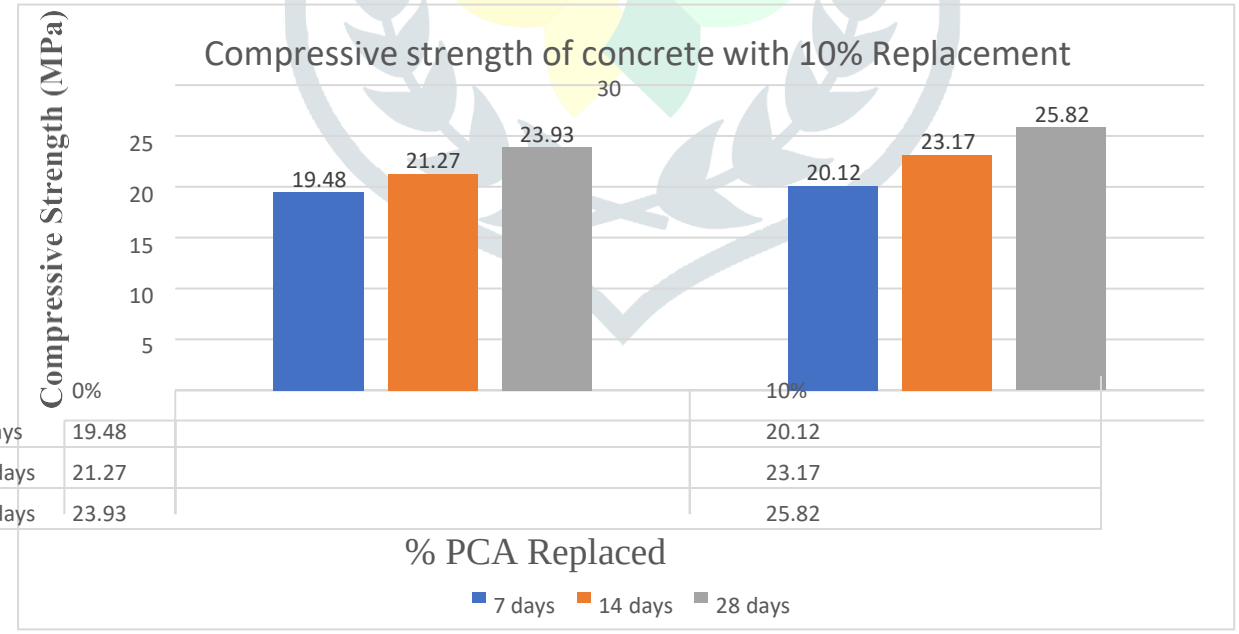
Results and Discussion
1. Compressive Strength

Compressive Strength of 0% vs 5%



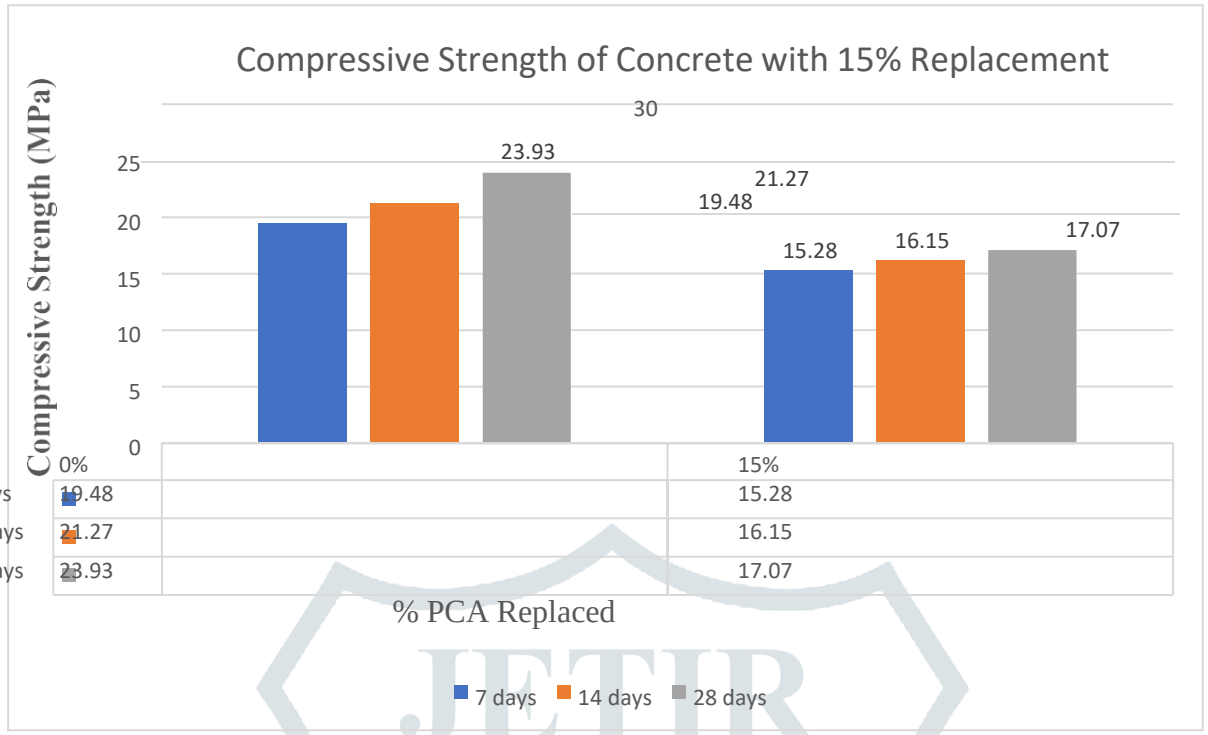
From the above graph it is observed that the compressive strength of conventional concrete at 28 days is found to be 23.93 MPa while the compressive strength of concrete with 5% of replacement with plastic aggregate at 28 days is found to be 20.82 MPa .
This shows that the concrete with 5% replacement of plastic aggregate gives nearly samestrength as conventional concrete.

Compressive Strength of 0% vs 10%



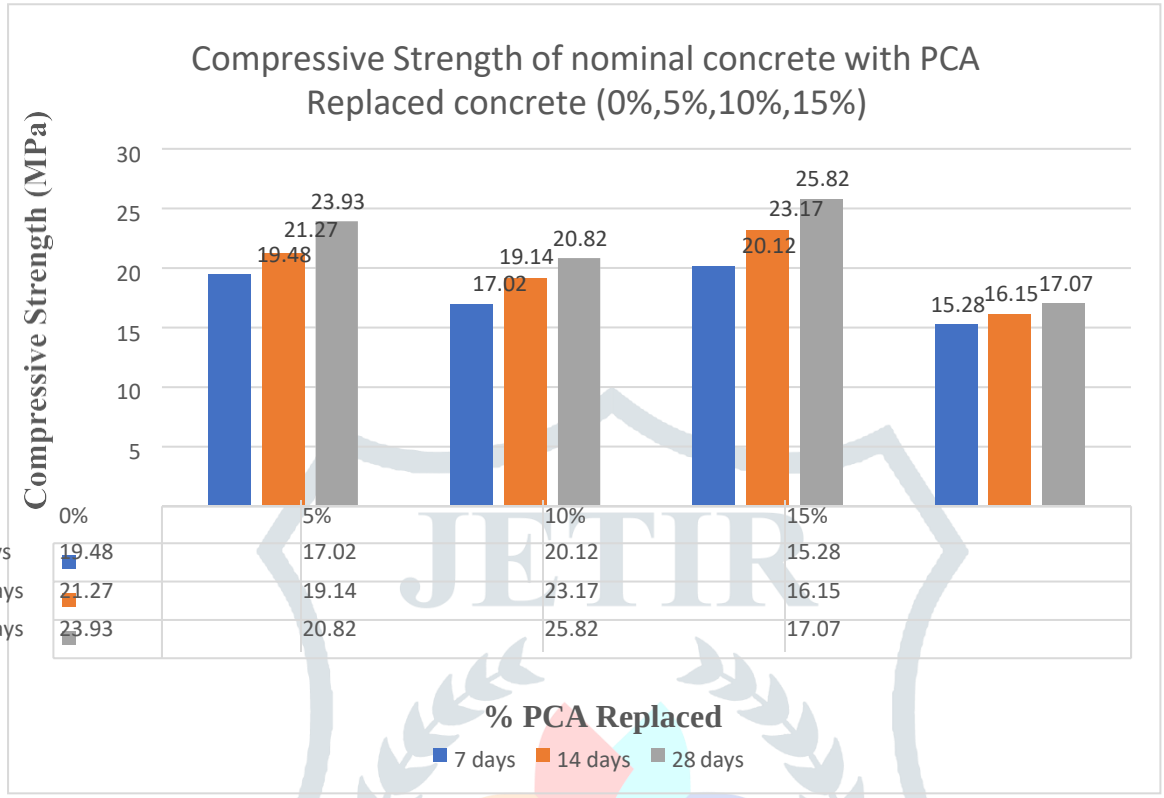
The compressive strength of traditional concrete at 28 days is 23.93 MPa, while the compressive strength of concrete with 10% plastic aggregate replacement at 28 days is 25.82 MPa, as seen in the graph above. This demonstrates that, when compared to ordinary concrete, the strength of the concrete with 10% plastic aggregate replacement improves.

c) Compressive Strength of 0% vs 15%



According to the graph above, the compressive strength of traditional concrete at 28 days is 23.93 MPa, while the compressive strength of concrete with 15% plastic aggregate replacement at 28 days is 17.07 MPa. This demonstrates that, as compared to conventional concrete, the strength of the concrete with 15% plastic aggregate replacement reduces.

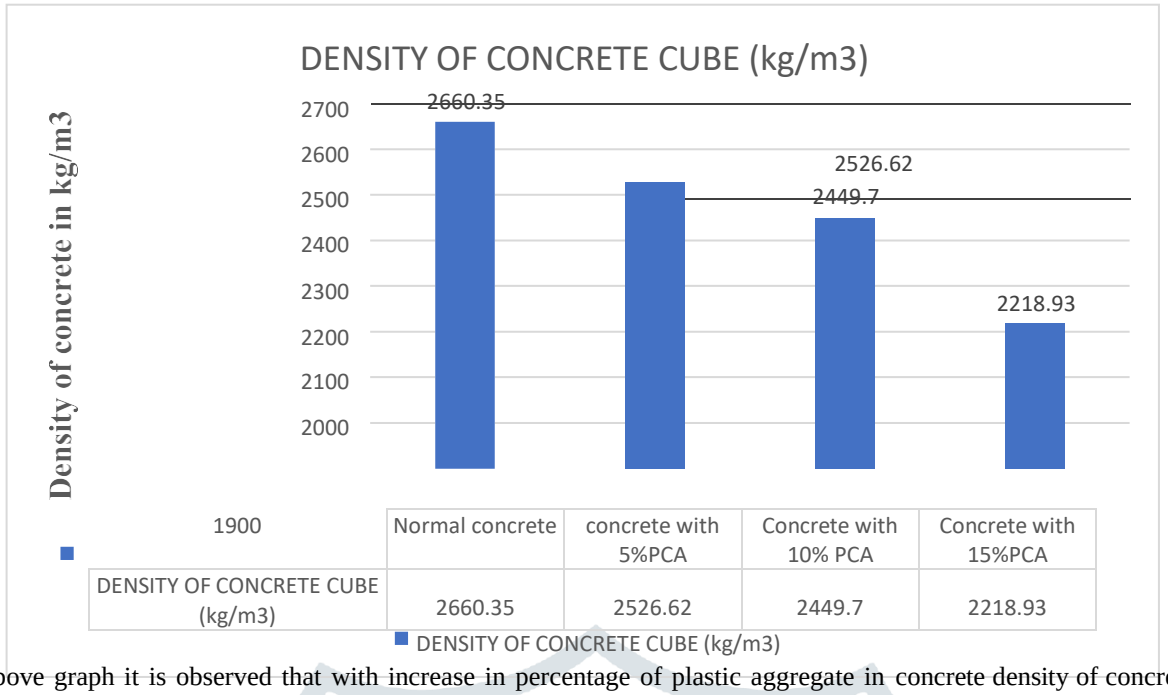
(d) Compressive Strength of 0%.5%,10%,15%



Compressive Strength of normal concrete with plastic aggregate concrete was compared. Fromthe above graph it is found that concrete with 10% of replacement of plastic aggregate shows strength nearly similar or more as compared to the normal concrete. Also, with further additionof plastic aggregate in concrete with replacement of 15% shows reduction in strength comparedto normal concrete.

2. Density of concrete Observationtable:

Sr no	% Of PCA replaced	Weight of concrete cube (kg)	Density of concrete cube (kg/m3)
1.	0%	8.992	2660.35
2.	5%	8.540	2526.62
3.	10%	8.280	2449.70
4.	15%	7.500	2218.93



From the above graph it is observed that with increase in percentage of plastic aggregate in concrete density of concrete decreases. Hence, we conclude that the concrete is lighter in weightas compare to normal concrete

Conclusion

Looking into the above aspects, the analysis concluded that the waste plastics can be used inthe cement concrete mix. It was observed while experiment that the compressive strength of concrete initially increases at 10% PCA but further addition of PCA shows reduction in strength. Hence, The optimum compressive strength is obtained at 10% PCA. The density of concrete decreases with increase in plastic aggregate. Hence concrete is lighter in weight. The cost of construction will reduce and also helps to avoid the general disposal technique of waste plastics namely land filling and incineration which have certain burden on ecology. The use of waste plastic in cement-based composite can significantly reduce cost of construction through partial replacement of aggregates. The used of waste plastics in constructions will grossly reduce rate of solid waste accumulation in the environment and income will be generated from its utilization. Detectable reductions in compressive strengths are observed with increasing the percentage of plastic. The percentage expansions of the specimens cast with partial replacement of plastic are within the permissible limits; hence the materials are safe for construction purpose. Use of plastic increases the strength and durability of concrete for construction.

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