WASTE PLASTIC USED AS A COARSE AGGREGATE IN CONCRETE

Dr. Kiran Tajne* and Mrs. Pranita Bhandari1

***Assistant Professor, Priyadarshini College of Engineering, Nagpur, Maharashtra, India**

1Assistant Professor, Priyadarshini College of Engineering, Nagpur, Maharashtra, India

kmtajne13@gmail.com, pranita.bhandari11@gmail.com

(9881747815)

Abstract:- The use of plastic is increasing day by day, although steps were taken to reduce its consumption. This creates substantial garbage every day which is much unhealthy. A healthy and sustainable reuse of plastics offers a host of advantages. The suitability of recycled plastics as coarse aggregate in concrete and its advantages are discussed here. The initial questions arising of the bond strength and the heat of hydration regarding plastic aggregate were solved. Tests were conducted to determine the properties of plastic aggregate such as density, specific gravity and aggregate crushing value. Partial replacement at various percentage. The percentage substitution that gave higher compressive strength and flexural strength, higher compressive strength was found with 10% &15% NCA replaced concrete.

Keywords: - Compressive strength, Flexural strength, M20 grade concrete

1 INTRODUCTION

Concrete is the most widely used man made construction material in the world and its second only to water as the most utilized substance in the planet. Seeking aggregates for concrete and to dispose of the waste from various commodities is the present concern. Today sustainability has got top priority in construction industry. In the present study the recycled plastics were used to prepare the coarse aggregates thereby providing a sustainable option to deal with the plastic waste. There are many recycling plants across the world, but as plastics are recycled they lose their strength with the number of recycling. So these plastics will end up as earth fill. In this circumstance instead of recycling it repeatedly, if it is utilized to prepare aggregates for concrete, it will be a boon to the construction industry. Most of the failures in concrete structures occur due to the failure of concrete by crushing of aggregates. PCAs which have low crushing values will not be crushed as easily as the stone aggregates. These aggregates are also lighter in weight compared to stone aggregates. Since a complete substitution for NCA was not found feasible, a partial substitution with various percentage of PCA was done.

2 MATERIALS

2.1 Cement: Cement used for the test was ordinary Portland cement of 43 grade confirming to IS 8112- 1989. Various test were carried out for determining the properties of cement.

2.2 Fine Aggregate: Natural river sand was used as fine aggregate. The properties of sand were determined by conducting tests as per IS2386 (Part-I).

2.3 Coarse aggregate: Crushed granite stones obtained from local quarries were used as a coarse aggregate. The maximum size of coarse aggregate used was 20 mm. The properties of aggregate were determined by conducting test as per IS: 2386 (Part – III).

2.4 Water: Portable water free from impurities and salt used for casting and curing the concrete blocks as per IS –456-2000.

2.5 Plastic Aggregate:

Plastics collected from the disposal area were sorted to get the superior one. These were crushed into small fraction and washed to remove the foreign particles. Then it was heated at a particular temperature so that the necessary brittleness was obtained. After extrusion the molten plastic was cooled down and collected in boulders of 100 mm size approximately. These plastic boulders were crushed down to the size of aggregates.

According to the Indian standard specifications the property of aggregates such as specific gravity, aggregate crushing value and density were determined [6], [7]. From Table I comparing the properties of aggregate for both NCA and PCA it is observed that the specific gravity and density for PCA is much lower than NCA which offers a light weight concrete. A lower crushing value indicates the complexity with which a PCA concrete could be crushed under compressive stresses.

3. EQUATIONS

Compressive strength = P/d^2

Where, P is the compressive load on the cube

d is the side of the cube

Flexural strength = Pl/bd^2

$$fb = \frac{3Pa}{bd^2}$$

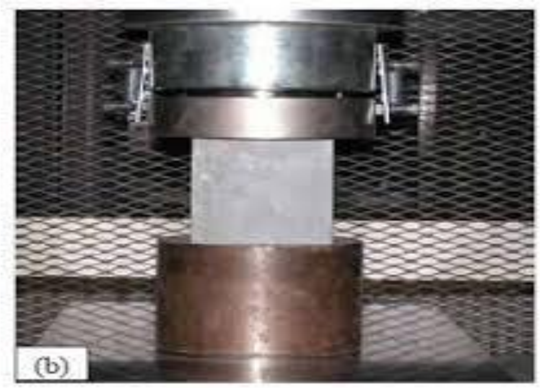
Where, P is the compressive load on the beam

a is the distance between line of fracture and nearer support.

b is the measured width of specimen.

4. FIGURES AND TABLES

I] COMPRESSIVE STRENGTH TEST



Compressive strength test was carried out on sample cube (15X15X15cm) at 28 days of curing age, conforming to NF EN 12390-5. The load was applied slowly without shock and increased continuously at a rate of approximately 140 kg/sq.cm/min until the resistance of the specimen to the increased load breaks down. The maximum load applied to the specimen was then be recorded and any unusual features noted at the time of failure brought out in the report.

Compressive strength for M20 grade of concrete mix with different % of plastic waste

DAYS	C.C(N/mm²)	10%PW(N/mm²)	15%PW (N/mm²)
7	21.11	21.78	24
28	25.93	28.15	30.3

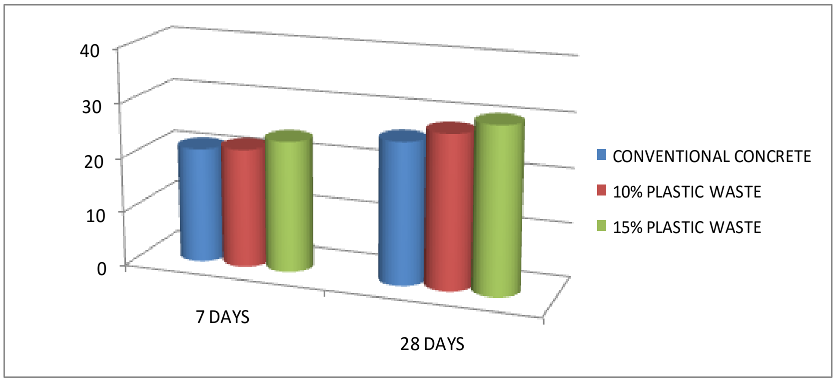


FIG.1 COMPRESSIVE STRENGTH

II] FLEXURAL STRENGTH TEST

Flexural strength test was carried out using a simple beam (15X15X70 cm) with two-point loading method at 28 days of curing age, conforming to NF EN 12390-5. The specimens were subjected to bending tests with a concentrated load at the center line in order to verify their behavior. The bending tests were performed by test machine of 60 KN maximum load, with a loading rate of 0.05MPa/s.

Flexural strength for M20 grade of concrete mix with different % of plastic waste

NO. OF DAYS	C.C (N/mm²)	10%PW (N/mm²)	15%PW (N/mm²)
7	2.58	3.37	2.93
28	3.82	3.68	3.94

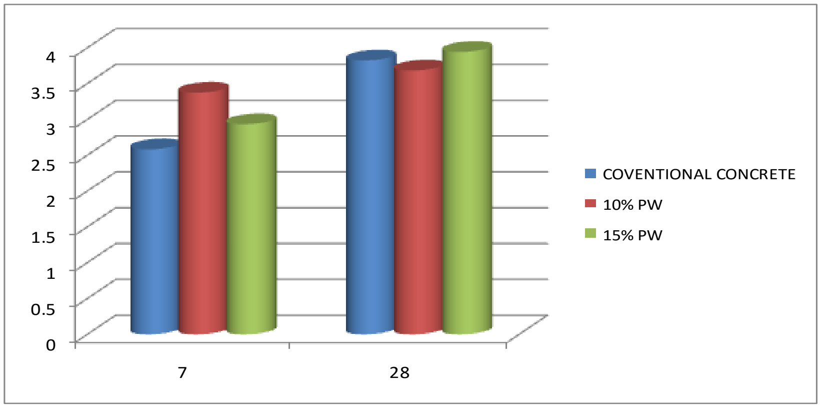


FIG 2 FLEXURAL STRENGTH

5. CONCLUSION

From the above results it is found that there is a rise in compressive strength for 10% and 15% replacement of coarse aggregate. The rise in compressive strength for 10% replacement mix is found out to be upto 4% after 7 days and upto 8% after 28 days. Rise of 14% in compressive strength is observed after 7 days and 17% increase is observed after 28 days for 15% replacement mix. Similarly, 30% rise in flexural strength is observed after 7 days where as 4% decrease is observed after 28 days for 10% replacement mix and 14% rise of flexural strength is seen after 7 days and 4% increase is seen after 28 days.

REFERENCES

[1]. Neville, A. M., Properties of concrete, 4th edition, Addison Wesley Longman, London, 1997

[2]. Shetty, M. S., Concrete Technology, S. Chand and company, New Delhi, 2005

[3]. Gambir, M. L., Concrete Technology, 3rd edition, Tata McGraw-Hill, New Delhi, 2007

[4]. IS: 516-1959, Methods of test for strength of concrete, Bureau of Indian Standards, New Delhi, 195

[5]. R.Lakshmi, S. Nagan, “Utilization of waste E plastic particles in cementitious mixtures” Journal of Structural Engineering,Vol.38, No. 1, April – May 2011, pp. 26-35

[6]. P.Muthupriya, K. Subramanian, B.G. Vishuram, “Experimental investigation on high performance reinforced concrete column with silica fume and fly ash as admixtures” Journal of Structural Engineering,Vol.38, No. 1, April – May 2011,pp. 46-59

[7]. Dr. M. Sivaraja “Application of coir fibers as concrete composites for disaster prone structures” submitted to Central Institute of Coir Technology.