

Study of Compressive Strength of Concrete Mix Cubes Made by the Partial Replacement of Fly Ash and Plastic Aggregate with Cement and Traditional Stone Aggregate

Raghvendra Gupta¹ Prof. R.D.Patel² Mrinank Pandey³

³Associate Professor

^{1,2,3}Department of Civil Engineering

^{1,2,3}Madan Mohan Malaviya University of Technology

Abstract— This experimental study present the effect of plastic aggregate on concrete mix cubes by making 15% partial replacement of fly ash constant to deal with the disposal of plastic waste. Plastic aggregate is partially replaced at different percentage by weight of traditional stone aggregate. The replacement of plastic aggregate are done at 4%, 8%, 12%, 16%, 20%, and 24% by weight of stone aggregate. The compressive strength of plastic aggregate partially replaced cubes is then tested on CTM (compression testing machine) after curing it for 7 days, 14 days and 28 days. Results of CTM are listed in paper. Plastic aggregate are used to make concreting material light in weight and more economical and eco-friendly.

Key words: Fly Ash, Traditional Stone Aggregate

I. INTRODUCTION

All over the Globe, Concrete is a versatile building material utilized and aggregate is vital constituent of concrete. It has properties like high compressive strength, fire resistant, durability and specific gravity. In the recent past years the awareness about the environment pollution has been increased. Household waste, industrial waste and other types of waste creating the major problem of their disposal due to which environmental pollution is coming serious these days. Today the cost is most important aspect in any construction work. Here we are aiming to use plastic waste to make concrete more economical as well as it also conserve the natural resources for future use and decreases the mining of stones. The aim of this paper is to make the structural component light in weight and also decrease its dead load. High density polythene is used for the partial replacement of stone aggregate.

II. PLASTIC AGGREGATE

High-density polyethylene (HDPE) or polyethylene high-density (PEHD) is a polyethylene thermoplastic made from petroleum. HDPE is well known for its large strength to density ratio, HDPE is commonly used in the production of plastic bottles, corrosion-resistant piping, geomembranes and plastic lumbers. HDPE is commonly recyclable material, and has the number "2" as its resin identification code. The global production of HDPE in the year 2007 is about 30 million tones. HDPE is largely known for its strength to density ratio.

A lot of plastic waste are generated are generated every day and from every home. HDPE type of plastic waste are sorted and collected from the waste disposal area. These waste plastic are now crushed into small pieces and then washed for removing foreign particles and kept for drying. Now these wastes are heated to a certain temperature so that the required brittleness is obtained. After extrusion the

molten plastic was allowed to cool down and molded into the shape of boulders of 100 mm size approximately. These big size boulders are then crushed and Converted into plastic aggregates. These plastic aggregates are now sieved as per aggregate size required.

III. PROPERTY OF PLASTIC AGGREGATE

Serial no.	Property	Value
1.	Plastic type	HDPE
2.	Density	0.958 g/cm ³
3.	Size	20 mm
4.	Softening temperature	120 °C

Table 1: Property of Plastic Aggregate

IV. MIX DESIGN

Serial no.	Material	Content	Ratio
1.	Cement	398.70kg/m ³	1
2.	Water	179.415	0.45
3.	Fine aggregate	669.847	1.68
4.	Coarse aggregate	1175.24	2.947
5.	Super plasticizers	3.98	0.01
6.	Water cement ratio		0.45

Table 2: Mix Design

V. WORKABILITY OF M-30 GRADE CONCRETE

serial no.	Cement	Water	Coarse aggregate	Fine aggregate	Super plasticizer	slump
1.	3.13	1.40	5.23	9.18	2%	118
2.	3.13	1.40	5.23	9.18	1%	93

Table 3: workability of m-30 grade concrete

VI. TEST RESULTS AT DIFFERENT PERCENTAGE OF PLASTIC AGGREGATE MAKING 15% FLY ASH REPLACEMENT CONSTANT

A. 7 Days Testing

Percentage Of Plastic Waste Replaced By Stone Aggregate	Average weight (kg)	Average Strength (N/mm ²)
4%	8.390	21.225
8%	8.181	22.115
12%	8.085	21.225
16%	7.964	19.890
20%	7.830	18.560
24%	7.775	16.780

Table 4: 7 Days Testing

B. 14 Days Testing

Percentage Of Plastic Waste Replaced By Stone Aggregate	Average weight (kg)	Average Strength (N/mm ²)
4%	8.390	30.555
8%	8.181	30.785
12%	8.085	28.115
16%	7.964	26.450
20%	7.830	26.450
24%	7.775	25.115

Table 5: 14 Days Testing

C. 28 Days Testing

Percentage of Plastic Waste Replaced By Stone Aggregate	Average weight (kg)	Average Strength (N/mm ²)
4%	8.390	32.885
8%	8.181	33.780
12%	8.085	32.115
16%	7.964	30.940
20%	7.830	29.000
24%	7.775	27.557

Table 6: 28 Days Testing

- [2] Central pollution control board.
- [3] International Journal on Civil and Structural Engineering, vol.4, no.2, 2013
- [4] International Journal on engineering trends and technology, vol.19, no.4, Jan 2015

VII. CONCLUSION

Various tests are conducted at different percentage of partially replaced plastic aggregate by making 15% partial replacement of fly ash constant. The data shows that with increase in the percentage of plastic aggregate in concrete mixture, the weight of concrete cubes is also decreasing. Decreasing weight of concrete cubes refers to the light weight concrete material and with 15% replacement of fly ash by cement and 8% replacement of plastic waste, the strength of concrete cube is 33.78 N/mm² (At 28 days testing of cubes). The result represents that the partial replacement of 15% fly ash with cement and 8% plastic aggregate with stone aggregate has also justified the strength and economical criteria in construction.

VIII. RESEARCH SIGNIFICANCE

The plastic which we use in our daily life for carrying goods, plastic boxes for storage and other daily plastic items become waste after their use which has disposal issue related to it. According to a report, about 180 million tones of plastic waste are generated globally in year 2008 and in India it is about 8 million tones per year and expected to increase by 12 million tones in year 2012. The world production of aggregates in year 2011 was marked to 26.8 billion metric tones. This signifies the reduction of aggregate use by 8% which saves the river and environment and also reduces the demand of aggregate by 2.144 billion metric tones. The use of plastic aggregate makes the concrete eco-friendly and also uses about 14.4 million tones of plastic which is creating disposal problem and pollution.

REFERENCES

- [1] Indian concrete journals on Forecast for construction materials - Cement and aggregates.