AN EXPERIMENTAL INVESTIGATION ON PHYSICAL AND MECHANICAL PROPERTIES OF CONCRETE WITH PARTIAL REPLACEMENT OF FINE AGGREGATE BY HIGH DENSITY POLYTHENE WASTE AND GLASS WASTE

Manish K. Chavada[1], Dr. H.S. Patel[2], Dr. V.S. Purani[3]
[1]PG Student, L.D. College of Engineering Ahmedabad, Gujarat, India
[2]Professor, Applied Mechanics Department, L.D. College of Engineering Ahmedabad, Gujarat, India
[3]Professor, Applied Mechanics Department, L.D. College of Engineering Ahmedabad, Gujarat, India

Abstract : Aim of this study is to study the possibility of replacing fine aggregate with mixture of plastic waste and glass waste in cement concrete. Various tests are carried out to determine the properties of fresh and harden concrete of M25 grade with partial replacement of fine aggregate with plastic waste and glass waste. The fine aggregate will be replaced at dosage of 10%,15% and 20% within acceptable limits. The physical properties (density, workability, water absorbsion) and mechanical properties (split tensile, flexural and compressive strength) of concrete mix can be found and study. The outcome will be compared with control specimen tests results.

Keywords; High Density Polyethene (HDPE) waste, Glass waste, Concrete, Strength

I. INTRODUCTION

Concrete is mixing of cement, water, sand, and gravel that hardens into a super strong building material. The aggregates are generally fine aggregate and course aggregate such as sand is fine aggregate whose size is less than 4.5 mm and granite and basalt are course aggregate whose size is more than 4.5 mm. Portland cement is generally used as binder material and other cementations materials like as fly ash, lime etc. Nowadays, one cannot imagine construction without concrete in building material. Concrete has natural resources like sand and aggregate. Concrete is Concrete has high strength and durability this is the main reason of the popularity.

Discarded waste (Plastic & Glass) is now a biggest environmental problem to modern civilization. This discarded Plastic and glass waste which have serval types of chemicals, and therefore this waste is water, air and soil pollution can be created. This waste is a nonbiodegradable material. So that it is not suitable for addition to land filling. Plastic and glass waste using it mean save the dangerous material forever. One of the best option recycling of plastic waste to produce new materials. Such as one of the best options of recycling of plastic waste, due to its environmental and economic benefit.

High density polyethylene is generally called HDPE. It has a high strength to density ratio. It is lightweight which means furniture made from this material can be handled and transported very easily. It is an ideal material for the injection moulding process making it suitable for batch and continuous production. HDPE has a density range from 930 to 970 kg/m^3. It has little branching which gives stronger intermolecular forces and tensile strength. If it has difference strength then it exceeds difference in density which give higher specific strength. Physical properties of HDPE can be vary that depend on the moulding process. The ultimate tensile strength of HDPE is 24 to 80 MPa. Water absorption of this material varies from 0.1 to 0.3%.

Glass is non crystalline solid which is the transparent. Glass is widely used in all over world because it is the hard and widespread practical, technological and transparent. It is usage generally table ware, soda bottles, window panes. It is used as decorative material. In the glass they have serval types of chemical compound such as silica (Sio2) 91.2%, Alumina (Al2o) 4.80%, (Cao) 0.61%, (Na2o) 3.37%. This Glass waste create environmental problem. If such glass waste used in construction industries, it would be solving the environmental and disposal problem.

II. EXPERIMENTAL INVESTIGATION

The fine aggregate of M25 grade of concrete was replaced by waste material of different proportion of HDPE powder and Glass powder. The replacement was done by using sieve analysis such that approximate same fineness modulus and gradation of fine aggregate. The concrete mix was prepared with 0.5 water cement (w/c) ratios with different proportion of wastes such as a (40-60) %, (50-50) % and (60-40) % of glass waste and HDPE waste.

[A]Material

Ordinary Portland cement (OPC) of 53 grade of conforming to requirement of bureau of Indian standard specification (BIS) (IS 12269:1987) was used for making concrete. The course aggregate confirming to IS 383:1970 was obtained with nominal maximum size of 20 mm and fineness modulus 7.93. The fine aggregate confirming to IS 383:1970 was obtained from local river with fineness modulus equal to 2.67. The waste material of HDPE was pulverised in grinding machine such that a size between 150 microns to 600 microns. Glass was obtained from waste window glass which was crushed and then mechanically

sieving process with size of 300 microns to 600 microns. Organic and inorganic impurities was removed by sieving process. Chemical composition of glass powder is presented in table 1

Table 1. Chemical composition of glass powder

Chemical composition	Fe_2O_3	SiO_2	Al_2O_3	CaO	MgO	LOI
Percentage of obtain value	0.11 %	91.2 %	4.80 %	0.61 %	0.24 %	0.59 %

[B] Mix Design

Concrete mix design was prepared as per IS 10262:1982 to achieve design compressive strength 25 MPa after 28 days of curing. The mix design data is shown in table 2

Table 2. Mix design proportion of concrete without waste material for 0.5 w/c ration

Water	Cement	F.A	C.A
207.07	383.16 kg/m^3	666 kg/m^3	1265.7 kg/m^3
0.50	1	1.73	3.3

The fine aggregate as a sand is substituted by the waste mixture at partial replacement of 10%, 15% and 20% such as (40-60) %, (50-50) % and (60-40) % of glass waste and HDPE waste by weight of sand.

2.3 Test Methods

Concrete was tested after mixing and curing by method described in IS 1199:1959. The compressive strength was calculated on cube size of 150*150*150 mm. The split tensile strength was calculated on cylinder size of 150 diameter and 300 mm height. The flexural strength of beam was calculated by size of 100*100*500 mm after 7 days and 28 days of curing (IS 516:2004).

3. RESULTS AND DISCUSSION

[A] Workability

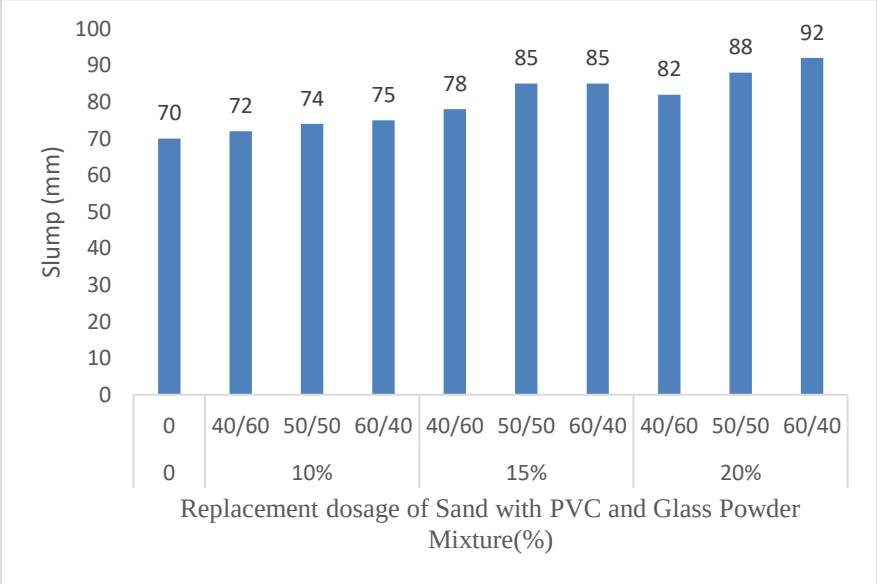

Figure 1. Effect of the HDPE and glass waste on workability of concrete.

The workability of concrete is increase with increasing replacement dosage of HDPE and glass waste for 0.5 w/c ratio. Up to 10% replacement of HDPE and glass waste, low slump obtained. Medium consistency was obtained for almost all specimen above 15% replacement.

[B] Strength

The compressive strength of the concrete at the end of 7 days goes on increasing as a replacement of waste is increased but at the end of 28 days goes on decreasing with replacement increased. The flexural strength of concrete at the end of 7 days as well as 28 days goes on increasing as a dosage of waste is increased.

Compressive strength

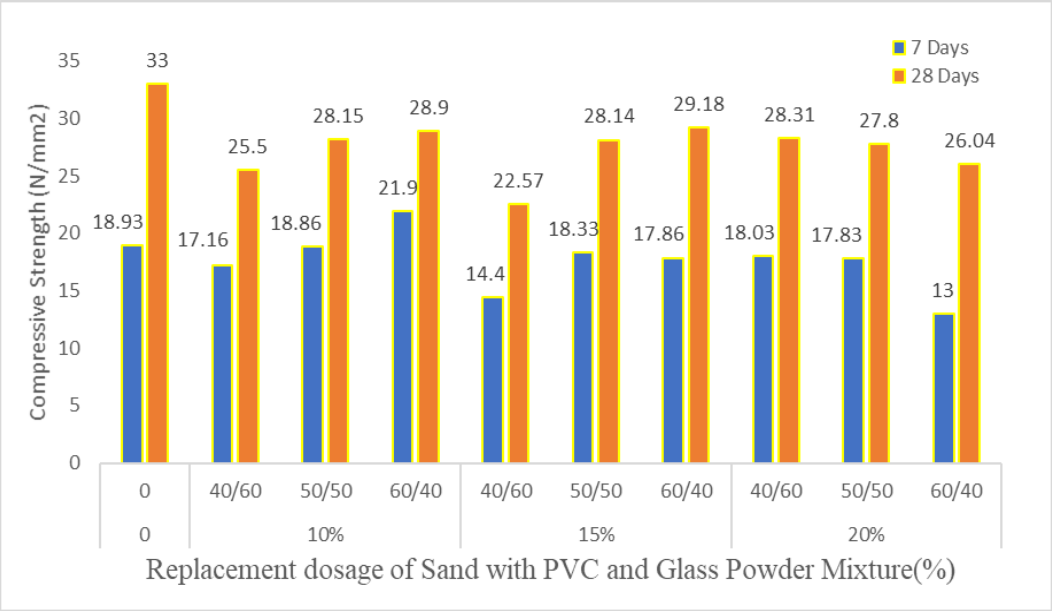

Figure 2. Compressive strength after 7 days and 28 days

Tensile strength

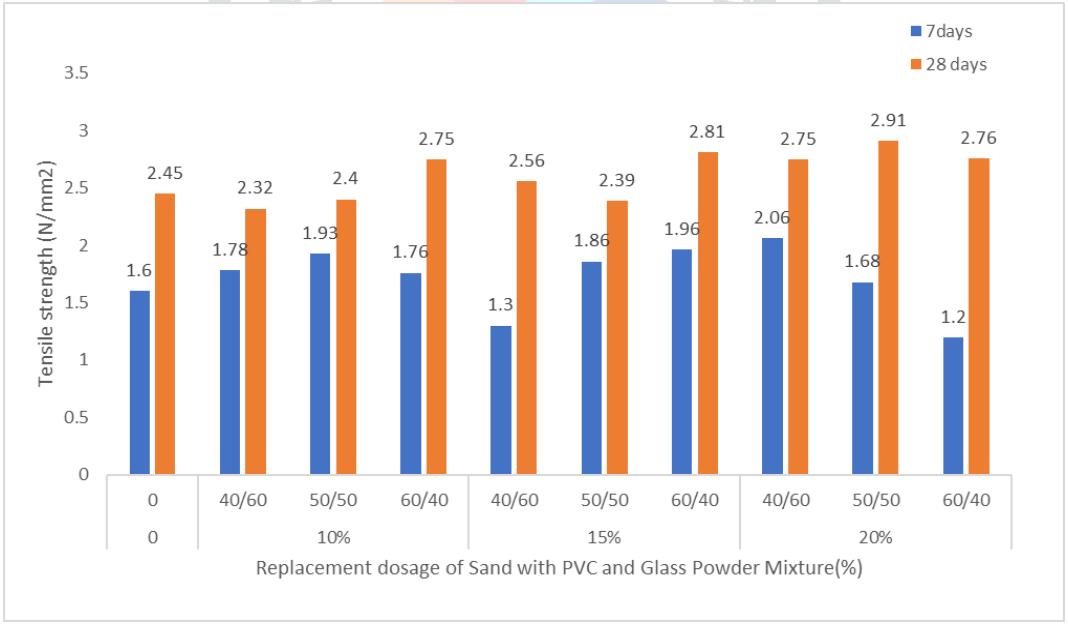

Figure 3. Tensile strength after 7 days and 28 days

Flexural strength

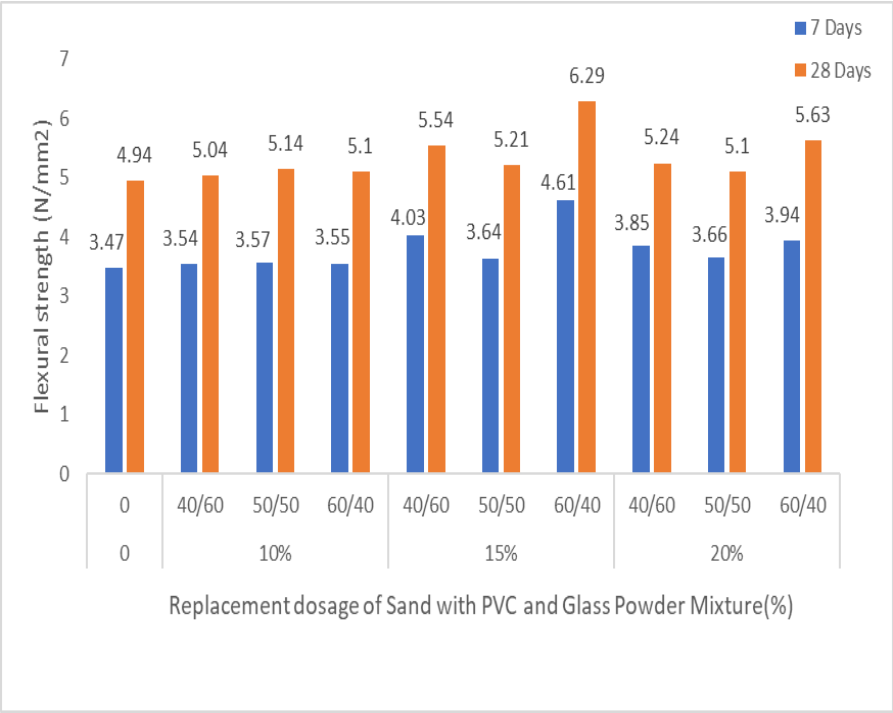

Figure 4. Flexural strength after 7 days and 28 days

IV. CONCLUSION

- By comparing above results with conventional concrete at 28 of curing, compressive strength is reduced when fine aggregate is replaced by 20% dosage of HDPE and Glass but strength equivalent to target strength is achieved as per IS code.
- Tensile strength and flexural strength are increased for 15% replacement of HDPE and Glass waste as (60-40) % proportion.
- From the test results it can be concluded that replacing fine aggregate up to 15% dosage of HDPE and Glass waste as a (60-40) % of HDPE and Glass material, concrete gives better results in overall compression, tensile and flexural strength.

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