

“Study of Use of Polystyrene as a Partial Replacement for Fine Aggregate in Concrete”

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Abstract:- In Civil engineering, due to urbanization the demand for construction material increases, with the increase in demand there is a strong need to utilize alternative materials for sustainable development. Polystyrene (also known as EPS Foam or Styrofoam) is a highly popular plastic packaging material. Polystyrene is essentially non-biodegradable and taking hundreds perhaps thousands of years to decompose in case of land filling. Other disposal methods or treatments methods are creating hazardous effect on environment. However, this material is having properties such as sound insulation, high thermal conductivity, and lightweight so we can use this material in concrete. This paper highlights the study of properties such as compressive strength and tensile strength of Polystyrene based concrete which is compared with conventional concrete.

Keywords:- Compressive Strength, Tensile Strength, Fine Aggregate, Waste Polystyrene.

I. INTRODUCTION

Due to industrialization construction industry is growing day by day along with this there is increase in demand of construction materials. For sustainable development there is need of utilizing alternative materials in construction and utilization of waste material is very important aspect of sustainability.

Polystyrene is one of the highly popular plastic packaging materials. It is waste material induced from packaging industry which causes pollution and is harmful to ecosystem. This waste is becoming expensive to dispose. Due large and bulky nature, polystyrene take up significant space for its disposal and also its treatment and disposal is creating environmental sustainability problem. Currently millions of tons of waste polystyrene are produced in world. Polystyrene Foam is a non- biodegradable material. Polystyrene is essentially non-biodegradable and taking thousands of years to decompose in case of land filling. Other disposal methods or treatments methods are creating hazardous effect on environment. However, this material is having properties such as sound insulation, high thermal conductivity, and lightweight so we can use these materials in construction industry which will add new material for construction and add new method of its disposal which is environmental friendly. This study aims at the use of polystyrene in concrete and analyzing its properties such as compressive strength, tensile strength along with its comparative study of strength against conventional concrete. In this study 5-30% Fine aggregate is replaced by polystyrene.

II. LITERATURE REVIEW

[1] In this study author has used waste polystyrene and resin in concrete to produce new concrete material. Author concludes that as the EPS and resin ratio increases, density, compressive strength and thermal conductivity of concrete decreased. Author also says that it is a best material for partition wall, ceiling, flooring, bricks etc.

[2] In this paper author said that thermocol has high thermal insulation and high sound absorption. Author also says that it is excellent material to use in construction of walls and ceiling. Author concludes that thermocol is applied in concrete due to its light weight nature which can give us light weight concrete

[3] In this paper, author says that Lightweight concrete can be used for repairing wooden floors of building, carrying wall of low thermal conduction, bridge deck etc . Author suggests that it is possible to improve the compressive strength versus specific gravity or to reach equivalent strength for lower specific gravity. In this study cement to EPS ratio is kept 1: 1

III. METHODOLOGY

Different basic tests are taken on concrete ingredient that is cement (Ordinary Portland cement 43 grade), fine aggregate and coarse aggregate. Mix proportion of concrete is modified for using polystyrene with partial replacement of fine aggregate with 0%, 5%, 10%, 15%, 20% and 25% of polystyrene. Different elements are casted with this percentage replacement and tested under standard conditions.

A. Test on Ingredients

Test	Fine Aggregate	Coarse Aggregate
Specific Gravity	2.60	2.7
Water Absorption (%)	0.52	1.00
Fineness Modulus	3.48	6.9

Table 1. Physical Properties of Materials- Aggregates

Test	Results
Fineness of Cement	5.33%
Initial Setting Time	50 min
Final Setting Time	563 min
Soundness	1 mm

Table 2. Physical Properties of Materials- Cement

B. Properties of Polystyrene

Test	Polystyrene
Specific Gravity	0.011
Water Absorption (%)	0.0
Moisture Content	0.0
Fineness Modulus	3.5

Table 3. Physical Properties of Polystyrene

C. Casting of Specimen

Specimens are casted as per design mix and tested after appropriate curing, and tests taken are compressive strength or cubes (150mm X 150mm X 150mm) and split tensile strength of cylinders (150mm X 300mm). From the studies, optimum results are found out and compared with conventional concrete.

IV. MIX PROPORTION

Concrete mix design procedure as per IS 10262:2009, a concrete mix proportions with characteristic compressive strength or 20Mpa was designed without any admixtures with water cement ratio 0.50. The mix adopted for study is given in table below:

Material	Water	Cement	Fine Aggregate	Coarse Aggregate
Kg/ m ³	186	372	688	1165
Ratio	0.5	1	1.85	3.13

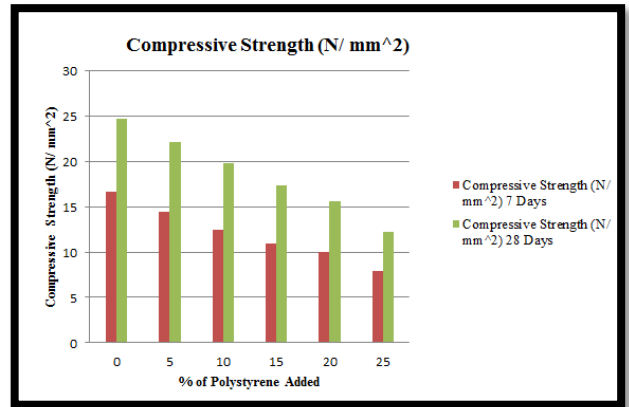
Table 4. Mix Proportion Concrete

V. TEST RESULTS AND DISCUSSION

On the concrete specimen the compressive strength and split tensile strength test were conducted, results obtained are discussed below:

A. Compressive Strength

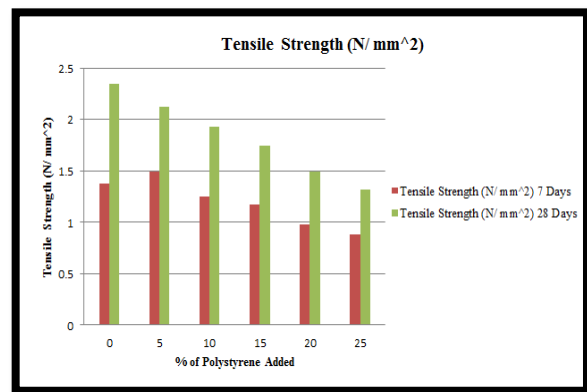
Specimens are casted in concrete cube of size (150mm X 150mm X 150mm) and cured the tested under compressive strength under compression testing machine (CTM). Graph No.1 shows compressive strength of concrete using polystyrene at 7th and 28th day for 0.50 W/C.



Graph 1: Compressive Strength of Polystyrene based Concrete

A. Split Tensile Strength

Specimens are casted in concrete cylinder of size (150mm X 300mm) and cured and then tested. Graph No.2 shows Split Tensile strength of concrete using polystyrene at 7th and 28th day for 0.50 W/C.



Graph 2: Tensile Strength of Polystyrene based Concrete

It can be observed from the results that, compressive strength and tensile strength of concrete will decrease with partial replacement of fine aggregate with polystyrene as compared to conventional concrete which is considerable for lightweight concrete.

Which do not require high compressive and tensile strength also after this study; it has proven better way for disposal of polystyrene.

VI. CONCLUSION

The partial replacement of fine aggregate with polystyrene reduces the compressive strength and tensile strength of concrete. This polystyrene based concrete is best suitable for non-structural elements.

REFERENCES

- [1]. *Ayse Kaya, FilizKar*, “Properties of concrete containing waste expanded polystyrene and natural resin”, *Construction and Building Materials* 105 (2016) 572-578.
- [2]. *Dr. G. Elangovan* , “Experimental study on light weight concrete by partial replacement of fine aggregate using flyash and adding thermocol”, *International Journal on Engineering Technology and Sciences*, Volume II, Issue IX, September-2015.
- [3]. *AbhijitMandlik, TarunSarthakSood, ShekarKarade, SangramNaik, AmrutaKulkarni*, “Lightweight Concrete Using EPS”, *International Journal of Science and research (IJSR)*, Volume 4 Issue 3, March 2015
- [4]. *Ali a sayadi, juan v tapia, thomas r neitzert, g charles Clifton*,“ Effectof expanded polystyrene particles on fire resistance, thermal conductivity and compressive strength of foamed concrete”, *construction and building materials* 112 (2016) 716-724.
- [5]. IS 383:1970 “Specifications for coarse and fine aggregates from natural sources for concrete”, Bureau of Indian Standards, New Delhi.
- [6]. IS 456: 2000 – ‘Code of practice for plain and reinforcedConcrete’, Bureau of Indian Standards, New Delhi
- [7]. IS: 10262: 1982, “Recommended guidelines for concrete mix design” Bureau of Indian Standards, New Delhi.