ISSN: 2277-5528
Impact Factor: 4.015

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

# EXPERIMENTAL INVESTIGATION ON THE PROPERTIES OF CONCRETE FOR RIGID PAVEMENT CONSTRUCTION WITH PET FIBRES

**Kumar Saurabh[1], Arka Singha[2], Siddharth Barbhuiya[3], Prof. K. V. R. Prasad[4]**
Department of Civil Engineering
SIR M. VISVESVARAYA INSTITUTE OF TECHNOLOGY, BANGALORE 1,2,3,4

## ABSTRACT
A pavement is a structure composed of structural elements, whose function is to protect the natural sugared and to carry the traffic safety and economically. The surface of any roadway should be stable and non-yielding to allow heavy wheel loads of road traffic to move with least possible rolling resistance. The road surface should also be even along the longitudinal profile to enable fast vehicles to move safely and smoothly at design speed. Road surfaces must also maintain their strength in adverse environmental conditions The pavement carries the wheel load and transfers the load stresses through a wider area on the soil subgrade below. A pavement layer is considered more effective or superior, if it is able to distribute the wheel load stress through a larger area per unit depth of the layer. One of the objectives of a well designed and constructed pavement is therefore to keep this elastic deformation of the pavement within permissible limits, so that the pavement can sustain a large number of repeated load applications during the design life. The purpose of this paper is to evaluate the possibility of using granulated plastic waste materials to partially substitute for the fine aggregate (sand) in concrete composites. The polyethylene (PET) bottle which can easily be obtained from the environment with almost no cost is shredded and added into ordinary concrete to examine the strength behaviour of various specimens.

**KEYWORD- Concrete, Rigid Pavement, Polyethylene Terephthalate (PET) Fibres,**

## INTRODUCTION
This project deals with the possibility of using the fibres obtained from waste PET bottles as the partial replacement of aggregate in Portland cement to construct rigid pavements. The Polyethylene Terephthalate (PET) reinforced concrete is of significant use in the construction of rigid pavement for bush roads leading to mines and in forest areas for lumbering activities. The terrain makes it difficult and uneconomical to use steel as reinforcement because of undulating terrain and meandering alignment. Hence it makes sense logistically and economically to use fibre reinforced concrete. Steel fibres are the most commonly used fibres for reinforcement; however their use in pavement might be detrimental to the performance of tires. Therefore, PET fibres present an efficient solution for such specific needs. PET fibre-reinforced concrete was applied to a bush road between Hayatogawa and Kanazawa, Kanagawa Prefecture, Japan.

### *A. Ordinary Portland Cement:*
Ordinary Portland cement (53-grade) confirming to BIS, IS: 12269 was used. The 53-grade means the average compressive strength of cement is 53 N/mm2 after 28 days of curing; this cement is normally used for structural & nonstructural building purposes. Cement used was ordinary Portland cement of Grade 53 meeting the requirement of Indian Standard (IS 8112- 1989). It should be free from lumps and fresh. Specific gravity of cement was 3.15.

### *B. Specific Gravity and Water Absorption of Fine Aggregate*
The two tests are conducted together. The Specific Gravity of aggregate is an indirect measure of its strength. The higher the specific gravity, the denser the rock is and stronger is the aggregate. Similarly, Water absorption depends on the pores and void age in the rock. The more the water absorption, higher the void age. Some rocks are adversely affected in their strength when water enters the material and softens it. Laterite is a good example.

### *C. Sieve Analysis Test*

The fineness modulus is a mere number representing the cumulative percentage of weights retained on various sieves. The larger the fineness modulus, coarser is the aggregate. The sum of cumulative percentage of weight retained divided by 100 is known as the fineness modulus of aggregate. The test consists of the simple operation of dividing aggregate into fraction, each consisting of particles of the same size. The sieves used for the test have square openings. Sieves are described by the sizes of their openings as 80 mm, 63 mm, 50 mm, 40 mm, 25 mm, 20 mm, 16 mm, 12.5 mm, 10 mm, 6.3 mm, 4.75 mm, 3.35 mm, 2.36 mm, 1.70 mm, 1.18 mm, 850µm, 600µm, 425µm, 300µm, 212µm, 150µm, 75µm. All the sieves are mounted in frames one above the other in ascending order.

### *D. Specific Gravity and Water Absorption of Coarse Aggregate*

The two tests are conducted together. The Specific Gravity of aggregate is an indirect measure of its strength. The higher the specific gravity, the denser the rock is and stronger is the aggregate. Similarly, Water absorption depends on the pores and void age in the rock. The more the water absorption, higher the void age. Some rocks are adversely affected in their strength when water enters the material and softens it. Laterite is a good example. The Bulk specific gravity of aggregates varies from 1.9 to 3.0. Those with the values above 2.5 are generally good. Aggregates having water absorption above 1.0% are unsatisfactory, for use in wearing courses while those having water absorption over 2.0% are considered unsatisfactory for use in base courses.

## METHODOLOGY

In this study, PET waste 0%, 1%, 2%, & 3% of traditional fine aggregate is replaced for M30 grade concrete. The replacement percent is by weight of total aggregate content derived from the mixture proportioned. Cube specimens of size 150 mm x 150 mm × 150 mm, cylinder specimens of 150 mm diameter and 300 mm height and beam specimens of size 100 mm × 100 mm ×500 mm of 2 numbers each were casted for different proportions with PET bottles (grounded) and compared against a control mixture.

## RESULTS

It was observed that the compressive strength increased for 1% replacement of the fine aggregate with PET bottle fibres and then decreased by a small quantity for 2% replacement. The decrease in compressive strength was significant for 3% replacement.

**Table 1: Test Results of Compressive Strength of cubes**

| No. of days/ Percentage | 0% | 1% | 2% | 3% |
|---|---|---|---|---|
| **7 days (N/$mm^2$ )** | 10.32 | 14.49 | 16.16 | 6.15 |
| **28 days (N/$mm^2$ )** | 35.45 | 48.32 | 46.49 | 18.39 |

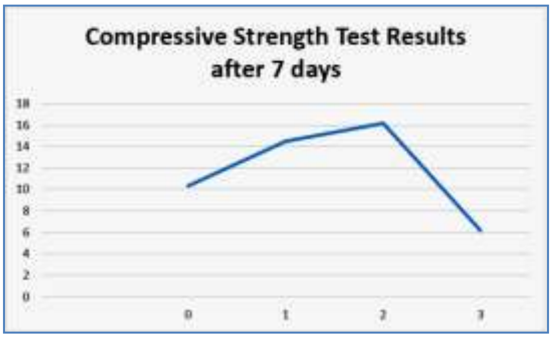


*Fig. 1: Compressive Strength Test Results after 7 days*


*Fig. 2: Compressive Strength Test Results after 28 days*

**Table 2: Test Results of Split Tensile Strength of cylinders**

| No. of days/ Percentage | 0% | 1% | 2% | 3% |
|---|---|---|---|---|
| **7 days (N/$mm^2$ )** | 0.96 | 2.44 | 2.83 | 2.05 |
| **28 days (N/$mm^2$)** | 2.6 | 3.298 | 2.975 | 2.78 |

The split tensile strength increased for 1% replacement of the fine aggregate with PET bottle fibres and decreased gradually thereafter.

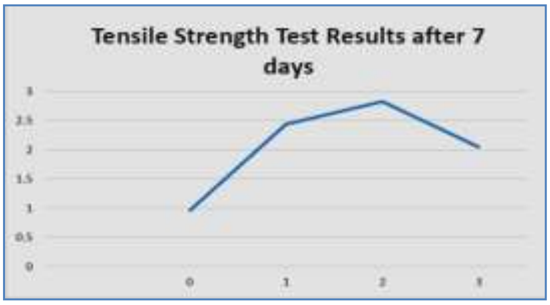


*Fig. 3: Tensile Strength Test Results after 7 days*

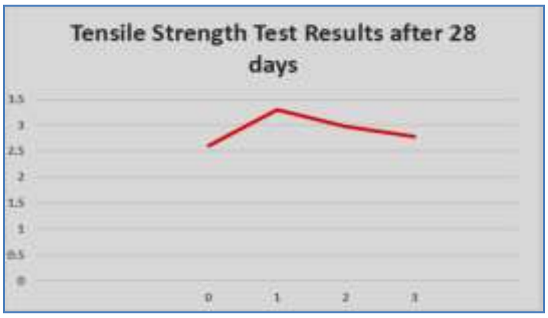


*Fig. 4: Tensile Strength Test Results after 28 days*

**Table 3: Test Results of Flexural Strength of beams**

| No. of days/ Percentage | 0% | 1% | 2% | 3% |
|---|---|---|---|---|
| **7 days** (N/$mm^2$) | 6.28 | 7.11 | 9.56 | 9.27 |
| **28 days** (N/$mm^2$) | 17.658 | 27.07 | 12.875 | 12.11 |

It was observed that the flexural strength increased for 1% replacement of the fine aggregate with PET bottle fibers and the n decreased sharply for 2% and 3% replacement.

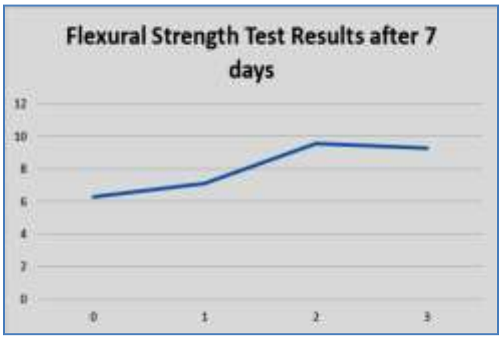


**Fig. 5: Flexural Strength Test Results after 7 days**

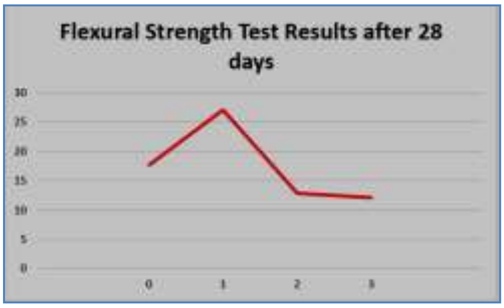


***Fig. 6: Flexural Strength Test Results after 28 days***

## CONCLUSION

It was observed that the compressive strength increased for 1% replacement of the fine aggregate with PET bottle fibres and then decreased by a small quantity for 2% replacement. The decrease in compressive strength was significant for 3% replacement. The split tensile strength increased for 1% replacement of the fine aggregate with PET bottle fibres and decreased gradually thereafter.

It was observed that the flexural strength increased for 1% replacement of the fine aggregate with PET bottle fibers and the n decreased sharply for 2% and 3% replacement. Hence, the replacement of the fine aggregate with 1% of PET bottle fibres will be reasonable than other replacement percentages like 2% and 3% as the compression , flexural and split tensile strength are maximum for 1% replacement.

## REFERENCES

1. "Experimental Research On Concrete with Straight And Crimpled Waste Plastic Fibre." Asha S, Resmi P.R.
2. Ms. K.Ramadevi, Ms. R. Manju , " Experimental Investigation On Properties of Concrete with Plastic (Bottle) Fibres as Fine Aggregates.
3. Concrete Technology, By M.S. Shetty
4. Rajarajeshwari B Vibhuti1, Radhakrishna2, Aravind N , "Mechanical Properties Of Hybrid Fiber Reinforced Concrete For Pavements".
5. " Experimental Investigations on The Flexural Strength of PET Reinforced Concrete" by M. L. Anoop Kumar (Lecturer in Civil Engineering, Govt. Polytechnic, Dept. of Technical Education, A.P., India), Dr. I. V. Ramana Reddy (Professor, Dept. of Civil Engineering, S.V.University College of Engineering, Tirupati, India), Dr. C. Sasidhar (Professor, Dept. of Civil Engineering, JNT University College of Engineering, Anantapuramu, India)