International Journal of Recent Trends in Engineering & Research
ISSN (ONLINE) : 2455 – 1457
IMPACT FACTOR : 4.101

An Experimental Investigation on Use of Polymeric Waste Materials for Rigid Pavements

[1]Diwanshu Yadav,[2] Deepak Mathur
[1]M.Tech Scholar ,Department of Civil Engineering Kautilya Institute of Technology & Engineering,Jaipur
[2]Assistant professor, Department of Civil Engineering Kautilya Institute of Technology & Engineering,Jaipur

Abstract-Concrete is strong in compression but weak in tension and brittle also. Cracks also start forming as soon as the concrete is placed. Polyethylene is a synthetic hydrocarbon polymer which can improve the ductility, strength, shrinkage characteristics etc. This paper deals with the effects of addition of polyethylene fiber on the properties of concrete. Polyethylene and tire fibers were cut into the size of 30mm x 6mm and they were used 1.5% each by volume. Grade of concrete used were M30, M35 and M40. IRC 44:2008 was followed for the design of concrete mix. In this study, the results of the Strength properties of Polyethylene fiber reinforced concrete have been presented. 4 point bending test and double shear test were performed in the laboratory for flexure and shear strength determinations. There was seen an increase of 18% in the 28 day compressive strength along with an increase of 39% in flexure and 32% in shear strength. 22% decrease in 4 point bending test and 36% decrease in double shear test in deflection was found out from the experiments. Theoretical analysis of deflection was carried out by the help of energy methods. Practical values were verified with the theoretical values within the permissible limits. Finally it can be concluded that polyethylene and tire can be used effectively in reinforced cement concrete.

Keywords:-concrete, waste material, polyethylene, synthetic hydrocarbon polymer

I. INTRODUCTION

The present work is aimed at using two polymeric waste materials, such as polyethylene and tire fibers as reinforcement in concrete pavement. The basic objective of this work is to assess the advantages of using such waste materials such as increase in compressive, flexure and shear strength and decrease in deflection characteristics of the resultant concrete and also the determination of the deflection in the laboratory testing then its comparison to the theoretical deflection and check whether the errors are in the permissible limits of 20%.The main goal of the study is to utilize waste materials polyethylene and tire to achieve greater concrete strength properties in order to recycle them into something very useful and helping in reducing the environmental impact that the both of them have.

II. LITERATURE REVIEW

Under a static, dynamic or impact load, the energy absorption capacity of material is measured through fracture toughness .Post-cracking behavior of concrete beam is checked at mid span by determining the deflection for fracture toughness. There have been made many studies over the effects of toughness on fiber type, dosage, properties, and bonding conditions. These affects can further be found in ACI 544 and other literatures are also available. Conventional reinforcement such as steel is provided in the concrete because it fails in tension. Similarly due to very good ductile and toughness properties fibers can also be inducted into the concrete as reinforcement in order to improve the tensile resisting capacity of the concrete by redistributing the stress concentration

.Studies done on concrete to understand this stress redistribution result that crack surface is the surface in the concrete matrix where fibers restrain cracks. There are 3 regions of stress redistribution which are - traction free zone where much larger crack openings are found with respect to the other zones, fiber 6 bridge zone where frictional slip of fiber is responsible for stress transfer and micro-macro crack growth zones where interlock between aggregates is found to have transferred the stress.

III. MATERIALS

1. Cement:

Cement is described s a material with adhesive and cohesive properties that make it capable of linking ore fragments into a compact whole. It covers a wide range of material cementing. For the purpose of the construction of the meaning of the term is restricted to the cement binder used with rock, sand, bricks, blocks, etc. The main components of thisTypes of lime cement compounds, resulting in construction and civil engineering connected with calcareous cement. The cement has low water adjustments in property by the chemical reaction of the liberation of heat of hydration. Named as hydraulic cement.

2. Water:

Are the main ingredients which, when mixed with cement to form a paste that unifies the addition? Water must be pure in order to avoid side reactions that occurred that this may weaken the concrete, the role of water cement ratio of water is important because it is the most important factor in the production of concrete ' perfect '.

3. Sand:

The sand is a natural material that is available that consists of rock and mineral particles. In a different size, but the size of the sand must pass through the sieve 1.18 mm. It must be free of impurities in the form of vegetation and gravel. Some of the inert material likes sand, water or ash and surkhi lubricants, pastes so plastic in nature; This paste is known as mortar.

4. Methodology

To study the various parameters of polymeric fiber reinforce concrete that affect the service life of a pavement with minimal maintenance, the following experiments are needed to be carried out:

1. Test of aggregates
   a. Abrasion resistance of aggregates
   b. Impact resistance of aggregates
   c. Crushing resistance of aggregates

2. Test of concrete
   a. Physical inspection of concrete
   b. 28 day compressive strength test
   c. Flexural strength test
   d. Shear strength test

The flexural strength test to be conducted is *2-point load test (4-point bend test)* and the shear strength test to be conducted is *double shear test*.

IV. RESULT ANALYSIS

The values of deflection are calculated theoretically and the obtained values are compared with the values obtained in the respective experiments. Some standard values are taken into consideration:

1. Poisson's ratio (μ) = 0.2

2. Modulus of elasticity (E) = 5000 √fck Where fck = characteristic strength of concrete
So for M30, E=27386.13 MPa
M35, E =29580.40 MPa
M40, E = 31622.77 MPa

Table 5.1: Theoretical and experimental deflection of conventional concrete

GRADE OF CONCRETE	SPECIMEN NO.	FAILURE LOAD (KN)	THEORETICAL DEFLECTION (mm)	EXPERIMENTAL DEFLECTION (mm)
M30	1	5.41	0.093	0.088
	2	5.5	0.0945	0.091
	3	5.6	0.096	0.091
M35	1	5.66	0.0915	0.086
	2	5.57	0.090	0.086
	3	5.76	0.0915	0.083
M40	1	5.77	0.090	0.079
	2	5.65	0.0855	0.077
	3	5.91	0.090	0.076

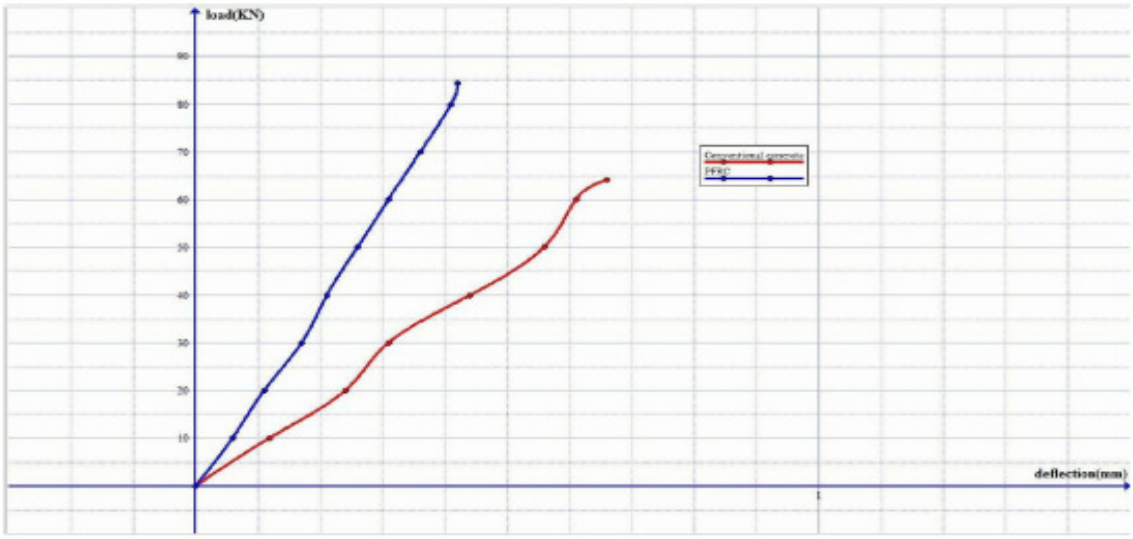

Fig-4.3(b): Double shear test Load vs Deflection for M30 concrete

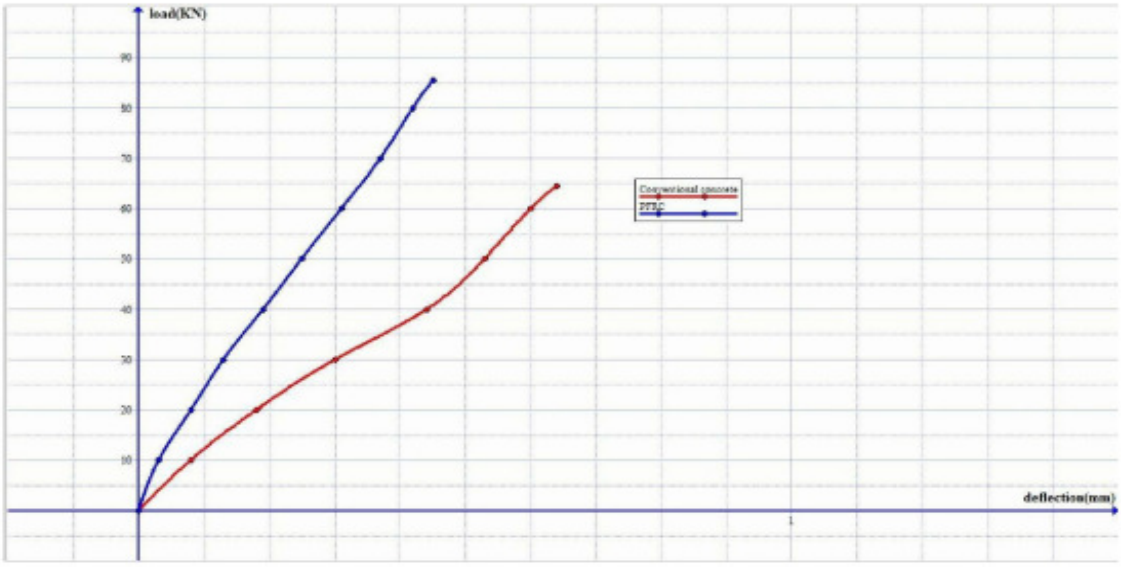

Fig-4.3(c): Double shear test Load vs Deflection for M35 concrete

Fig-4.3(d): Double shear test Load vs Deflection for M40 concrete

V. CONCLUSION

1. There is a gain of 17.93%, 15.98% and 16.1% in compressive strength of M30, M35 and M40 grade concrete respectively. Again in flexural strength were found to be 37.34%, 39.70% and 39.66% for M30, M35, and M40 respectively. And respective reduction in deflection were 22.22%, 23.53% and 20.78%.

2. There is a significant amount of gain found in shear strength. Gain in shear strength were found to be 31.33%, 32.56% and 32.72% for M30, M35, and M40 respectively. And respective reduction in deflection were 38.69%, 36.23% and 33.75%.

3. From the above observations it can be seen that the gain in flexural strength is more than gain in shear strength. However the center point deflection due to shear force is much more reduced than deflection due to flexure.

4. From theoretical analysis of results it is observed in case of 4-point bend test that the percentage of variation of deflection in fiber introduced concrete is much higher than that of conventional concrete and it goes on increasing with increase in characteristic strength for both conventional concrete and fiber introduced concrete.

REFERENCES

1. ACI Committee 544, State-of-The-Art Report on Fiber Reinforced Concrete, ACI 544 1.R-96. Retrieved May 10, 2015, from http://www.forta-ferro.com/pdfs/5441r_96.pdf.
2. Vasani, P., & Mehta, B. (n.d.). Ductility requirements for buildings. Retrieved May10, 2015, from https://www.sefindia.org/?q=system/files/Ductility-1.pdf.
3. Fracture Toughness. (n.d.). Retrieved May 10, 2015, from https://www.ndeed.org/EducationResources/CommunityCollege/Materials/Mechanical/Fr actureToughness.
4. Ronald F. Zollo (1997) 'Fiber-reinforced Concrete: an Overview after 30 Years ofDevelopment' Cement and Concrete Composites, Vol.19, pp.107-122.
5. Balaguru P.N and Shah S.P (1992) 'Fiber Reinforced Cement Composites' McGraw Hill,In., New York.
6. IS 456 – 2000 'Indian Standard Code of Practice for Plain and Reinforced Concrete', 4th revision, Bureau of Indian Standards, New Delhi – 110 002.
7. IRC 44 2008 'Guidelines for Cement Concrete Mix Design for Pavements', 2nd revision, Indian Roads Congress, New Delhi – 110 002. (2008). Retrieved on May 10, 2015, from http://www.scribd.com/doc/52635635/IRC-44-2008#scribd.

