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Research on Utilization of Polymer Waste for Road Pavement Concrete

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ABSTRACT

Concrete is brittle and low stress, but pressure resistant. In addition, cracks will appear as soon as the concrete is poured. These three deficiencies prevent the use of regular concrete for sidewalks. Using fibers as reinforcement in concrete mixes can reduce these defects in concrete. Tires and waste polyethylene cause environmental pollution and cause various health problems. Both used tires and polyethylene can be recycled and used as fiber reinforcement in concrete. A synthetic hydrocarbon polymer called polyethylene can have improved ductility, strength, shrinkage properties, and other properties. The effect of polyethylene fiber addition on concrete properties is the subject of this essay. Both tire fiber and polyethylene are used after being cut into 30mm x 6mm with a volume fraction of 1.5%. Concrete grades M30, M35 and M40 were used. IRC 44:2008 was used to design the concrete mix. In this study, results of strength properties of polyethylene fiber reinforced concrete are presented. A four-point bending test and a double shear test were performed in the laboratory to measure the bending strength and shear strength.

Keywords: Concrete, polyethylene waste, fibre, polymer, Cement.

INTRODUCTION

For developing countries like India, the road network plays a key role in providing durability and comfort to vehicles. The pavement is mostly made of bitumen. However, in certain situations, concrete paving is also preferred. Many additives have been investigated for the beneficial use of concrete as a paving material. Recent studies have shown that fiber reinforced concrete (FRC) has very good strength and other desirable properties, making it suitable for use in pavement construction [25]. The FRC definition given by ACI Commission 544 is, "Fiber concrete is concrete made from cement containing fine and coarse aggregates together with water to obtain cementitious properties and discontinuous fibers." [1]. The fibers used are of different types such as steel fibres, polymers or natural fibres [5 and 6]. As mentioned earlier, fiber-reinforced concrete is a form of concrete in which fibers are placed in the concrete as reinforcement to improve the concrete's strength and other mechanical properties. Fiber concrete is not only intended for local tension reinforcement, but also helps achieve increased compression and tension along with reduced deformation and shrinkage and increased ductility [3, 4 , 13, 14, 15, 16, and 25]. In addition to the above properties, polymer fibers also help reduce corrosion. Traditionally for FRC he has used Recron 3s, polyester and polypropylene. These days, other forms of recycled fibers are being used for the same purpose, such as plastics, waste tires, carpet waste, and textile industrial waste. The basic function of these fibers is to act as a tear barrier. The fibers prevent small cracks from developing into larger cracks. [4、13、14、16].

LITERATURE REVIEW

Fiber concrete (FRC) is made by mixing polymer fibers into a conventional concrete mix. The definition of FRC by ACI Commission 544 is:

Role of polymers in pavement

The pavement quality needs to be improved as steadily increasing wheel loads, changing climatic conditions, tire pressure, and daily wear and tear affect the performance of vehicles on the pavement [28]. Synthetic polymer fibers can be used to overcome the above problems faced in daily life. Modification of concrete with polymers can improve crack resistance, fatigue life, and many other mechanical properties of pavements [28].

Polymer fibers as an alternative to conventional reinforcement

Textiles are known to have first been used by the ancient Egyptians in 1500 BC. was used for These people used animal hair not only to reinforce adobe bricks, but also on the walls of their dwellings [6]. Various studies provide an overview of the development stages of fiber-reinforced concrete. In the 1960s, polymer fibers were taken seriously for use in reinforced concrete, and they picked up speed from there [5].

Types of fiber reinforced concrete

ACI classifies fiber reinforced concrete into four categories: SFRC, GFRC and SNFRC.
NFC. SFRC is an acronym for Steel Fiber Reinforced Concrete, GFRC is Glass Fiber Reinforced Concrete, SNFRC is Synthetic Fiber Reinforced Concrete, and NFRC is Natural Fiber Reinforced Concrete. Many theoretical and practical insights on various design applications and physical and mechanical properties are also described [1]. Another classification system adopted by the Cement and Concrete Institute classifies fibers into glass, steel, synthetic and natural fibers [2].

Synthetic fiber

Synthetic fibers include polyethylene, polypropylene, acrylic, carbon, aramid, nylon, and polyester [2]. Synthetic fibers can be further classified into macrofibers and microfibers. These two subtypes have different characteristics from each other. As reinforcement used tires in the form of polyethylene and macrofibers. The selected size is 30mm x 6mm.

Fiber Properties

The effects of fibers of all kinds have been studied by many researchers. We studied the physical properties as well as the mechanical properties of concrete. However, little research has been done on polyethylene fiber reinforced concrete and waste tire fiber reinforced concrete. Knowledge of these fibers as reinforcement in concrete is limited.

Other Properties

Fiber reinforcement reduces premature shrinkage and drying shrinkage of concrete. Concrete fibers trap microcracks and prevent them from turning into macrocracks too early [12, 19, 20, 21, 22, 23, 24]. Concrete reinforced with 2-4% by volume polyethylene fibers exhibits a linear deformation curve until the first crack occurs, but loads are transferred to the fibers until they break [2].

BASE MATERIALS

Basic materials

The basic materials which compose concrete are:

1. Water
2. Cement
3. Fine aggregate
4. Coarse aggregate
5. Admixture

In case of polymer fiber reinforced concrete fibers are added. For this experiment 2 types of fiber are chosen. The fibers to be used in the concrete mix are:

1. Polyethylene fiber
2. Tire (Nylon) fiber

Waste resources will be used to create both of the fibres that will be used in the concrete matrix. Although leftover tyres will be utilised to manufacture nylon fibre, leftover OMFED milk sachets will be used to create polyethylene fibre.

METHODOLOGY

To study the various parameters of polymeric fiber reinforce concrete that affect the service life ofa 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
c. Flexural strength test
d. Shear strength test

CONCLUSIONS

The following conclusions were drawn from experiments performed on concrete with polyethylene and tire fibers.

1. The compressive strength of concrete grades M30, M35 and M40 increases by 17.93%, 15.98% and 16.1% respectively.
2. The increase in bending strength was 37.34%, 39.70% and 39.66% for M30, M35 and M40 respectively. Also, the respective reductions in deflection were 22.22%, 23.53%, and 20.78%.
3. Significantly improved shear strength. The increase in shear strength was found to be 31.33%, 32.56% and 32.72% for M30, M35 and M40 respectively. Also, the respective reductions in deflection were 38.69%, 36.23%, and 33.75%.
4. From the above observations, we can see that the increase in flexural strength is greater than the increase in shear strength. However, center deflection due to shear is much less than deflection due to bending.
5. However, for the double shear test, we find that the deflection variation rate of fiber-reinforced concrete is almost the same as that of conventional concrete, which continues to increase with increasing characteristic strength for conventional concrete and decreases for fiber. . - Reinforced concrete beams.
6. The deflection variability for conventional concrete is 12.19%, 17.86% and 19.5% for M30, M35 and M40 respectively, and 16.98%, 13.72% and 10.41% for fiber reinforced concrete.

From the above, it can be concluded that discarded polyethylene and tire fibers can be put to good use to positively influence the mechanical properties of fiber-reinforced concrete.

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