A Study On Use Of Polyethylene Fibers And Tire Fibers In Concrete Blocks

Munim Mushtaq, Punit Verma

Abstract: As we grasp that Concrete is forceful in pressure however weak in strain and firm too. Splits start establishing from the period concrete is expressed sited. A few drawbacks in concrete don't permit the utilization of normal concrete in various constructional func-
tions as they lead to nonexistence of flexibility alongside break and disappointment. These obscurity in cement can be uninvolved by expending fibers as support in the solid combination. Non-biodegradable squanders like polyethylene and tires cause biological contamina-
tion which lead to different wellbeing hitches. Polyethylene and overabundance tires can be reused and utilized solidly in the solid as fortification as fiber. Polyethylene is a fake hydrocarbon polymer which can upsurge the flexibility, quality, shrinkage physiognomies and so forth. This paper the home-work is done about the outcome of expansion of Polyethylene fiber on the benefits of cement. Polyethylene and tire strands where cut into the different and disconnected sizes and they were utilized in concrete. Assessment of cement utilized were M.30, M.35. IRC 44: 2008 was shadowed for the technique of solid blend. In this preparation, the aftereffects of the quality assets of Polyethylene fiber strengthened cement have been advertised. Four bowing test and offer test were done in lab for flexure and shear quality reason.

INTRODUCTION

For a forming country, for example, India, constructional structures exceptionally rely on the blocks and solid squares and so forth. These days solid squares are most habitually utilized in building expansion. These squares are just comprised of solid blend. Numerous glues can be utilized to expand the nature of solid squares. An unending has shown that the fortitude underwired concrete (FRC) can be exploited for expansion of solid thwarts as it is bare generally excellent in eminence and it likewise parades other striking schattels. Fiber strengthened cement isn't just for procurement of neighborhood quality in pliable district however it additionally helps in increasing compressive strength and side by side it likewise helps in decrease in deflection character. In early times, various kinds of reused filaments like plastic, arranged levels, diverse wastes from material ventures are in like manner being utilized for a comparable explanation. Key limit of these strands is to go about as break safe. Strands help in contradicting the minor breaks and would not allow them to form into full scale parts. Greater quality all things considered, filaments in blended in with bond which aides in improving early properties like shrinkage parting, diminished water ingestion, redesigned flexural quality and rigid nature of concrete and in like manner shields the strong from drying shrinkage breaks. Usage of superfluous polyethylene and waste tires. Plastics has stretched all around rapidly and it has transformed into a run of the mill penchant for folks to just fling out the pliable and instigating the standard contaminating. More than 1 billion tons of malleable have been bore meanwhile 1950s, and the equal is daintily to remain in that limit with regards to quite a while. These wastes are fundamentally hurled making sullyng the social order.

2 Objectives

The fundamental target of this work is to survey the upsides of utilizing such waste materials,
1. Determine compressive strength.
2. Determine flexure strength.
3. Determine shear strength.
4. Determine Decrease in deflection qualities of the resultant cement.

BASIC MATERIALS

Elementary resources
The elementary resources cast-off in concrete are:
(a) Water
(b) Cements
(c) Fine aggregate
(d) Coarse aggregate
(e) Admixture
(f) Fibers

In instance of polymer fiber bounded concrete fibers are added. For this exploration two types of fibers are preferred. Fibers used are:
Polyethylene fibers

Tire fibers
Both fibers are reserved to be used in concrete that is to use it matrix. The matrix will be made which will include waste constituents of tires and polythene. The waste pure of KHY-BER milk will be used for assembly polyethylene fibers although waste tires will be used to devise nylon fiber.
Polyethylene used

Methodology
To get educated through the various constraints of polymeric fiber reinforced concrete that disturb the service life of a concrete blocks. The following tryouts are desired to be carried out:

Test of aggregates
- Abrasion resistance of aggregates
- Impact resistance of aggregates
- Crushing resistance of aggregates

Test of concrete
- 28 days compressive strength test
- Flexural test
- Shear Strength test

Tests on aggregates
Abrasion resistance of aggregates
The loss angles abrasion test is directed to analyze the abrasion resistance of uneven aggregates.
In this trial
Weight of sample = W1 = 5kg or 5000 grams.
Weight of fines passed 1.7 mm sieve = W2 = 1170 gram.
So LAAV = \( \frac{W2}{W1} \) *100
= \( \frac{1170}{5000} \) *100
= 23.4%

Impact resistance test
The impact value test is led to quinate the resistance of the aggregates in the direction of impact load.
In this experiment
Weight of sample = W1 = 341 gram
Weight of sample passing 2.36 mm = W2 = 75.3 gram
So, the impact value = \( \frac{W2}{W1} \) *100
= \( \frac{75.3}{341} \) *100
= 22.05

Crushing resistance of aggregates
The crushing resistance test of aggregates is led to measure the resistance of the aggregates in the direction of crushing load.
In this trial
Weight of sample = W1 = 362 grams
Weight of fines passing 2.63 mm = W2 = 75.1 grams
So, impact value = \( \frac{W2}{W1} \) *100
= \( \frac{75.1}{362} \) *100
= 20.7
Mix design
The percentage of concrete mix is to be planned in such a way that it guarantees the workability of concrete. And it must give concrete that compulsory strength, toughness and durability at the hardened conditions.

- The design mix is M30, M35 are carried out.
- The stipulations of ingredients used are:
  - Cement – OPC 43 grade
  - Fine aggregates
  - Coarse aggregates crushed rocks (10mm and 20mm)
  - Admixture plasticizer
  - The water cement proportion for design was elected in amongst 0.4 to 0.45.
  - The coarse aggregates 10mm and 20mm are used in share of 90 to 10.
  - In case of fiber introduced concrete, the polyethylene fibers and tire fibers each are used in 0.5%, 1.0% both with respect to weight of concrete block.

<table>
<thead>
<tr>
<th>Los Angeles Abrasion test</th>
<th>Impact value test</th>
<th>Crushing value test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum value permissible in fiber reinforced concrete = 30%</td>
<td>Maximum value acceptable in fiber reinforced concrete = 45%</td>
<td>Maximum value allowable in fiber reinforced concrete = 30 %</td>
</tr>
<tr>
<td>Trial outcome value = 23.4 %</td>
<td>Trial outcome value = 22.05%</td>
<td>Trial outcome value = 20.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concrete grades</th>
<th>Water</th>
<th>Cement</th>
<th>Fine aggregates</th>
<th>Coarse aggregates (10mm)</th>
<th>Coarse aggregates (20mm)</th>
<th>Admixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>M30</td>
<td>0.43</td>
<td>01</td>
<td>2.21</td>
<td>3.04</td>
<td>0.32</td>
<td>0.015</td>
</tr>
<tr>
<td>M35</td>
<td>0.41</td>
<td>01</td>
<td>1.77</td>
<td>2.7</td>
<td>0.38</td>
<td>0.019</td>
</tr>
</tbody>
</table>
Size of the concrete blocks chosen:
Although there are different types of concrete blocks such as:
75mm*200*400mm,
100mm*200mm*400mm,
200mm*200mm*400mm
Size of concrete block used here in compression test is:
75mm*100mm*400mm

Weight of this concrete block = 28

Amount of fibers used:
When 0.5% fiber was used then the weight of polyethylene fiber was 60 grams and weight of tire fiber was 80 grams.
When 1.0% fiber was used then the weight of polyethylene was 135 grams and weight of tire fiber was 145 grams.

Tests on concrete
Compressive strength test
It is the utmost extreme essential preliminary test to be done on solids as it encourages in depicting the trademark qualities of solids which gives the show down of solids in split of pulverizing load. Preliminary it is done for both costumery cement and as well as and also or fiber reinforced cement after days. tried for compressive strength in the compression testing machine. Trial is completed for both conventional concrete and fiber reinforced concrete block Specimens after 28 day.

strength was calculated by formulation.
\[ f_{ck} = \frac{P}{A} \]
Where P = failure load
A = area on which load is applied
100mm*400mm
40000mm²
compressive strength of conventional concrete blocks

<table>
<thead>
<tr>
<th>Grade of concrete</th>
<th>Failure load(tons)</th>
<th>Compressive strength (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M30</td>
<td>127</td>
<td>31.75</td>
</tr>
<tr>
<td>M35</td>
<td>145</td>
<td>36.25</td>
</tr>
</tbody>
</table>

compressive strength of fiber reinforced concrete blocks with 0.5% of fiber.

<table>
<thead>
<tr>
<th>Grade of concrete</th>
<th>Percentage of fiber</th>
<th>Failure load(tons)</th>
<th>Compressive strength (N/mm²)</th>
<th>Strength gain w.r.t conventional concrete blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>M30</td>
<td>0.5</td>
<td>139</td>
<td>34.75</td>
<td>9.44%</td>
</tr>
<tr>
<td>M35</td>
<td>0.5</td>
<td>159</td>
<td>39.75</td>
<td>9.6%</td>
</tr>
</tbody>
</table>

compressive strength of fiber reinforced concrete blocks with 1.0% of fiber.

<table>
<thead>
<tr>
<th>Grade of concrete</th>
<th>Percentage of fiber</th>
<th>Failure load</th>
<th>Compressive strength (N/mm²)</th>
<th>Strength gain w.r.t conventional concrete blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>M30</td>
<td>1.0</td>
<td>143</td>
<td>35.75</td>
<td>12.44%</td>
</tr>
<tr>
<td>M35</td>
<td>1.0</td>
<td>168</td>
<td>42.0</td>
<td>15.86%</td>
</tr>
</tbody>
</table>

4-Point bend test (2-Point load test)
The flexural quality is one the very pinnacle of key resources of cement blocks. The flexural quality is flexural vigor exemplifies the opposition presented by concrete toward bowing. The threw squares are tried for flexural quality in 4-Point twist test machine. The flexural strength of block is resulted utilizing formula:

\[
\sigma = \frac{pl}{bd^2}
\]

Where \( p \) = load applied  
\( l \) = effective span= 400 mm  
\( b \) = width of specimen = 100 mm  
\( d \) = depth of specimen = 75 mm  
Weight of Block = 17kg
When 0.5% of fiber is used then the weight of polyethylene fiber used is 40 gram and weight of tire fiber used is 45 grams.

When 1.0% of fiber is used then the weight of polyethylene fiber used is 80 gram and weight of fiber used is 90 grams.

*Flexural Strength and strength gain in 4-point bent test.*

<table>
<thead>
<tr>
<th>Types of concrete</th>
<th>Grade of concrete</th>
<th>Failure load (kn)</th>
<th>Flexural strength (n/mm²)</th>
<th>Percentage of strength gain W.r.t Conventional concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional concrete</td>
<td>M30</td>
<td>5.37</td>
<td>3.8</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>M35</td>
<td>5.47</td>
<td>4.001</td>
<td>-</td>
</tr>
<tr>
<td>Fiber reinforced concrete</td>
<td>M30 (0.5%) fibers added</td>
<td>7.30</td>
<td>5.1</td>
<td>30.76</td>
</tr>
<tr>
<td></td>
<td>M35 (0.5%) fibers added</td>
<td>7.90</td>
<td>5.61</td>
<td>38.51</td>
</tr>
<tr>
<td></td>
<td>M30 (1.0%) fibers added</td>
<td>7.71</td>
<td>5.48</td>
<td>40.5</td>
</tr>
<tr>
<td></td>
<td>M35 (1.0%) fibers added</td>
<td>8.10</td>
<td>5.76</td>
<td>42.2</td>
</tr>
</tbody>
</table>

*Deflection character in 4. bent test* 

<table>
<thead>
<tr>
<th>Type of concrete</th>
<th>Grade of concrete</th>
<th>Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional concrete</td>
<td>M30</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>M35</td>
<td>0.07</td>
</tr>
<tr>
<td>Fiber reinforced concrete</td>
<td>M30(0.5)</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>M35(0.5)</td>
<td>0.064</td>
</tr>
<tr>
<td></td>
<td>M30(1.0)</td>
<td>0.059</td>
</tr>
<tr>
<td></td>
<td>M35(1.0)</td>
<td>0.57</td>
</tr>
</tbody>
</table>

*Double shear test*

Shear quality is one the very pinnacle of crucial characters of cement. The shear quality of cement encapsulates the power of opposition exhibited by the solid on the way to shear force which is applied on concrete. The squares which are casted are experienced for shear quality in pressure testing apparatus with certain given criteria. The shear of squares is resulted utilizing equation

\[ \tau = \frac{p}{bd} \]

Where \( p \) = load applied
L = length = 400 mm
b = width = 100 mm
d = depth = 75 mm

The weight of block of this size is approx. equal to 24 kg therefore amount of fiber used is: when 0.5% of fiber is used then 55 grams of polyethylene used and 65 grams of tire fiber is used. When 1.0% of fiber is used then 115 grams of polyethylene and 125 grams of tire fiber is used.

Shear strength and strength gain in shear strength test.

<table>
<thead>
<tr>
<th>Types of concrete</th>
<th>Grade of concrete</th>
<th>Failure load (kn)</th>
<th>Shear strength (n/mm²)</th>
<th>Percentage of Strength gain w.r.t Conventional Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional concrete</td>
<td>M30</td>
<td>65.01</td>
<td>8.63</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>M35</td>
<td>65.53</td>
<td>8.701</td>
<td>-</td>
</tr>
<tr>
<td>Fiber reinforced concrete</td>
<td>M30 (0.5%) fibers added</td>
<td>85.21</td>
<td>11.36</td>
<td>30.87</td>
</tr>
<tr>
<td></td>
<td>M35 (0.5%) fibers added</td>
<td>86.32</td>
<td>11.50</td>
<td>31.57</td>
</tr>
<tr>
<td></td>
<td>M30 (1.0%) fibers added</td>
<td>87.72</td>
<td>11.69</td>
<td>34.6</td>
</tr>
<tr>
<td></td>
<td>M35 (1.0%) fibers added</td>
<td>88.92</td>
<td>11.85</td>
<td>35.5</td>
</tr>
</tbody>
</table>

Deflection character in shear test.

<table>
<thead>
<tr>
<th>Type of concrete</th>
<th>Grade of concrete</th>
<th>Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional concrete</td>
<td>M30</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>M35</td>
<td>0.68</td>
</tr>
<tr>
<td>Fiber reinforced concrete</td>
<td>M30(0.5)</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td>M35(0.5)</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td>M30(1.0)</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>M35(1.0)</td>
<td>0.41</td>
</tr>
</tbody>
</table>

Discussion and conclusion

Discussion where polyethylene and tire products are increasing day by day, there is also increase in the environmental pollution. As these products are non-biodegradable and hence highly
pollute environment. Use of non-biodegradable substances like waste polyethylene and tires is an economical and environmentally friendly approach in terms of field of transportation. Also, the steel fibers which are used in concrete have less weight, non-corrosive in nature are used in concrete effectively. These two materials when together used in concrete fulfill some of the important requirements of concrete as well as reduce the pollution of environment. By use of these two materials in concrete it significantly increases the strength of concrete to some extent. The materials help in increase in compressive strength, flexural strength, and shear strength of concrete. It also helps concrete in increase its toughness and reduce its deflection character, which concrete shows when put under external loads.

conclusions
These results have been drawn from the experiments done on concrete with polyethylene and tire fibers.

Compressive strength:
When 0.5% of fiber is added with concrete mix then the strength gain with respect to conventional concrete is given as
M30 (strength gain) = 23.2%
M35 (strength gain) = 12.44%
When 1.0% of fiber is added with concrete mix then the strength gain with respect to conventional concrete is given as
M30 (strength gain) = 38%
M35 (strength gain) = 21%

Flexural strength:
When 0.5% of fiber is added with concrete mix then the strength gain with respect to conventional concrete is given as
M30 (strength gain) = 9.44%
M35 (strength gain) = 12.59%
When 1.0% of fiber is added with concrete mix then the strength gain with respect to conventional concrete is given as
M30 (strength gain) = 9.6%
M35 (strength gain) = 15.86%
Shear strength
When 0.5% of fiber is added with concrete mix then the strength gain with respect to conventional concrete is given as
M30 (strength gain) = 30.87
M35 (strength gain) = 31.57
When 1.0% of fiber is added with concrete mix then the strength gain with respect to conventional concrete is given as
M30 (strength gain) = 34.6%
M35 (strength gain) = 35.5%
Deflection character
There is also a significant decrease in the deflection character of the concrete blocks when fiber is added to them. From above noted results it can be clearly said that waste polyethylene and tire fibers can be used effectively to positively influence the mechanical properties of the fiber reinforced concrete.

References