Development of High Strength Concrete by using Industrial Iron Waste

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Abstract

High strength concrete is being adopted by engineers and designers worldwide. Most of the applications of high strength concrete have been found in high rise buildings, long span bridges etc. Iron is generally used as resistance of cracking and strengthening of concrete. In this project, we are going to carry out test on industrial iron waste reinforced concrete to check the compressive strength, flexural strength, split tensile strength. According to various research papers, it has been found that iron waste give the maximum strength in comparison to other waste. Hence, in this paper presents experimental study in finding out the optimum quantity of iron waste required to achieve the maximum flexural strength, compressive strength, split tensile strength for M25 grade concrete. Iron waste content was varied by 1.0%, 1.5% and 2.0% by volume of cement. Also comprised of preparing concrete cubes, beams and cylinders with and without iron waste for checking compressive strength, flexural strength and split tensile test. All the specimens were cured for the period of 7, 14 and 28 days. Before castling all specimens slump test was adopted to measure the workability of concrete. Hence a project work is planned to check the suitability of use of Industrial iron waste in developing High strength cement concrete.

Keywords: Compressive Strength, Industrial Iron Waste, Tensile Strength, Flexural Strength, High Strength Concrete

I. INTRODUCTION

Concrete is most frequently used man made material in the world. It is durable, inexpensive and readily moldable into complicated shapes and has good compressive strength and stiffness. However it has low tensile strength, low ductility and low energy absorption. Due to its lack of tensile strength, it is reinforced with reinforcement bars or mesh (rebar) in structures (carrying traffic load, spanning a void or bearing another structure such as a wall) but this kind of reinforcement in the form of polymeric fibers, steel or glass fibers are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. Some types of fibers produce greater impact, abrasion and shatter resistance in concrete. Generally fibers do not increase the flexural strength of concrete and so cannot replace moment resisting or structural steel reinforcement. Indeed, some fibers actually reduce the strength of concrete. Iron waste reinforced concrete may be defined as a material made with Portland cement, aggregates and industrial iron waste. Iron waste is usually used in concrete to control cracking due to both plastic shrinkage and drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding water.

A. Industrial Iron Waste

The rapid growth of iron and steel used in industries as a row material on other side utilization and disposal of iron waste among the more important are iron dust and spiral iron waste. Fairly satisfactory processes for the utilization of certain waste have been in operation for years, but improvements are desired. The extended researches which have resulted in methods and processes for utilisation of iron waste. The industrial iron waste use in making a high strength concrete for buildings, thin concrete pipes, road pavements etc. we use industrial waste like iron powder and spiral wires these byproducts can be used as partial replacement of sand in concrete. Investigation done in India and abroad indicated that mechanical properties of concrete have improved when spiral and powder of iron were used as partial replacement of sand in specified percentages. In additional use of these byproducts as partial replacement of sand will reduce the consumption of sand in the construction industry thus preserving more of these natural resources. Recycling of these by products and using them in concrete will reduces health hazards impact and reduce the permeability of concrete. When iron dust and spiral iron waste is mixed with cement and aggregate they reacts a good binding material.

B. Benefits of using of iron waste in concrete

Improve ductility, resistance to explosive in case of a severe fire, impact resistance and abrasion resistance, plastic shrinkage during curing, structural strength, pumpability over long distances.
C. Experimental Investigation

In Investigation concrete mix include Portland cement, sand, iron powder, iron spiral, coarse aggregates, superplasticizer and water. We prepare concrete cubes of size 150mm X 150mm X 150mm were used to test compressive strength of concrete. The beams and cylinders of size 700mm X 150mm X 150mm. and 150mm dia. And 300mm height were used to test the flexural strength and split tensile strength respectively. Specimens casted in two separate batches, first is with iron powder and iron spiral as partial replaced with sand and second batch will be without iron powder and iron spiral replacement. All the specimens were cured for the period of 7, 14 and 28 days. Before casting all specimens slump test was adopted to measure the workability of concrete.

Experimental Test Results of concrete with iron waste as partial replacement with sand

<table>
<thead>
<tr>
<th>Sample Designation</th>
<th>% of iron waste</th>
<th>Compressive Strength of Cube Specimens in Mpa.</th>
<th>7 days</th>
<th>14 days</th>
<th>28 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-25</td>
<td>1.00</td>
<td>15.60</td>
<td>20.11</td>
<td>32.22</td>
<td></td>
</tr>
<tr>
<td>M-25</td>
<td>1.50</td>
<td>18.77</td>
<td>20.88</td>
<td>35.10</td>
<td></td>
</tr>
<tr>
<td>M-25</td>
<td>2.00</td>
<td>23.32</td>
<td>26.20</td>
<td>39.40</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1: Graph showing variations in compressive strengths replaced with iron waste at 7, 14 & 28 days

The compressive strengths were increasing with the increase in the replacement content of iron waste

<table>
<thead>
<tr>
<th>Sample Designation</th>
<th>% of iron waste</th>
<th>Split Tensile Strength of Cylinder Specimens in Mpa.</th>
<th>7 days</th>
<th>14 days</th>
<th>28 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-25</td>
<td>1.00</td>
<td>6.26</td>
<td>7.25</td>
<td>9.30</td>
<td></td>
</tr>
<tr>
<td>M-25</td>
<td>1.50</td>
<td>6.30</td>
<td>8.10</td>
<td>10.29</td>
<td></td>
</tr>
<tr>
<td>M-25</td>
<td>2.00</td>
<td>6.38</td>
<td>8.56</td>
<td>11.26</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 2: Graph showing variations in Split Tensile strength of Cylinder Specimens replaced with Iron waste at 7, 14 & 28 days
Table - 3
Flexural Strength of Beams replaced with Iron waste at 7, 14 & 28 days

<table>
<thead>
<tr>
<th>Sample Designation</th>
<th>% of Iron waste</th>
<th>Flexural Strength of Beam Specimens in Mpa.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7 days</td>
</tr>
<tr>
<td>M-25</td>
<td>1.0</td>
<td>10.14</td>
</tr>
<tr>
<td>M-25</td>
<td>1.5</td>
<td>11.20</td>
</tr>
<tr>
<td>M-25</td>
<td>2.0</td>
<td>12.05</td>
</tr>
</tbody>
</table>

Fig. 3: Graph showing variations in Flexural Strength of Beams replaced with Iron waste at 7, 14 & 28 days.

D. Experimental Test Results of ordinary concrete

Table - 4
Compressive Strength of cubes without Iron waste at 7, 14 & 28 days

<table>
<thead>
<tr>
<th>Sample Designation</th>
<th>Compressive Strength of Beam Specimens in Mpa.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7 days</td>
</tr>
<tr>
<td>M-25</td>
<td>12.14</td>
</tr>
</tbody>
</table>

Fig. 4: Graph showing variations in Compressive Strengths of ordinary concrete at 7, 14 and 28 days.

Table - 5
Split Tensile Strength of cylinder specimen without Iron waste at 7, 14 & 28 days

<table>
<thead>
<tr>
<th>Sample Designation</th>
<th>Split Tensile Strength of Cylinder Specimens in Mpa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7 days</td>
</tr>
<tr>
<td>M-25</td>
<td>5.23</td>
</tr>
</tbody>
</table>
Development of High Strength Concrete by using Industrial Iron Waste

Fig. 5: Graph showing variations in Split Tensile Strength of ordinary concrete at 7, 14 and 28 days.

![Graph showing variations in Split Tensile Strength of ordinary concrete at 7, 14 and 28 days.](image)

Table - 6

<table>
<thead>
<tr>
<th>Sample Designation</th>
<th>Flexural Strength of Beam Specimens in Mpa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7 days</td>
</tr>
<tr>
<td>M-25</td>
<td>8.40</td>
</tr>
</tbody>
</table>

Fig. 6: Graph showing variations in Flexural Strength of Beams with ordinary concrete at 7, 14 & 28 days

![Graph showing variations in Flexural Strength of Beams with ordinary concrete at 7, 14 & 28 days.](image)

II. CONCLUSIONS

The following are the conclusions drawn from various experimental results reported from this work:

1) Industrial Iron waste can be successfully used as a mineral admixture for replacement of Sand.

2) The compressive strength values were found to be slightly higher when compared with the ordinary concrete.

3) The trial mix M-25 i.e 1% replacement of Iron waste along with super-plasticizer gave the compressive strength up to 32.22 MPa, which is more than that of designed M25 grade compressive strength.

4) The other trial mixes M-25 i.e replacement levels of Iron waste viz. 1.5% and 2.0%, the compressive strength values were found to be increasing with the increase in the percentage replacement of Industrial iron waste which was tested after 28 days of curing.

5) The percentage increase in compressive strength when compared with ordinary concrete for the replacement of Iron waste were 1.89%, 2.27% and 2.83% respectively for the trail mixed M-25 after 7 days of curing.
6) The percentage increase in compressive strength when compared with ordinary concrete for the replacement of Iron waste were 3.78%, 3.92% and 4.92% respectively for the trail mixed M-25 after 14 days of curing.

7) The percentage increase in compressive strength when compared with ordinary concrete for the replacement of Iron waste were 8.10%, 8.83% and 9.91% respectively for the trail mixed M-25 after 28 days of curing.

8) The Splitting tensile strength values were found to be slightly increased when compared with the ordinary concrete.

9) The Trail mixed M-25 i.e replacement levels iron waste viz., 1.0%, 1.5% and 2.0% the Splitting tensile strength values were found to be increasing with the increase in the percentage replacement of the iron waste which were tested after 28 days of curing.

10) The percentage increase in Splitting tensile strength when compared with ordinary concrete for the replacement of iron waste were 0.32%, 0.33% and 0.34% respectively for the trail mixed M-25 after 7 days of curing.

11) The percentage increase in Splitting tensile strength when compared with ordinary concrete for the replacement of iron waste were 0.49%, 0.55% and 0.58% respectively for the trail mixed M-25 after 14 days of curing.

12) The percentage increase in Splitting tensile strength when compared with ordinary concrete for the replacement of iron waste were 0.82%, 0.91% and 1.0% respectively for the trail mixed M-25 after 28 days of curing.

13) The Flexural strength values were found to be slightly increased when compared with the ordinary concrete.

14) The percentage increase in Flexural strength when compared with ordinary concrete for the replacement of iron waste were respectively for the trail mixed M-25 after 28 days of curing.

15) The percentage increase in Flexural strength when compared with ordinary concrete for the replacement of Iron waste were 0.85%, 0.94% and 1.0% respectively for the trail mixed M-25 after 7 days of curing.

16) The percentage increase in Flexural strength when compared with ordinary concrete for the replacement of Iron waste were 1.3%, 1.4% and 1.69% respectively for the trail mixed M-25 after 14 days of curing.

17) The percentage increase in Flexural strength when compared with ordinary concrete for the replacement of Iron waste were 2.12%, 2.32% and 2.46% respectively for the trail mixed M-25 after 28 days of curing.

18) 2.0% of iron waste is sufficient for maximum compressive strength for M-25 concrete after 14 days of curing

REFERENCES


