Investigation Study on Geo-Polymer Concrete

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Abstract - Now a day in a fast-moving world, we don’t want to do the work for a long time, and we are not using the materials with one benefit, so we are looking into the material which has more than one benefits. A new material is created to make more efficient and looking for less limitations in it. Many research is going on new material innovation. geo-polymer concrete is one of the new materials. It is widely used in many construction fields. Normally the geo-polymer concrete has many advantages in it. The permeability in the geo-polymer concrete is less because the air voids present in the concrete is very less as compared to the conventional concrete. Now we can see the properties, merits & demerits, manufacturing process and areas where the geo-polymer concrete are used.

INTRODUCTION

Geo-polymer concrete is one of the new construction materials. It becomes more famous in recent years because of its advantages. The geo-polymer concrete is highly environmentally friendly as compared to the normal conventional concrete. The geo-polymer concrete is made by reacting aluminate and silicate bearing materials with a caustic activator. Fly ash and slag from iron and metal production are used in geo-polymer. It will increase the properties of the geo-polymer concrete and in other hand it will clean the environment. Geo-polymer concrete does not require heat to make it and it will not produce any harmful gases like carbon dioxide. But in normal conventional concrete requires heat to make it and it will also emit harmful gases like carbon dioxides. We have to add element, or the substance require for the geo-polymer concrete, fly ash from thermal power plant, GGBS from steel plant, Fine aggregate and coarse aggregate and alkaline activator solution. This substance should be mixed in the proper mix ratio.

OBJECTIVES

The geo-polymer concrete is compared to the conventional concrete and we can find many advantages in geo-polymer concrete.

• The geo-polymer concrete does not require heat to make it, but the conventional concrete requires heat.
• The geo-polymer concrete will not emit any harmful gases, but the conventional concrete will emit harmful gases.
• The geo-polymer is very small in size it can fill the air voids present in the concrete so, the permeability of the concrete will get reduced.
• The cost of the geo-polymer concrete is economic.

When we use geo-polymer concrete there is no change in the strength and properties. We have only advantage in using geo-polymer concrete as compared to the normal conventional concrete. It is also more environmentally friendly as compared to the normal conventional concrete.

METHODOLOGY

1. Study of geo-polymer concrete
2. Material collection
3. Manufacturing of geo-polymer concrete
4. Test on geo-polymer concrete
5. Conclusion
Study of geo-polymer concrete:
The general knowledge about the geo-polymer concrete is very much important and the chemical substance present in the geo-polymer and what are the reaction may occur in the geo-polymer should be studied and properties of the geo-polymer and manufacture of the geo-polymer should be known. Everything about the geo-polymer like the reaction of the geo-polymer at different temperature should be well. Every information will help us to apply the geo-polymer at different problems and application.

\[
n(\text{SiO}_2 \text{Al}_2 \text{O}_3) + 2n\text{SiO}_2 + 4n\text{H}_2\text{O} \rightarrow n\text{OH}_2\text{SiO}_2\text{Al}_2\text{O}_3\text{Si}_n\text{H}_2\text{O} + n\text{H}_2\text{O}
\]

Material collection
The following materials are required to produce geo-polymer concrete:
- Fly ash from thermal power plant.
- GGBS from steel plant.
- Fine aggregate and coarse aggregate.
- Alkaline activator solution.

Manufacturing of geo-polymer
The manufacturing of geo-polymer concrete is made by, in one hand mix fly ash, GGBS & metakaolin. In other hand prepare the alkaline solution by mixing sodium or potassium silicate and sodium or potassium hydroxide. Then mix both the substance with coarse aggregate and fine aggregate. Then curing is done by use of oven or at ambient temperature. Finally, we get the geo-polymer concrete.

Test on geo-polymer concrete

<table>
<thead>
<tr>
<th>Compressive strength</th>
<th>Geo-polymer Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaline/Fly Ash Ratio</td>
<td>0.55</td>
</tr>
<tr>
<td>Sieve Designation particle size range (mm)</td>
<td>½” - 1” (12.5 – 25)</td>
</tr>
<tr>
<td>% by Mass</td>
<td></td>
</tr>
<tr>
<td>Fly Ash</td>
<td>16.67 %</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>24.50 %</td>
</tr>
<tr>
<td>Coarse Aggregates</td>
<td>45.50 %</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>2.62 %</td>
</tr>
<tr>
<td>Sodium Silicate</td>
<td>6.54 %</td>
</tr>
<tr>
<td>Added Water</td>
<td>4.17 %</td>
</tr>
<tr>
<td>Total Percentage (%)</td>
<td>100 %</td>
</tr>
</tbody>
</table>

The compressive strength of geo-polymer concrete is compared with the normal conventional concrete and at the end of 28 days there is not much difference in the strength of concrete for both geo-polymer concrete and conventional concrete. The geo-polymer concrete is made at the mix ratio that has given above. The conventional concrete is made with the use of M45 grade cement.

Formula:

\[
\text{Compressive Strength of Concrete} = \frac{\text{Max Load Carried by Specimen}}{\text{Top Surface Area of Specimen}}
\]

<table>
<thead>
<tr>
<th>S.No</th>
<th>7 Days</th>
<th>14 Days</th>
<th>21 Days</th>
<th>28 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional concrete</td>
<td>18</td>
<td>29.25</td>
<td>40.5</td>
<td>45</td>
</tr>
<tr>
<td>Geo-polymer concrete</td>
<td>20</td>
<td>30</td>
<td>41</td>
<td>45.13</td>
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</tbody>
</table>
Chart

Sorptivity, Porosity and Water absorption

<table>
<thead>
<tr>
<th>Concrete type</th>
<th>f_c (MPa)</th>
<th>E_c (MPa)</th>
<th>(\varepsilon)</th>
<th>Density (kg/m(^3))</th>
<th>Water absorption (%)</th>
<th>AVPV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fly ash control</td>
<td>49.51</td>
<td>30093.02</td>
<td>0.00217</td>
<td>2463.87</td>
<td>3.51</td>
<td>8.64</td>
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<tr>
<td>Fly ash sodium chloride</td>
<td>47.37</td>
<td>29542.34</td>
<td>0.00241</td>
<td>2268.38</td>
<td>2.28</td>
<td>5.98</td>
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<tr>
<td>Fly ash sodium sulphate</td>
<td>42.88</td>
<td>27119.94</td>
<td>0.00203</td>
<td>2250.04</td>
<td>3.72</td>
<td>9.14</td>
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<td>Fly ash sodium sulphate + magnesium sulphate</td>
<td>46.95</td>
<td>30278.87</td>
<td>0.00184</td>
<td>2183.67</td>
<td>3.37</td>
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<tr>
<td>Fly ash sulphuric acid</td>
<td>44.12</td>
<td>34572.66</td>
<td>0.00170</td>
<td>2169.28</td>
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<td>GLSS control</td>
<td>34.20</td>
<td>28880.28</td>
<td>0.00171</td>
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<td>GLSS sodium chloride</td>
<td>32.78</td>
<td>29707.30</td>
<td>0.00173</td>
<td>2435.80</td>
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<td>GLSS sodium sulphate</td>
<td>30.01</td>
<td>28028.48</td>
<td>0.00197</td>
<td>2413.90</td>
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<td>GLSS sodium sulphate + magnesium sulphate</td>
<td>32.91</td>
<td>28146.79</td>
<td>0.00158</td>
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<td>3.00</td>
<td>9.14</td>
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<tr>
<td>GLSS sulphuric acid</td>
<td>31.72</td>
<td>29977.94</td>
<td>0.00170</td>
<td>2311.48</td>
<td>3.22</td>
<td>10.08</td>
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<tr>
<td>OPC control</td>
<td>71.06</td>
<td>42900.28</td>
<td>0.00192</td>
<td>2344.40</td>
<td>2.44</td>
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<td>OPC sodium chloride</td>
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<td>0.00246</td>
<td>2340.11</td>
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<tr>
<td>OPC sodium sulphate</td>
<td>60.12</td>
<td>41319.13</td>
<td>0.00204</td>
<td>2342.23</td>
<td>2.16</td>
<td>6.92</td>
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<tr>
<td>OPC sulphuric acid</td>
<td>52.17</td>
<td>39698.47</td>
<td>0.00193</td>
<td>2326.58</td>
<td>2.93</td>
<td>9.31</td>
</tr>
</tbody>
</table>

**CONCLUSION**

- The colour of the geo-polymer concrete is light in colour and the surface is more smooth than normal conventional concrete.
- The compressive strength of the specimens are depends upon the curing temperature and method of curing influences.
- The compressive strength of the geo-polymer concrete can be increased by the addition of 40% of GGBS.
- There is no mix-design for the Geo-polymer concrete, so we have to look into many outcomes.
of the test make by different cement at different ratio.

REFERENCE


