STUDY OF COMPRESSIVE STRENGTH OF BLENDED NANO FLYASH PPC CEMENT MORTAR

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ABSTRACT: Change in the surface energy, surface chemistry, and surface morphology of the particle by reducing the size of particles to nano provides an exceptional surface area-to-volume ratio and, which can be possible by altering its basic properties and reactivity. Here the recent progresses in material science with their use in various concrete researches are discussed. Nano-engineered concrete can be synthesized by incorporating Nano-sized building blocks or objects (e.g., nanoparticles and nanotubes) to control the behaviour of the material and adds novel properties by grafting molecules onto cement particles, and aggregates. Mechanical performances of a variety of materials are being influenced by this, including metals, polymers, ceramic, and concrete composites. Nano fly-ash for example, has been shown to improve workability and strength in concrete in this paper. Substitute material is named so because its particles possess size in both Nanolevel which was obtained from particle size analysis data. Further this sample is authenticated by compressive strength, SEM, XRD, acid test, alkalinity test and testing of cubes in salt water was done.

Here the strength properties of cement mortars with Nano-fly ash were experimentally studied. The rate of the reaction is proportional to the amount of surface area available for reaction. Therefore, it is plausible to add Nano-fly ash particles in order to make high-performance concrete. In this study cement is substituted with Nano-fly ash at (2%, 4%, 6% & 8% by weight) the result from the experiment shows that the compressive strengths of mortars with 6% Nano-fly ash particle is highest than those of plain cement mortars and maximum among the blended specimens at 7 and 28 days. Also it was found that the resistant towards acid and alkali is maximum in case of 6% nano flyash intringed mortar samples. It is demonstrated that the Nano incorporated particles are more valuable in enhancing strength. The results of these experiments indicate that Nano scale fly ash behaves not only as a filler to improve microstructure, but also as an element to enhance the compressive strength. It makes the construction process quick and economical.

1. INTRODUCTION

Various products generated from the Cement industry consists cement as well as releases different harmful waste into the environment which is harmful for us. The pollution may be reduced by reducing the use of cement to some extent, which indirectly reduces its production. As we know without cement concrete structures are impossible, so cement can be blended with different supplementary cementitious material to form blended cement and can be used instead of cement. Supplementary cementitious materials are those materials which are added in concrete as a part of the total cementitious component reducing the amount of cement to be used. It also helps to increase the strength of the concrete from normal to higher strength. Some of the supplementary cementitious materials such as fly-ash, micro-silica, Nano lime, Nano TiO2, Nano Fe2O3 , Nano CaCO3, Nano Al2O3 GGBS (ground granulated blast furnace slag), carbon nanotubes, calcinated shale’s and many more are those which are generally blended with cement which contributes to the chemical and physical properties.

In this experiment cement is replaced with Nano sized flyash at (2%,4%,6% & 8%),by weight respectively which reduces the voids in concrete increasing the compressive strength and enhancing different physical properties. Nano sized fly-ash possesses size around 10-9 m which makes the concrete or mortar void free. This also decreases the absorption of water in mortar and concrete.

In the recent years researchers have started using nano particles in concrete industry as admixtures to improve its strength. Nano aluminium oxide, Nano Iron oxide ,Nano zinc oxide, Nano slag, Nano silica and Nano fly ash are used in concrete .undoubtedly its production is costly but it provides better strength .from the literatures it is clear that using Nano particle in concrete mechanical
properties as well as microstructure of the specimen has been improved. Most of the researchers had done a small quantity Nano sized admixtures because of its higher cost of production.

1.1. OBJECTIVE OF PRESENT STUDY

The specific objectives of the present study are as below.
1. Preparation of nano fly ash by grinding 15hrs in ball mill.
3. Various tests to analyse the compressive strength, water absorption test, durability test.
4. For study of microstructure XRD and SEM test is to be performed.
5. Casting of mortar specimens with 2%, 4%, 6%, 8% replacement with nano fly ash
6. Study the influence of compressive strength of various cement mortars with different percentage (2%, 4%, 6%, 8%) by using Nano fly-ash as partial replacement of cement at 7days, 14 days, 28 days, 56 days respectively.
7. To study the water absorption tests of various n-FA mortar samples having (2, 4, 6 and 8) % of Nano fly-ash as partial replacement with cement at 28 days.

2. EXPERIMENTAL WORK

2.1. PREPARATION OF NANO FLYASH

The attempt has been made to modify the micro sized fly ash into nano structured fly ash using High Energy Ball Mill. The smooth, glassy and an inert surface of the fly ash can be altered to a rough and more reactive state by this technique. Dry Ball milling was carried out for the total duration of 15 hours. The sample was taken out after every 5 hours of milling for characterizing. The nano structured fly ash was characterized for its crystallite size, lattice strain and percentage of crystallinity by using X-Ray Diffractometer. It was found that for the 10 hrs milling, the crystallite size was reduced from 92 nm to 29 nm and the percentage of crystallinity got reduced from 63% to 38%. The size, shape and texture of the fresh as well as nano structured fly ash were studied using Scanning Electron Microscopy (SEM).

2.2. CEMENT

Cement used in the experimental work is PORTLAND POZZOLANA CEMENT (PPC) conforming to IS: 1489.1.1981

2.3. N-FLY ASH

Here fly ash in terms of nano Fly ash is used as filling element in cement mortar as well as to improve the strength properties.

2.4. FINE AGGREGATE

In this project all types of casting of mortar specimens were made using Indian standard sand of three grades of equal quantities.

2.5. WATER

Clean and portable water free from colour and odour and normal pH value was used in this project for casting and curing of samples.

2.6. PREPARATION OF NANO MORTAR SPECIMEN

Using standard mix proportion of 1:3 the mortars samples prepared as per IS 2386(part 6):1963 using standard specimen cubes of size 7.06 cm, for compression testing of the specimens. n-FA were added at percentages of (2, 4, 6, 8) % respectively. These samples were cured for 7 days, 28 days and 56 days before test.

2.7. COMpressive STRENGTH

Sample prepared for the compression strength test is listed as below.

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Sample code</th>
<th>Cement in gm per cube</th>
<th>% of n-FA added</th>
<th>Sand in gm per cube</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N</td>
<td>200</td>
<td>0</td>
<td>600</td>
</tr>
<tr>
<td>2</td>
<td>N2</td>
<td>196</td>
<td>2</td>
<td>600</td>
</tr>
<tr>
<td>3</td>
<td>N4</td>
<td>192</td>
<td>4</td>
<td>600</td>
</tr>
<tr>
<td>4</td>
<td>N6</td>
<td>188</td>
<td>6</td>
<td>600</td>
</tr>
<tr>
<td>5</td>
<td>N8</td>
<td>184</td>
<td>8</td>
<td>600</td>
</tr>
</tbody>
</table>

3. RESULTS AND DISCUSSION

3.1. SEM OF NANO FLYASH

The surface morphology and the grain sizes was determined by this and results were determined in the figures given below.
Fig 2. SEM of bulk FA

Fig 3. Image of 15Hr grind nano FA sample.

Fig 4. Image of 0% nano flyash added mortar sample.

Fig 5. Image of 2% nano flyash added mortar sample.

Fig 6. Image of 4% nano flyash added mortar sample.

Fig 7. Image of 6% nano flyash added mortar sample.

Fig 8. Image of 8% nano flyash added mortar sample.

3.2. XRD
The X-ray technique was used to determine the particle size and percentage of crystallinity of the samples.

Fig 9. XRD plot for cube specimens having 0% nano flyash

Fig 10. XRD plot for cube specimens having 6% nano flyash

3.3. COMPRESSIVE STRENGTH

Compressive strength of the prepared specimens were determined in the laboratory using compression testing machine and the results were analysed below.

<table>
<thead>
<tr>
<th>No of cubes</th>
<th>Cube Size in cm²</th>
<th>% of nano flyash in mortar</th>
<th>28 DAYS strength in(Mpa)</th>
<th>56 DAYS strength in(Mpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>49.9</td>
<td>0</td>
<td>31.463</td>
<td>42.345</td>
</tr>
<tr>
<td>M2</td>
<td>49.9</td>
<td>2</td>
<td>30.842</td>
<td>41.692</td>
</tr>
<tr>
<td>M4</td>
<td>49.9</td>
<td>4</td>
<td>33.006</td>
<td>41.333</td>
</tr>
</tbody>
</table>

Water absorption test of cubes

<table>
<thead>
<tr>
<th>Name of sample</th>
<th>% Water Absorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>1.170</td>
</tr>
<tr>
<td>M2</td>
<td>1.230</td>
</tr>
<tr>
<td>M4</td>
<td>1.001</td>
</tr>
<tr>
<td>M6</td>
<td>0.899</td>
</tr>
<tr>
<td>M8</td>
<td>0.986</td>
</tr>
</tbody>
</table>
thanked all those who have directly or indirectly helped in completion of this work. Beside all this I am grateful to LARPMB labs (CIPET) for determination of XRD and SEM of samples.

5. REFERENCE


Table 2. Compressive Strength of cube at 28 and 56 days.

<table>
<thead>
<tr>
<th>Mortar</th>
<th>28 Days</th>
<th>56 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6</td>
<td>49.9</td>
<td>42.255</td>
</tr>
<tr>
<td>M8</td>
<td>49.9</td>
<td>37.595</td>
</tr>
</tbody>
</table>

Table 3. Water absorption relation of samples at 28 days.

4. CONCLUSION

1. The compressive strength of 2%, 4%, 6%, 8% nano mortar specimens was found out at, 28 days, 56 days respectively.
2. The increase in compressive strength of 6% nano mortar specimens was found out to be highest among all the proportions of nano mortar specimens at 28 days, 56 days respectively.
3. From the table of water absorption it is clear that PPC mortar sample having 6 percent of nano fly ash possess least water absorption capacity.

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5. REFERENCE

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