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# EFFECT OF RECYCLED COARSE AGGREGATE ON WORKABILITY ON GEOPOLYMER CONCRETE

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**Abstract: -** Geopolymers are new materials for fire and heat-resistant coatings and adhesives, medicinal applications, high-temperature ceramics, new binders for fire-resistant fiber composites, toxic and radioactive waste encapsulation and new cements for concrete.[1] In this study Recycled coarse aggregate (Waste material) was used for the replacement of conventional coarse aggregates to find out the possible best replacement of conventional coarse aggregate. From the study it indicates that replacement by Recycled Coarse Aggregate is reducing the workability of Geopolymer concrete.

**Keywords:** Fly Ash, recycled coarse aggregate, Geopolymer Concrete, alkaline solution

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## INTRODUCTION

Geopolymers are novel materials intended for fire and heat-resistant coatings and adhesives, medicinal applications, high-temperature ceramics, novel binders for fire-resistant fiber composites, toxic and radioactive waste encapsulation and novel cements for concrete [2].

The properties and utilize of geopolymers are being explored in numerous scientific and industrial disciplines: recent inorganic chemistry, physical chemistry, colloid chemistry, mineralogy, geology, and in further types of engineering practice technologies.

Geopolymers are division of polymer science, chemistry and technology that forms one of the most important areas of materials science. Polymers are either organic material, i.e. carbon-based, or inorganic polymer, for example silicon-based.

The organic polymers comprise the classes of natural polymers (rubber, cellulose), synthetic organic polymers (textile fibers, plastics, films, elastomers, etc.) and natural biopolymers (biology, medicine, pharmacy) [3]. Raw materials used in the synthesis of silicon-based polymers are mainly rock-forming minerals of geological origin [4].

**Materials:**

***a. Fly ash***

Fly ash used in this study was unprocessed fly ash from torrent power plant (locally available). The whole quantity of fly ash was obtained from one batch. Later, Fly ash was used in small proportions in mass concreting for dams and other hydraulic.

**Table 1: Physical Properties of low calcium class F Fly Ash**

| Physical properties | Properties of fly ash used | Properties of fly ash according to IS 1320-1981 |
|---|---|---|
| Specific gravity | 2.52 | - |
| Initial setting time | 120 minutes | - |
| Final setting time | 280 minutes | - |
| Fineness specific surface in m2/ kg min | 310 | 345 |
| Lime reactivity Avg compressive strength | 4.10 | 6.320 |

***b. Course Aggregates & Fine aggregate***

Locally available crushed stones of 10 mm and 20 mm aggregates were used as coarse aggregates. Local river sand was used as fine aggregate in the concrete mixtures.

***c. Alkaline Solution as binder materials***

The alkaline liquid used was a combination of sodium silicate solution and sodium hydroxide solution. The sodium silicate solution (NaOH = 15.38%, $Na_2SiO3$ = 46, 15%, and water = 38.46% by mass) was purchased from a local supplier in bulk. The sodium hydroxide (NaOH) in flakes or pellets from with 97%-98% purity was also purchased from a local supplier in bulk. The NaOH solids were dissolved in water to make the solution. To make alkaline solution first of all to prepare 10 M solution 400 grams of NaOH are dissolved in 1000 gm of water than 1200 grams of $Na_2SiO_3$ are added in dissolved solution. Then this solution kept as it for 24 hours at normal room temperature.

***d.* Recycled Coarse aggregate**

Recycled coarse aggregate were taken from the debris which is demolished building having grade of M20.

**Mix Proportion:**

**Table 1-Mix Design**

| Mix Design | Fly Ash(kg) | Fine Aggregate(kg) | Coarse Aggregate(kg) | Alkaline Solution | Recycled Coarse Aggregate (kg) | % of Replacement |
|---|---|---|---|---|---|---|
| M0 | 503.47 | 554.07 | 1212.44 | 449.56 | 0 | 0 |
| M1 | 503.47 | 554.07 | 1091.196 | 449.56 | 121.244 | 10% |
| M2 | 503.47 | 554.07 | 969.952 | 449.56 | 242.488 | 20% |
| M3 | 503.47 | 554.07 | 848.708 | 449.56 | 363.732 | 30% |
| M4 | 503.47 | 554.07 | 727.464 | 449.56 | 484.976 | 40% |
| M5 | 503.47 | 554.07 | 606.22 | 449.56 | 606.22 | 50% |

**Workability Tests**

**a) Slump Test:**

To determine the workability of concrete mix by slump test conducted by as per IS 1199-1959. The internal surface of the mould thoroughly cleaned and freed from superfluous moisture than mould placed on a smooth, horizontal, rigid and nonabsorbent surface. The mould was filled in four layers, each approximately one-quarter of the height of the mould. Each layer was tamped with twenty-five strokes of the rounded end of the tamping rod. The bottom layer tamped throughout its depth. After the top layer has been rodded, the concrete was struck off level with a trowel or the tamping rod, so that the mould is exactly filled. The mould removed from the concrete immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to subside and the slump shall be measured immediately by determining the difference between the height of the mould and that of the highest point of the specimen being tested.

**Fig. – 2 Slump Test**

**b) Compaction Factor Test:**

The concrete was placed gently in upper hopper, using the hand scoop. The hopper was filled level with its brim and trap door was opened so concrete falls in to lower hopper. Than the trapdoor of second hopper was opened and concrete was allowed to fall in cylinder. The excess concrete above the top of cylinder was removed by towel. The weight of concrete was measured and compare that with the weight of concrete was fully compacted in same cylinder and the ratio of both known as compaction factor.

**Fig. – 3 Compaction Factor Test**

**Result:**

**(Table 2-Slump test results)**

| Mix Proportion | Slump(mm) |
|---|---|
| M0 | 128 |
| M1 | 124 |
| M2 | 119 |
| M3 | 112 |
| M4 | 106 |
| M5 | 101 |

**(Table 3-C.F. Test results)**

| Mix Proportion | C.F. |
|---|---|
| **M0** | 0.96 |
| **M1** | 0.96 |
| **M2** | 0.96 |
| **M3** | 0.95 |
| **M4** | 0.95 |
| **M5** | 0.95 |

**CONCLUSION:**

In this study of replacement of coarse aggregates with Recycled Coarse Aggregate, we got maximum workability when replacement percentage is zero and minimum workability when replacement percentage is 50. Replacement of coarse aggregates with Recycled Coarse Aggregate will reduce the workability of Concrete. Increase in the percentage of replacement of aggregate will decrease the workability of Geopolymer concrete.

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