Experimental Investigations on Chloride Permeability and Strength Properties of Concrete using Alccofine

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Abstract. This paper presents the test examination done on porousness qualities of solid utilizing "Alccofine". The evaluation picked for the examination was M-20 evaluation of cement concrete. The variety was concentrated on the examples exposed to solidify supplanted by different rates of alccofine (0, 10, 12, 14 and 16 rates separately). Casted examples are relieved in climatic temperature and solidified properties of cement are tried at 7 and 28 days and RCPT was led at 28 and 35 days and the outcomes acquired are looked at. The test outcomes show that the specimen permits 2000 to 4000 Coulombs giving medium rating according to ASTM 1202. The RCPT esteems show improved opposition for chloride penetrability and low pace of consumption chance level.

1. Introduction

The alccofine is a uniquely prepared item dependent on high glass slag content with high reactivity acquired through the controlled granulation process. Owing prompts its extraordinary science and ultra-fine molecule size and shape turns into the alccofine gives a prerequisite of solid execution for quality and sturdiness [1]. Alccofine can likewise be used as a high range water reducer (HRWR) because of the expanding the compressive quality and flexural quality. The alccofine (ultra fine slag) is to deliver a high quality cement [2]. The alccofine is for the most part utilized in two unique manners as an in part concrete substitution, so as to diminish the concrete substance prompts monetary reasons and as an added substance to improve properties of cement in both new and solidified states. The alccofine is utilized in a different field with application arranged like Reinforced concrete solid business structures and private structures, tall structures or structures with moving circumstances to siphon the solid easily and efficient device[3]. In the mass cement for heap and pontoon heap establishment solid territories temperature controlled operator. For aluminum/burrow structure work with utilizing alccofine substitution concrete for high stream or self-compacting concrete [4].In alccofine supplanting of elite cement with low water to solidify proportion Shortcrete with improved the attachment properties and fastest introductory quality increased Precast solid components for connect, burrows, segmental development, squares, empty center sections, business precast units followed by an alccofine substitution concrete[5]. The piece concrete utilized by Post strain/pre focused on concrete. The dirt adjustments by development grouts, mortars, fix mortars LEED/GREEN consistent structures[6]
2. Experimental Programme
The mix proportion used in this preparation of concrete is M20. The water to binder ratio was taken as 0.5, the cement was replaced with Alccofine by weight at various levels such as 0, 10%, 12%, 14% & 16%. The casted specimens are de moulded after 24 hours and all the specimens are cured 28 days. The mechanical properties are compressive strength, split tensile strength and flexural strength and durability property is rapid chloride permeability test are found. M30 grade concrete is set up under the rules of IS 10262-2019[7,8].The mixture proportion for 1m3 is shown in the Table 1

Table 1. Mixture proportion of control and Concrete with alccofine

| Type Of Specimen | Cement Kg | F.A Kg | C.A Kg | Alccofine Kg |
|------------------|-----------|--------|--------|--------------|
| CC               | 462       | 785    | 1154   | -            |
| AL 10%           | 415       | 785    | 1154   | 47           |
| AL 12%           | 406       | 785    | 1154   | 56           |
| AL 14%           | 397       | 785    | 1154   | 65           |
| AL 16%           | 388       | 785    | 1154   | 74           |

3. Material Properties

3.1 Cement
We have utilize Ordinary Portland Cement of Grade 43. According to IS 12269-2013 prerequisites[9,10,11] the OPC 43 Grade concrete should have a compressive quality of 43MPa after 28days standard relieving. The ordinary portland concrete (OPC) 43 evaluation gives a higher-evaluation of cement becomes to affordable for concrete substance. In solid blend plan, for solid M-20 or more evaluations a sparing of 8 to 10% of concrete might be accomplished with the utilization of 43 evaluation OPC. The specific gravity of cement was seen as 3.15

3.2 Fine Aggregate
Fine aggregate is characterized as material that will go through 4.75mm strainer and will, generally, be held on a 75 sifter. For expanded usefulness and for economy as reflected by utilization of less substance, the fine total ought to have an adjusted shape[12]. The reason for the fine total is to go about as a usefulness operator. For this reason we have utilized totals going through the 1.18mm strainer. In India waterway sand is utilized as fine total. The sand is washed and screened at site to evacuate harmful materials and tried according to the method given in IS 2386-1963 and the test outcomes ought to follow the necessities of IS383-1970. The outcomes are as per the following,

- Fineness modulus : 3.85
- Specific gravity : 2.60

3.3 Coarse Aggregates
Coarse aggregate utilized can be rock coming about because of the devastating of parent rock, regular stone, slags, extended earth and shale (lightweight totals) and other affirmed idle materials with comparative attributes, having hard, solid, tough particles, adjusting to the details of IS Codes[13]. The outcomes are as per the following,

- Specific gravity: 2.78
3.4 Alccofine

Alccofine 1203 is restrictive low calcium silicate based mineral added substance. Controlled granulation process brings about remarkable molecule size appropriation [14]. Its idle water powered property and pozzlanic reactivity brings about upgraded hydration process [15]. Addition of Alccofine 1203 improves the pressing thickness of glue segment. This outcomes in bringing down water request, admixture measurements and consequently improving quality and strength boundaries of cement at all ages[16].

The test consequences of Mechanical Properties, for example, Compressive Strength Test, Split Tensile Strength Test and Flexural Strength Test are talked about[17,18]. The after effects of the Mechanical Properties, for example, Compressive Strength Test, Split Tensile Strength Test and Flexural Strength Test is given in Table 2.

The consequences of Rapid Chloride Permeability test for various blends of cement are talked about. The after effects of RCPT is classified in Table 3.

4. Results And Discussion:

The test consequences of Mechanical Properties such as, Compressive Strength Test, Split Tensile Strength Test and Flexural Strength Test are talked about[19,20,21,22]. The aftereffects of the Mechanical Properties, for example, Compressive Strength Test, Split Tensile Strength Test and Flexural Strength Test is given in Table 2.

The consequences of Rapid Chloride Permeability test for various blends of cement concrete are talked about. The after effects of RCPT is classified in Table 3.

4.1 Mechanical Properties:

The mechanical properties such as compressive strength, splitting tensile strength and flexural strength are tabulated below in Table 2. And the Figure 1,2 and 3 shown s a compressive strength, tensile strength and flexural strength is respectively.

Table 2. Mechanical Properties concrete with alccofine effect

| Types of specimen | Compressive strength (MPa) | Splitting tensile strength (MPa) | Flexural Strength (MPa) |
|-------------------|---------------------------|---------------------------------|------------------------|
|                   | (7days) (28days)          | (28days)                        | (28days)               |
| CC                | 13.7 24.4                 | 3.27                            | 4.45                   |
| AL10%             | 16 26.7                    | 3.96                            | 5.11                   |
| AL 12%            | 18.3 29.6                  | 4.67                            | 5.45                   |
| AL 14%            | 16 26.5                    | 3.82                            | 5.23                   |
| AL 16%            | 12.3 22.7                  | 2.88                            | 4.31                   |
Based on the experimental results the compressive strength of concrete is founded by optimum and maximum for cement replacement is 12% by alcofine with compared to control concrete. Meanwhile the ultrafine slag replacement level is more than 12% the compressive strength of concrete is slightly reduced.

Based on the experimental results the tensile strength of concrete is founded by optimum and maximum for cement replacement is 12% by alcofine with compared to control concrete. Meanwhile the ultrafine slag replacement level is more than 12% the tensile strength of concrete is slightly reduced.

Based on the experimental results the flexural strength of concrete is founded by optimum and maximum for cement replacement is 12% by alcofine with compared to control concrete. Meanwhile the ultrafine slag replacement level is more than 12% the flexural strength of concrete is slightly reduced.
4.2. Rapid Chloride Permeability Test:
The RCPT was conducted at 28 and 35 days and the results are tabulated below in Table 3

Table 3. Rapid Chloride Permeability Test

| Mixture | Total Charge Passed (Coulomb) | Chloride Ion Permeability |
|---------|-------------------------------|---------------------------|
|         | 28 Days | 35 days                  |
| CC      | 5208    | 4817                     | High                      |
| AL 10%  | 5023    | 3250                     | High                      |
| AL 12%  | 2350    | 2200                     | Medium                    |
| AL 14%  | 2530    | 2378                     | Medium                    |
| AL 16%  | 2480    | 2275                     | Medium                    |

Figure 4. Rapid Chloride Permeability Test on M20 Grade Concrete

The based on the experimental results are obtained when the Alccofine is presence inside of the concrete the porous will be reduced. Meanwhile the permeability is gradually reduced due the percentage of Alccofine is replaced with cement.

5. Conclusion
The experimental investigation of Concrete with various levels of Alccofine as cement replacement were studied and based on the results the following conclusions are made.

- Generally conventional concrete is having greater permeability when compared to the Concrete using Alccofine.
- When the replacement of Cement by Alccofine increases, the permeability of Concrete is decreased.
- However, the Compressive Strength, Flexural Strength and the Tensile Strength of concrete with 10,12,14 percentage Alccofine replacement higher than the strengths obtained from Control Concrete.
The Strengths obtained are maximum at 12% replacement of Alccofine to Cement. Also the permeability of Concrete is lowest in case of 12% replacement of Alccofine to Cement.

Addition of Alccofine above 12% reduces the Strengths and also increases the Permeability of the Concrete when comparing with the results obtained for 12% replacement.

Similarly, when Alccofine is added above 14% it reduces the strength which will be lower than the strength obtained by control concrete.

Hence it is concluded that the optimum percentage of replacement of Cement by alccofine is 12% for both strength and durability properties.

6. References

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