PERFOMANCE OF GEOPOLYMER CONCRETE WITH AMBIENT CURING

By,

R.Jayasankar[1], K.Ashwin[2],M.Balaji[3], A.Divya[4],A.Sai venkatesh[5],K.Saraswathi[6]

[1]Associative professor,[2]Assistant professor,[3,4,5,6]final year students,

Department of Civil Engineering,

A.V.C College of Engineering,Mannampandal,Mayiladuthurai

ABSTRACT - Geopolymer concrete is a type of concrete that is made by reacting aluminate and silicate bearing materials with a caustic activator. Shortage of good quality natural sand due to depletion of resources and limitation due to environmental considerations has made concrete manufacturers to look for suitable alternative fine aggregate. One such alternative is "manufactured sand". Workability strength and durability of concrete with manufactured sand as replacement to natural sand in proportions of 25%, 50%, 75% and 100% is studied. The experiments were conducted on M25 concrete grade. This study is an experimental on the nature of silica fume and its influences on the properties of fresh concrete. The partially replacement of cement by silica fume the strength parameters of concrete have been studied. First the strength parameters of concrete without any partial replacement were studied then strength parameters by partial replacement with silica fume have been studied by placing cube on compression testing machine (CTM). Silica fume were used to replace 5%,10%,15% and 20% of cement. The results showed that partial replacement of cement with silica fume had significant effect on the compressive strength of cube. The strength of concrete increases rapidly as we increases the silica fume content. Development of geopolymer concrete suitable for curing at ambient temperature will widen its application to concrete structures. This study aimed to achieve silica fume based geopolymer concretes suitable for ambient curing condition

Keywords : Concrete , Geopolymer , M-sand ,Silica fume , ambient curing.

1. INTRODUCTION

Concrete is the most widely used construction material in the world. It is a composite construction material made primarily with aggregate, cement and wate,Silica fume, also known as micro silica is an amorphous (non-crystalline) polymorph of silicon dioxide. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production. It is extremely fine with particles size less than 1 micron and with an average diameter of about 0.1 microns, about 100 times smaller than average cement particles .The M-sand is available at all the crushing units as a by-product during production of 20mm and 10mm size aggregates. Another form of crushed stone sand is manufactured sand (M sand), which is better in terms of quality and fulfils the requirements of suitable material for use in concrete. M sand is manufactured by any of the methods- by crushing of coarse aggregates (20mm& 10mm) in separate sand plants or using 3 stage VSI crushers. Then this material is further processed either by washing with water or dry sieving, if required to improve the grading and reduce fine powder content.

2.LITERATURE SURVEY

Dr. T Suresh Babu , M Anveshkuma (2016)., studied to replacement of Portland cement to silica fume at 5%,10%,15% and 20%.with the replacement of river sand to M- sand at 25%,50%,755 and 100%.

Halesh Kumar B T Anusha H Set,al.,(2017) One such alternative is "manufactured sand". Workability strength and durability of concrete with manufactured sand as replacement to natural sand in proportions of 0%, 5%, 10%, 15%, 20% and 25% is studied. The experiments were conducted on M20 concrete grade.

Shubham Chitransh et al.,(2017) The review of earlier studies related to partial replacement of Cement with

Silica fume reveals that there is a significant change in the strength properties of concrete such as compressive strength, flexural strength, split tensile strength

partha pratim das, farhana nazni (2015).,experiment an attempt has been made to increase the strength of concrete by replacing cement with 0%,5%,10%,15% and 2 of Micro silica in a design mix of M35 and M40.

Abhinav Shyam& Abdullah Anwa (2017)., The review of earlier studies related to partial replacement of Cement with Silica fume reveals that there is a significant change in the strength properties of concrete such as compressive strength, flexural strength, split tensile strength. These experiments were carried out in various grade concrete to find out the result. From the above literature reviews optimum percentage of Silica Fume varies from 5% to 15%.

METHODOLOGY

3.MATERIAL COLLECTION

Design of concrete by using the materials of

1.cement

2.fine aggregate

3.coarse aggregate

4.manufacturing sand

5.silica fume

6.water

3.1 Cement

Cement used was 43 grade ordinary Portland cement confirming IS:12269 : 1987. The cement used for experiments was obtained from a single consignment and of same grade and some source. After producing the cement , it was strored properly. In mix design the most important property of a cement is its influence on the strength of the concrete. First mix allows the properties of three standard cement to be used.

3.2 Fine aggregate

The aggregates most of which pass through 4.75 mm IS sieve are termed as fine aggregates. The fine aggregate may be of following types: 1. Natural sand, 2.Crushed stone sand, 3.Crushed gravel sand According to size, the fine aggregate may be described as coarse, medium and fine sands. Depending upon the particle size distribution IS: 383-1970 has divided the fine aggregate into four grading zones (Grade I to IV). The grading zones become progressively finer from grading zone I to IV. In this experimental program, fine aggregate was locally procured and conformed to Indian Standard Specifications IS: 383-1970. The sand was sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and conforming to grading zone II. It was coarse sand light brown in colour. Sieve analysis and physical properties of fine aggregate are tested as per IS: 383-1970 .

3.3 Coarse aggregate

The aggregate which is retained over IS Sieve 4.75 mm is termed as coarse aggregate. The coarse aggregates may be of following types:- 1. Crushed graves or stone obtained by crushing of gravel or hard stone. 2. Uncrushed gravel or stone resulting from the natural disintegration of rock 3. Partially crushed gravel obtained as product of blending of above two types. The normal maximum size is gradually 10-20 mm. Locally available coarse aggregate having the maximum size of 20 mm was used in concrete work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per IS: 383-1970.

3.4 Manufacturing sand

Manufactured Sand is produced by feeding hard stones of varying sizes to primary and secondary crushers (Jaw crusher and Cone crusher), for size reduction and these crushed stones are further crushed in Vertical Shaft Impact (VSI) crusher to reduce the particle size to that of sand. The VSI crusher by its unique design and action of attrition produces well-shaped fine aggregate particles that are cubical and angular. The process of attrition also enables the reduction of surface roughness of the fine aggregate particles to some extent

Properties of m-sand used are as follows,

- Specific Gravity of M-Sand = 2.65
- As per IS 383-1970 the M-sand is classified under grading zone II.

3.5 Silica fume

The Silica fume is a crystalline form of silica that may perform as a filler material in concrete. It will not contribute as a pozzolan.Ferro silicon alloys are produced with nominal silicon contents of61% to 98%.

As the silicon content increases in the alloy, the SiO2 content increases in the silica fume. Generally more than 85% SiO2 in Silica fume is satisfactory for the use of silica fume in concrete.

3.6 Water

Generally, water that is suitable for drinking is satisfactory for use in concrete. The potable water is generally considered satisfactory for use in concrete. The water should satisfy the requirements of Section 5.4 of IS: 456 - 2000.

4. MIX DESIGN

Mix design calculations for M25 grade has been done as per IS 10262:2009 and IS 456:2000. Some values have been assumed here.

As per clause 3.2 of IS 10262:2009

Target mean strength fck'= fck + 1.65

S = 25+ 1.65*4

= 31.6 N/mm²

S= standard deviation from table-1 of IS 10262:2009 according to grade.

Water cement ratio has been considered as 0.43 (as per table-5 IS 456:2000). For aggregate size as 20mm, Percentage of coarse aggregate in total all in aggregate= 0.6.

Percentage of fine aggregate = 1-0.624 = 0.376

Considering 1 cumec of volume of concrete and specific gravity of cement as 3.15.

Volume of cement = 0.1025m3

Volume of water = 0.192m3

Volume of all in aggregate = 1- [0.1025+ 0.192]

= 0.7055m3

Specific gravity of Coarse Aggregate= 2.61

Specific gravity of Fine Aggregate=2.58

Mass of fine aggregate = 1104.813 Kg

Mass of coarse aggregate = 728.076 Kg

Mix proportion in m^3

TABLE-1

Cement	Fine aggregate	Coarse aggregate	water
320	729	1104	192

5. EXPERIMENTATION

Specific gravity test

TABLE-2

S.No	MATERIALS	SPECIFIC GRAVITY
1	Coarse aggregate	2.61
2	Fine aggregate	2.58
3	Silica fume	2.18
4	M sand	2.65
5	Cement	3.12

Results and Discussions

The results of strength tests 14-28 days using both the fine aggregates M. sand and silica fume are given below in the following sections.

Compressive Strength

Compressive strength is by far the most important property checked for the concrete and even more important in high strength concrete.

The compressive strength was carried out as per IS 1199: 1959 .

M-Sand :

TABLE-3

DAYS	PERCENTAGAE OF M-SAND (%)			
	25	50	75	100
	COMPRESSIVE STRENGTH IN N\mm²			
14	16.71	17.20	21.06	18.46
28	27.72	28.85	32.23	30.59

Normal concrete with combination of Silica Fume with M-Sand

TABLE-4

DAYS	PERCENTAGAE OF SILICA FUME AND M-SAND(%)			
	5+75%	10+75%	15+75%	20+75%
	COMPRESSIVE STRENGTH in N\mm²			
14	19.87	22.38	26.23	23.41
28	28.49	31.01	32.88	30.63

6. GRAPHICAL REPRESENTATION

Linear comparison of cubes according to days:-

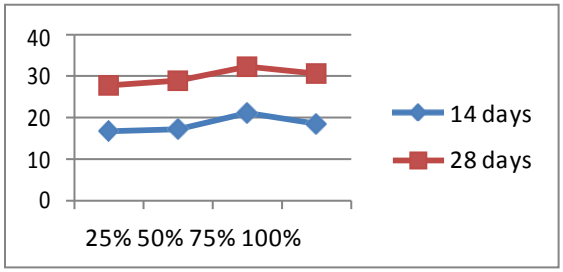

Figure 1 : compressive strength of M-sand

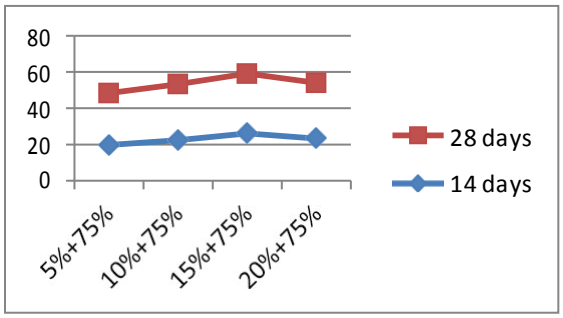

Figure 2 : compressive strength of silica fume with M-sand

Figure 3: Ambient curing of concrete cube

Figure 4: compressive strength test on cube

7. CONCLUSION

We conclude to after performing for mix design of M25 grade concrete at partial replacement of Cement with Silica fume and replacement of fine aggregate with M-sand reveals that there is a significant change in the strength properties of concrete such as compressive strength.The optimum percentage of silica fume with M-sand is upto 15%and75% Percentage replacement improvement in the strength of concrete has been observed in terms of Compressive Strength on partial replacement of Cement to silica fume with Fine aggregate to M-sand at using of ambient curing.

8. REFERENCES

1. *Partha pratim Das,Farhana Naznin,Nayanmoni (2015) experiment studies were Cheti concrete mix proportioning using micro silica proceedings, 4th IRF International Conference on 19th April 2015, Cochin, India.*

2. *V. Umamaheswaran , C. Sudha, P. T. Ravichandran and P. R. Kannan Rajkumar(2015) refers to Use of M Sand in High Strength and High Performance Concrete,Vol 8 (28) October 2015.*

3. *S.Sachi kumar,S.Roshan(2018),to study the experiment on M-Sand an Alternative to the River Sand In Construction Technology, International Journal of Scientific & Engineering Research Volume 9, Issue4,April-2018 ISSN 2229-5518 IJSER © 2018.*

4. *B T Halesh Kumar, H.Anusha S B hargavi,S P Syed Zabiulla. (2017)Replacement of Fine Aggregate by M-Sand,IJSTE - International Journal of Science Technology & Engineering | Volume 3 | Issue 12 | June 2017 ISSN.*

5. *Dr.T Suresh Babu, M Anveshkumar (2016) Manufactured sand with silica fume, an alternative to river sand and in concrete industry , International Journal of Applied Research 2016; 2(3): 441-448*

6. *Lakhbir Singh, Arjun Kumar, Anil Singh (2016) Study of Partial Repalcement of Silica Fume, International Journal of Advanced Research (2016), Volume 4, Issue 7, 104-120*