

Experimental Investigation on Cenosphere Bricks with Silica Fume

P. Ajithkumar, S. Karthikeyan, V. Thamaraiselvan, M. Manoj Arjun, M. Manoj Kumar

Abstract: Our project based on made of bricks using cenosphere and silica fume materials. since cenosphere is collected as waste material from thermal power plants and also silica fume known as micro silica collected as a product of the silicon and ferrosilicon alloy producing .those are used as partial replacement material in cement .the ingredients of brick are cenosphere (20%) ,pp cement (18%), quarry dust (50%),silica fume (12%).the mix proportions are mixed and the mould of 230mm×100mm×100 mm used for molding of bricks .then the compressive strength, water absorption test ,efflorescence test ,acid test ,impact test were performed to find out the quality of bricks we have tested few specimen as per proportions to obtain the results . we also compare those bricks with the fly ash bricks now a days these bricks are commonly used instead of clay bricks in construction the brick has a proportion of fly ash (60%) , quarry dust (50%),opc (10%).we introduce cenosphere and silica fume instead of fly ash and also compare these cenosphere bricks with the fly ash bricks .

Keywords: Cenosphere, PPC (Portland Pozzolana Cement), Quarry Dust, Compressive, Acid Test, Water Absorption Test and Impact Test, Efflorescence Test.

I. INTRODUCTION

This chapter tells about literature review of bricks using cenosphere and silica fume, the chapter includes the material proportion, mix design, test and results.

A. Objective

1. To achieve the maximum compressive strength, water absorption and quality of bricks.
2. By using silica fume and Cenosphere to reduce the residue amount of industry
3. By using silica fume to resist the shear failure in bricks due to the hollow shape of cenosphere.

II. METHODOLOGY

A. Material and Methods:

Its shows the proportion of material and the processing method.

Revised Version Manuscript Received on March 05, 2018.

P. Ajithkumar, Department of Civil Engineering, Park College of Engineering and Technology, and Anna University, Coimbatore (Tamil Nadu), India.

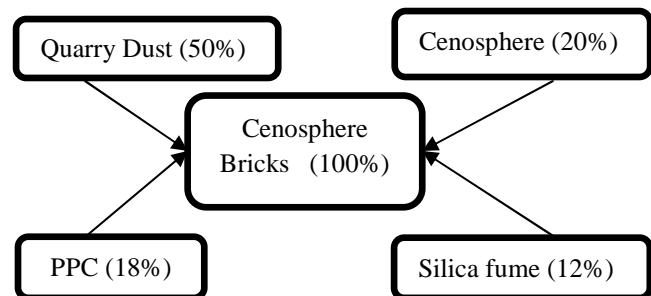
S. Karthikeyan, Department of Civil Engineering, Park College of Engineering and Technology, and Anna University, Coimbatore (Tamil Nadu), India.

V. Thamaraiselvan, Department of Civil Engineering, Park College of Engineering and Technology, and Anna University, Coimbatore (Tamil Nadu), India.

M. Manoj Arjun, Department of Civil Engineering, Park College of Engineering and Technology, and Anna University, Coimbatore (Tamil Nadu), India.

M. Manoj Kumar, Department of Civil Engineering, Park College of Engineering and Technology, and Anna University, Coimbatore (Tamil Nadu), India.

B. Material used:



III. PROPERTIES OF MATERIALS

A. Cenosphere

It's a hollow sphere and light weight .inert made with large amount of thermal and silica by the process of thermal power plants it filled with inert gas .the density is 0.4-0.8 g/cm² .the color of this material becomes gray like cement .It is a water proof material .now a days the material used to fill the metals and polymers. It is also used in conductive coating.

B. PPC (Portland Pozzolana Cement)

PPC is the common material used in the concrete, mortar and other building works .its produced from organic lime stone. the kiln is a heating place where the clinker becomes cement the material easily available in market but the ingredients in cement causes some unusual environment effects. Like crystalline silica, Hexavalent chromium. it also leads the air pollution ,by release of green house gases (Eg: CO₂,NO_x,SO₂).to avoid these issues we replace the alternate material ,in stead of cement .the availability and low cost makes the usage of material economic.

C. Quarry Dust

It is residue taken from granite quarry due to the recent problem ,occurs in supply of natural river sand to construction makes the cost of sand reached more high level .to overcome this problem we use the quarry dust in stead of natural river sand .quarry dust also creates the environmental effects. Recently quarry dust is used for all type of construction like building works and highway project also, to consider that works, We use the materials in our brick manufacturing process .the size of used quarry dust is 4.75 mm.

Experimental Investigation on Cenosphere Bricks with Silica Fume

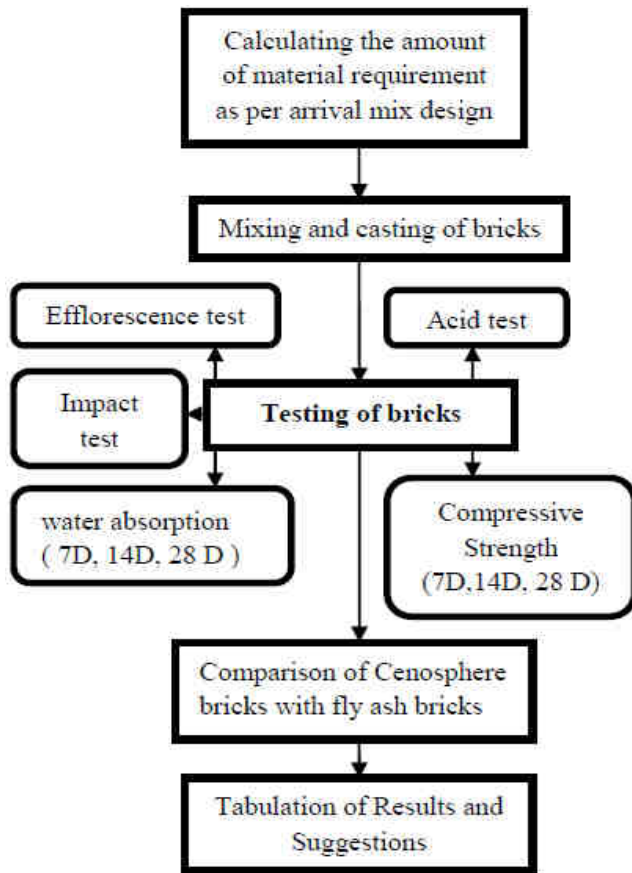


Fig.2 Flowchart Shows the Methodology

Initially arriving the mix percentage of cenosphere (20%) and calculating the required amount of quantity used materials, for each brick cenosphere 0.345kg, quarry dust 1.9 kg, ppc-1.305 kg, s.f- 0.297 kg. then the proper material are collected from the industries and shops. next the material are mixed thoroughly with the water cement ratio 0.5% and the bricks are casted at the mould size of 230mm×100mm×100 mm. then it alloys for 24 hours of air curing. next day the bricks are drop in to the tank of water for curing. then, the test are performed in 7, 14, 28 days as per procedure with 3000 kN capacity compression testing machine for crushing strength. for each 7, 14, 28 days totally 15 bricks are used to get the average value of crushing strength and water absorption test.

D. Mix Proportion

To make the brick the following mix proportion is used.

Table .1 Standard Mix Proportion

Cenosphere	PPC	Silica fume	Quarry dust
20 %	18 %	12 %	50

E. Water Binder Ratio

Used water binder ratio is 0.5 % as per the water cement ratio. Here cement is used as binder material

IV. PREPARATION AND TESTING OF SPECIMENS

A. Moulding of Bricks

A normal hand mould of size 230mm×100mm×100 mm is used to cast the bricks. The cenosphere silica fume, quarry dust, cement with water were mixed and filled and compacted in mould. After 2 minutes the mould is removed.

then the brick is allowed for 24 hours of air curing and then bricks well water cured for period of 7, 14, 28 days.



PPC



Quarry Dust



Cenosphere

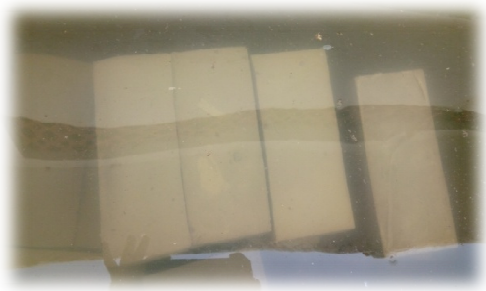


Mould



Casting of Brick





Curing of Bricks



Casted Bricks Kept for Air Curing

V. RESULTS AND DISCUSSIONS

The investigation was carried out to determine the crushing strength, water absorption test, acid test, efflorescence test, impact value is better than the fly ash bricks in cenosphere.

A. Arriving Proportions

The optimum mix proportion are arrived from the journal of experimental study on low density bricks (cenosphere bricks) published by, international journal of recent technology and engineering [IJRTE] ISSN 2277-3878, volume of issue 1 march 2017 by this results. we changed the mix proportion with silica fume of 12 % to resist the shear failure and cenosphere 20%, OPC -18%, quarry -50%. The bricks are mixed as per mix design and casted.

B. Tests Applied to Bricks

- Compressive strength test
- Water absorption test
- Efflorescence test
- Acid test
- Impact test

C. Compressive Strength test

The compressive strength test is performed with CTM (compression testing machine) of capacity of 3000 kN applied a load uniform at the rate of 2.9 kN/min. in that each and cenosphere bricks are tested. by the results the strength of cenosphere bricks at 7, 14, 28 days also higher than the fly ash bricks, the results are tabulated.

Table 2. Value of Compression Strength (N/mm²) are Obtained on Cenosphere Bricks

Specimen No	Compressive Strength (N/mm ²)		
	7 days	14 days	28 days
S1	12.17	12.60	13.47
S2	11.30	14.78	14.56
S3	11.95	13.04	15.21
S4	12.17	12.82	16.52
S5	13.47	13.04	15.62

Table 3. Average of Compressive Strength (N/mm²)

Specimen No	Compressive Strength (N/mm ²)		
	7 days	14 days	28 days
S1	12.26	13.256	15.076

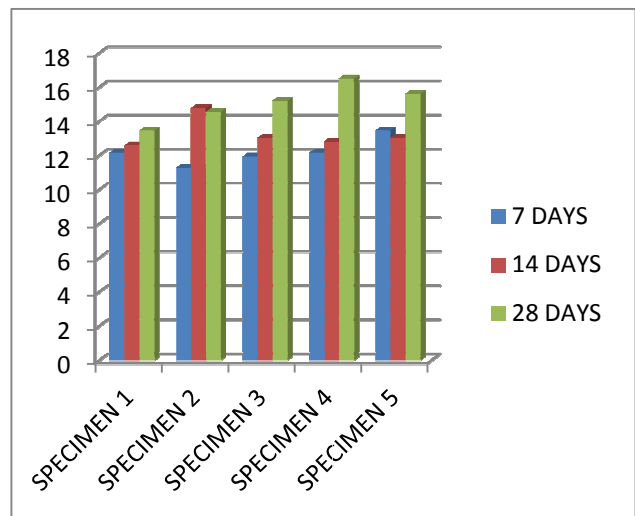
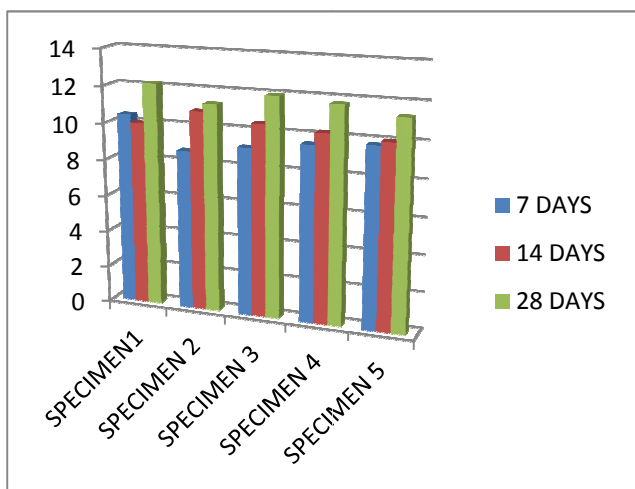


Table 4. Value of Compressive Strength (N/mm²) of Fly Ash Bricks

Specimen No	Compressive Strength (N/mm ²)		
	7 days	14 days	28 days
S1	10.43	10	12.17
S2	08.69	10.86	11.30
S3	09.13	10.43	11.95
S4	09.56	10.21	11.74
S5	09.78	10	11.30

Table 5. Average of Compressive Strength (N/mm²)

Specimen No	Compressive Strength (N/mm ²)		
	7 days	14 days	28 days
S1	9.518	10.3	11.692

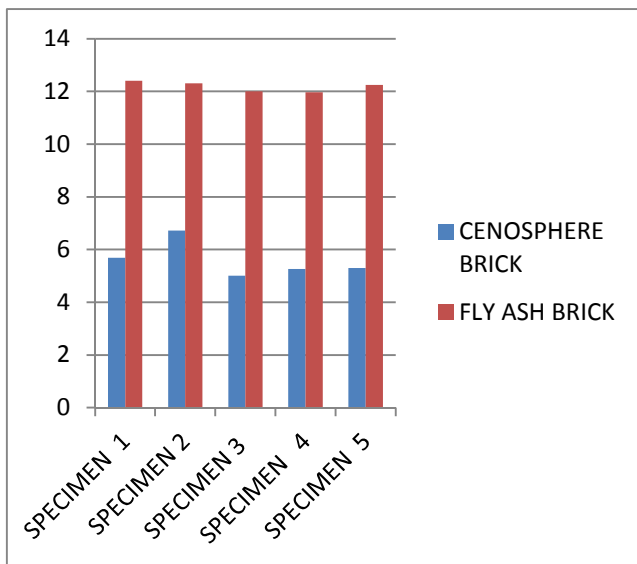


D. Water Absorption Test

The test was conducted using 5 specimen the bricks are dried in an oven at the temperature of 115° to attain the weight without any moisture. the weight is taken as w_1 and then the bricks are immersed in clean water for 24 hours after that period the brick are taken out and weighted as w_2 . then the water absorption in % by weight is calculated = $(W_2 - W_1 / W_1) \times 100$

Table 6. Average of Water Absorption (%)

Specimen No	Water absorption value (%) of cenosphere bricks	Water absorption value (%) of fly ash bricks
1	5.69	12.4
2	6.72	12.31
3	5.01	12.0
4	5.26	12.0
5	5.03	12.24



E. Acid test

After casting of bricks the bricks are cured for 7 days. Then its kept in atmosphere for 2 days for constant weight. Subsequently, the specimen immersed in 5 % sulfuric acid (H_2SO_4) solution for 3 days. The pH value of the acidic media was at 0.3. After 3 days of immersing in acid solution, the specimens are taken out and were washed in running water and kept in atmosphere for 2 days for constant weight. Subsequently the specimen are weighted the loss in weight and hence the percentage loss of weight was calculated as 1.86%.

F. Impact Test

By the impact test, the brick was dropped from 1m. Then the damage is calculated. as per calculated the damage is minimum in brick.

G. Efflorescence Test

As per procedure the brick was vertically immersed in a 25mm depth of distilled water for 24 hours. Then the brick was remove from water and exposed to the atmosphere for 24 hours. After that the period the efflorescence is observed. There is no efflorescence is formed on the brick.

VI.CONCLUSION

As per test results the compressive strength of cenosphere brick is greater than the fly ash bricks. Due to usage of silica fume there is no efflorescence effect on found in bricks. Hence the brick is in good quality state. The water absorption test results as showing the cenosphere bricks were absorb less amount of water than the fly ash bricks hence it attains good quality as per the test. The weight of cenosphere bricks is almost equal to the weight of fly ash bricks hence there is no new difficulties is faces by workers. Due to impact test results the damage is minimum hence the shape and structures of brick does not affected by improper handling of bricks. By adding of silica fume there is no color changes occurs in the bricks cenosphere air also look like the fly ash bricks. Cenosphere bricks air not affected the environment hence it is eco-friendly for the used surrounding environment. By the cenosphere used in this bricks the wastage from thermal power plant is reduced. Using silica fume in these bricks resisted the shear failure of bricks. The silica fume is also reduced from industry hence this project will gives the economic increase to the industry by selling silica fume for manufacturing of cenosphere bricks. In our project the compressive strength of cenosphere bricks attain the estimated strength durability and quality to increase the binding property of cenosphere any other binding material can be used for binding the cenosphere in the future project

REFERENCES

1. S.Lalithkumar, A. Priyadarshini, M.Manoj Kumar, N.Sekar Pandian , Experimental Study on Low Density Bricks (Cenosphere Bricks): International journal of Recent Technology and Engineering . Detailed Study About Cenosphere Bricks Comparison of Low density Brick and Fly ash Brick
2. Prabir Kumar Chaulia and Reeta Das, Process Parameter Optimization for Fly Ash Brick by Taguchi Method: Material Research; 2008.11. 159-164.
3. Tutunlu Faith, and Atalay Umit.Utilization of Fly ash in Manufacturing of Building Brick: International Ash utilization Symposium, Center for applied Engineering Research; 2001 paper 13.
4. Wang, J., Zhang, M., Li, W., Chia, k., and, Liew, R. (2012). Stability of cenosphere in lightweight cement composites in terms of alkali-silicareaction. Cement and Concrete Research, 42, 721-727.
5. Y, X., Shen, Z., Xu, Z., and, Wang, S. (2007).Fabrication and structural characterization of metal films coated on cenosphere particle by magnetron sputtering deposition. Applied Surface Science, 253, 7082-7088.
6. Cao, X., and, Zhang, H. (2013).Investigation into conductivity of silver-coated cenosphere composites prepared by a modified electroless process. Applied Surface Science, 264, 756- 76

Author Profile

P. Ajithkumar, We are pursuing B.E.Civil Engineering at Park college of technology in Anna university from India with regulation of 2013. We have done two project under the proper guidance of Mr.M.Manoj kumar M.E. This is our second project which regulates under technical one, our first project has related to design sector as topic of Planning, Analysis & Designing of sports club. The time spent for done the project is less than three months. Now, we are done our final year project in bricks are using with cenosphere and silica fume .We are using these materials , Which that wash from processing industries by using residue as a ingredient it will become got an economic value. Initially we found the properties of used materials in bricks. Then we calculating the design mix. After we collect all the materials as per requirements.



Next, we mixed all the materials and cured , then tested for results and compared with fly ash bricks which are made by using same processing method of cenosphere bricks. In future , the cenosphere bricks will get important role in civil construction works.

S. Karthikeyan, We are pursuing B.E.Civil Engineering at Park college of technology in Anna university from India with regulation of 2013. We have done two project under the proper guidance of Mr.M.Manoj kumar M.E. This is our second project which regulates under technical one, our first project has related to design sector as topic of Planning, Analysis & Designing of sports club. The time spent for done the project is less than three months. Now, we are done our final year project in bricks are using with cenosphere and silica fume .We are using these materials , Which that wash from processing industries by using residue as a ingredient it will become got an economic value. Initially we found the properties of used materials in bricks. Then we calculating the design mix. After we collect all the materials as per requirements. Next, we mixed all the materials and cured , then tested for results and compared with fly ash bricks which are made by using same processing method of cenosphere bricks. In future , the cenosphere bricks will get important role in civil construction works.

V. Thamaraiselvan, We are pursuing B.E.Civil Engineering at Park college of technology in Anna university from India with regulation of 2013. We have done two project under the proper guidance of Mr.M.Manoj kumar M.E. This is our second project which regulates under technical one, our first project has related to design sector as topic of Planning, Analysis & Designing of sports club. The time spent for done the project is less than three months. Now, we are done our final year project in bricks are using with cenosphere and silica fume .We are using these materials , Which that wash from processing industries by using residue as a ingredient it will become got an economic value. Initially we found the properties of used materials in bricks. Then we calculating the design mix. After we collect all the materials as per requirements. Next, we mixed all the materials and cured , then tested for results and compared with fly ash bricks which are made by using same processing method of cenosphere bricks. In future , the cenosphere bricks will get important role in civil construction works.

M. Manoj Arjun, We are pursuing B.E.Civil Engineering at Park college of technology in Anna university from India with regulation of 2013. We have done two project under the proper guidance of Mr.M.Manoj kumar M.E. This is our second project which regulates under technical one, our first project has related to design sector as topic of Planning, Analysis & Designing of sports club. The time spent for done the project is less than three months. Now, we are done our final year project in bricks are using with cenosphere and silica fume .We are using these materials , Which that wash from processing industries by using residue as a ingredient it will become got an economic value. Initially we found the properties of used materials in bricks. Then we calculating the design mix. After we collect all the materials as per requirements. Next, we mixed all the materials and cured , then tested for results and compared with fly ash bricks which are made by using same processing method of cenosphere bricks. In future , the cenosphere bricks will get important role in civil construction works.

M. Manoj Kumar, We are pursuing B.E.Civil Engineering at Park college of technology in Anna university from India with regulation of 2013. We have done two project under the proper guidance of Mr.M.Manoj kumar M.E. This is our second project which regulates under technical one, our first project has related to design sector as topic of Planning, Analysis & Designing of sports club. The time spent for done the project is less than three months. Now, we are done our final year project in bricks are using with cenosphere and silica fume .We are using these materials , Which that wash from processing industries by using residue as a ingredient it will become got an economic value. Initially we found the properties of used materials in bricks. Then we calculating the design mix. After we collect all the materials as per requirements. Next, we mixed all the materials and cured , then tested for results and compared with fly ash bricks which are made by using same processing method of cenosphere bricks. In future , the cenosphere bricks will get important role in civil construction works.