International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

Comparative Study on Strength of Concrete with Partial Replacement of Cement with Silica Fume and Quarry Dust

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Abstract: Concrete a composite material produced using concrete, water, fine total and coarse total. However, present analysts are in enthusiasm of finding new concrete materials by squander materials or waste items created from ventures which are unsafe to condition. The current paper manages halfway supplanting of concrete with silica smoke and quarry dust which are having silica utilized as admixture for making concrete. In this paper we presents the consequences of a trial examination completed to assess the mechanical properties of solid blends in which concrete was mostly supplanted with silica smoke and quarry dust utilizing M30 grade concrete. Silica seethe/quarry dust is made halfway substitution of concrete and found that 10% and 20% of incomplete substitution is valuable to concrete without loss of standard quality of concrete. Making 30% halfway supplanting of concrete with quarry dust as steady with some loss of solidarity of cement and results were discovered that silica smoke and quarry dust utilization in incomplete substitution to concrete can be made.

Keywords:

Concrete, silica fume, quarry dust, partial replacement, waste materials, crushing loads

Introduction

Silica smolder is another pozzolanic material that has gotten a lot of consideration as of late. As of late, various associations have gotten progressively engaged with research focused on vitality protection in the concrete and solid industry. This to some extent, is being cultivated by empowering the utilization of cementitious materials, for example, fly debris, slag and pozzolans. Of late, some consideration has been given to the utilization of silica seethe, as a potential halfway substitution for Portland concrete. This intrigue is because of the accessibility of this material in different nations, and to the exacting requirement of contamination control measures to quit scattering the material into the climate. Further more , the accessibility of high range water-lessening admixtures(super plasticizers) has opened up additional opportunities for the utilization of silica rage as a piece of the solidifying material in cement and mortars to create extremely high-quality solid mortar or high strong cement and mortars. Dissimilar to normal pozzolans and fly debris, the silica response including silica smolder is fast and in this manner, a long restoring period isn't essential. Examinations on the exhibition of silica smolder in cement and mortars have been directed in Scandinavian Countries, especially in Iceland, Norway, and Sweden, where the material has been being used on restricted scale since 1976.

In 1981, the world creation of silica seethe was assessed to be 10 million metric tons, with Norway and United States as driving makers representing 1, 20,000 tons each. In 1983, the United States, Norway, France, Switzerland, and West Germany delivered 140, 113, 75, 50, and 42 thousand metric huge amounts of silica smolder individually .Due to the quickly changing status of steel industry in numerous nations of the world the creation rates later on are probably going to increment altogether.

Quarry dust, a side-effect from the devastating procedure during quarrying exercises is one of such materials. Stone fines or rock dust is a result acquired during smashing of stone shakes and is additionally called quarry dust. Quarry dust is known to expand the quality of cement over cement made with equivalent amounts of waterway sand, however it causes a decrease in the functionality of cement. The particular gravity relies upon the idea of the stone from which it is handled and the variety is less. Shrinkage and water retention is more in quarry dust when contrasted with that of the characteristic stream sand.

To diminish the effect of the quarry residue and fly debris on condition and people, these loss results can be utilized to deliver new items or can be utilized as admixtures in concrete with the goal that the characteristic assets are utilized effectively and thus natural contamination can be decreased. This work portrays the attainability of utilizing quarry dust as halfway substitution of sand notwithstanding fly debris as fractional substitution of concrete in the creation of cement and to consider the impact of these admixtures on the mechanical properties of cement at various substitution levels and furthermore to evaluate the quality reviewing of cement.

Literature Review

Xiaofeng cong [1990] [1] have learned about job of silica smolder in compressive quality of concrete glue, mortar, and cement. This investigation is intended to clarify the conflicting proof and set up the pretended by silica smolder in controlling the quality of cement and its constituent materials. These objectives are cultivated utilizing concrete glues, mortars, and cements with water-cementitious material proportions going from 0.30 to 0.39. The exploration exhibits that substitution of concrete by silica seethe and the expansion of a superplasticizer expands the quality of concrete glue. Concrete containing silica seethe as an incomplete substitution for concrete shows an expanded compressive quality on account of the improved quality of its concrete glue constituent. Changes in the glue total interface brought about by silica rage seem to have little impact on the uniaxial compressive quality of cement.

K.G.Raveendran [2015] [2] found out about the exhibition of silica smolder on quality and solidness of cement. In this examination, impacts of mineral admixtures on the water penetrability and compressive quality of cements containing silica rage (SF) were tentatively researched. The primary boundary examined in this examination is M20 grade concrete with fractional substitution of concrete by silica fume.They were joined into concrete at the degrees of 0%, 5%, 10%, 15% and 20%. This paper presents a definite exploratory investigation on compressive quality, split elasticity and flexural quality at a time of 7and28 days. Test outcomes demonstrate that utilization of silica smolder in concrete has improved the exhibition of cement in quality at a specific rate substitution. In spite of the fact that the most noteworthy compressive qualities of cements watched was 10% silica seethe blend for conventional Portland concrete and were diminished as the expansion in the substitution proportions.

Ramanpreet Singh [2017] [3] has analyzed about investigation of high quality solid utilizing microsilica. The examination on silica was done which expressed that no quality is lost in silica-seethe cements. The examination involves four degrees of silica-rage at the pace of 0%, 5.5%, 8.0%,9.5% and 11.0% which results high quality cement. The compressive quality of solid increments with increment of small scale silica, however after certain rate the addition in quality beginnings diminishing. The 28days, 60 days and 90 days quality of cement aremaximum at 9.5% smaller scale silica content, though 7days quality is most extreme at 8.0% miniaturized scale silica content.

Liaqat A. Qureshi [2018] [4] found out about impact of concrete substitution by silica rage on compressive quality of glass fiber fortified cement. The current investigation centers around the planning of superior cement by utilizing mechanical waste to safeguard the regular crude elements of cement. In such manner, an endeavor was made to research the consolidated impacts of fusing glass filaments and silica smolder on compressive quality of cement. Glass filaments were included proportion of 0%, 0.5%, 1.0% and 1.5%. Likewise, concrete was halfway supplanted with silica rage by 0%, 5%, 10% and 15% by weight of concrete. It was discovered that compressive quality of GFRC expanded with the expansion in level of SF substitution and glass fiber content. Most extreme compressive quality of GFRC was acquired at 15% supplanting of concrete with SF. Moreover, it was likewise discovered that expansion of silica rage encouraged the early high quality of GFRC.

B. Patnaik et. al. [2015] [5] has found out about the force and quality components of cement having copper waste as a fragmentary replacement of sand and results have been presented in this paper. Two different sorts of Concrete Grade (M20 and M30) were used with different degrees of copper slag substitution (0 to half) in the solid. Quality and Durability properties, for instance, Compressive Strength, Split Tensile Strength, Flexural Strength, Acid Resistivity and Sulfate Resistivity were surveyed for the two mixes of cement. test comes about explains that the quality components of cement has better having copper slag as a fragmentary substitute of Sand (up to 40%) in concrete anyway to the extent robustness the solid saw to be low impenetrable to destructive ambush and better security against sulfate attack.

Material & Tests

A.GENERAL:- In this examination an endeavor has been made to think about the impact of jiggery on properties of concrete. The methodology took after, tests directed for determination of configuration blend is examined in this part .The properties considered in this investigation are zone of sand, assimilation limits of aggregates, surface dampness of aggregates ,mass thickness of aggregates, fineness of concrete .the trial program is comprehensively grouped into following classes, viz.

1) Specific gravity Test:

- Specific gravity Test for cement
- Specific gravity Test for fine aggregates
- Specific gravity Test for coarse aggregates

2) Water absorption Test

- Water absorption Test for fine aggregates
    - Test for coarse aggregates
    - Sieve analysis
    - Surface moisture Test

- Bulk density Test
- Water adsorption
- Fineness of cement Test.

CEMENT

PPC creates lessened warmth of hydration and that too at low rate. PPC being better than OPC and furthermore due to pozzolanic activity, it enhances the pore estimate appropriation and furthermore lessens the smaller scale splits at the progress zone. In this test work the Ordinary Portland pozzolana cement with 43 review affirming to Indian Standard IS12269-1987 was utilized.

Table .1 Composition of Ordinary Cement

Ingredients	Desired Range of Percentage
Lime (Cao)	62 to 67
Silica (SiO_2)	17 to 25
Alumina (Al_2O_3)	3 to 8
Calcium Sulphate ($CaSO_4$)	3 to 4
Iron Oxide (Fe_2O_3)	3 to 4
Magnesia (MgO)	0.1 to 3
Sulphur (S)	1 to 3
Alkalies	0.2 to 1

Coarse Aggregate

The totals which remained on 4.75mm IS Sieve is called coarse totals, coarse total is uncrushed rock or stone which comes about in light of the ordinary separating of rocks, crushed stone or stone when it comes about as a result of beating of rock or hard stone.

Fine Aggregate

Total which go from 4.75 mm sifter and contains just so remarkably coarser material as permitted, fine total is standard sand which is coming about in light of the typical weakening of shake and which has been spared by streams or frosty associations, it is moreover crushed stone sand which is conveyed by beating hard stone, it is similarly pounded rock sand which made by crushing regular stone.

Blending water

Water complying with prerequisite of IS: 456 has been seen as appropriate for delivering solid blend. In solid blend, the water necessity is diminished to the worth required for hydration of concrete, as abundance water prompts development of void in solidified concrete glue period of cement. In all inclusive, water fit for drinking is fit for creation of cement. The different polluting influences in water, for example, chloride, sulfate, carbonate, salt, and so forth.

Quarry dust

A quarry is a spot from which estimation stone, shake, improvement all out, riprap, sand, rock, or record has been uncovered beginning from the soonest stage. A quarry is an unclear thing from an open-pit mine from which minerals are evacuated. The fundamental non-insignificant differentiation between the two is that open-pit mines that convey building materials and estimation stone are ordinarily suggested as quarries. It is one of the most significant properties of cement and impacts numerous other describable properties of the solidified cement

Silica seethe

Silica seethe (little scope silica) is considered as a pozzolanic admixture which progresses the mechanical properties and furthermore quality of cement. To make high caliber and substance safe solid silica seethe is creating at significant scale. To get 28 days compressive quality, bond is superseded with silica. At present it is being used as blended cement. The two vital solid creators in Canada are legitimately displaying what is called type 10SFsilica-rage blended bond.

Result & Discussion

4.1 CONSISTENCY OF CEMENT TEST

S.No.	Material	Percentage of Replacement			
		0%	10%	20%	30%
1	Silica fume	30	33.5	35	36
2	Quarry dust	30	33.0	34.5	35

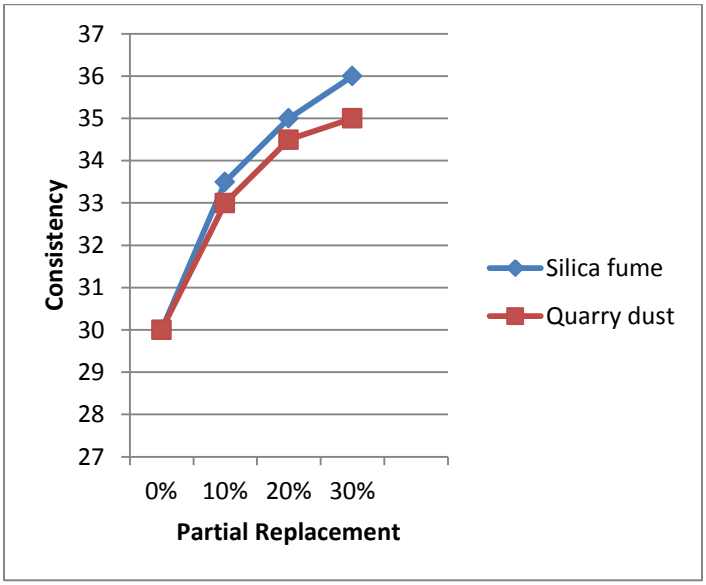


Figure 6: Normal Consistency of Cement

4.2 Workability of concrete

Table 3. Workability of Cement with Different Properties of Different Material

S.No.	Material	Partial Replcement			
		0%	10%	20%	30%
1	Silica	65	95	183	255
3	Quarry dust	65	135	195	285

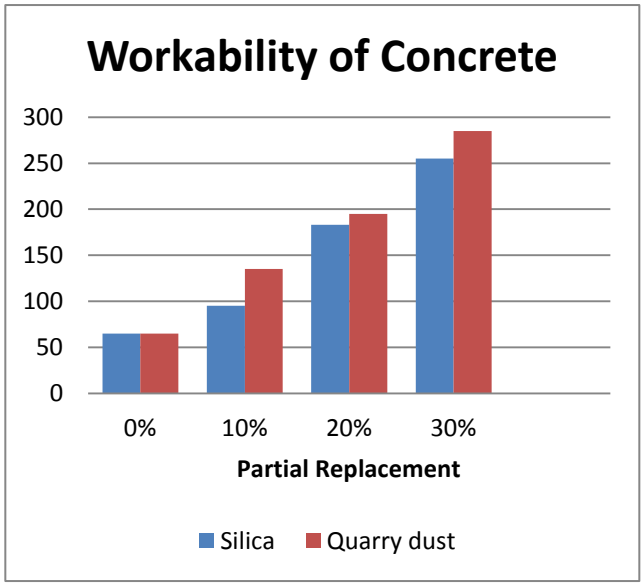


Figure 7: Slump Values of Different Waste Material

Compressive Strength of Containing Silica fume

The result of CTM of M30 grade of concrete cube having silica fume as replacement of cement with the percentage of 10%, 20% & 30% with normal aggregate (20 mm of 60% aggregate and 10 mm of 40% aggregate) nominal mix is given in Table

Table No 14 Compressive Strength of M30 having Silica fume

Compressive strength of M30 (N/mm²)				
Days	**0 %**	**10 %**	**20 %**	**30 %**
7	24.96	32.30	30.52	26.45
14	31.63	37.53	35.38	33.68
28	37.52	43.73	40.68	39.30
50	41.30	47.25	42.25	41.60

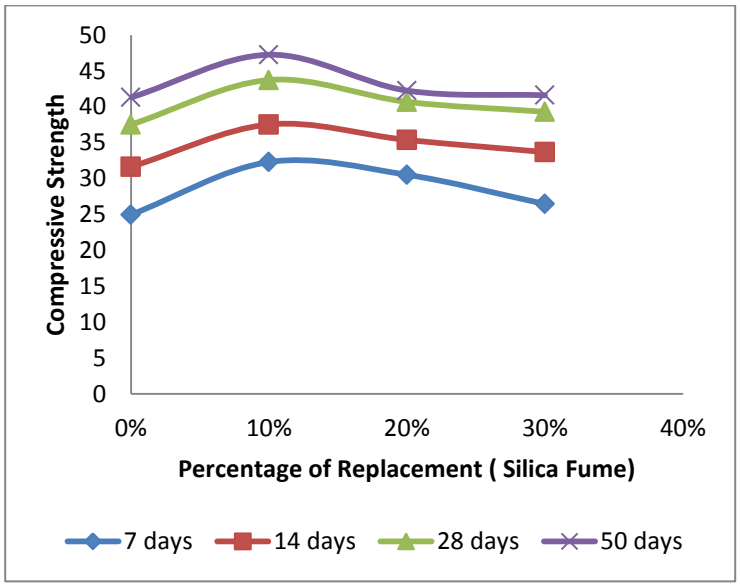


Figure 9: Compressive Strength of M30 Grade Contain of Silica Fume

Compressive strength of Containing Quarry dust

The result of UTM of M30 grade of concrete cube having quarry dust as replacement of cement with the percentage of 0%, 10%, 20% and 30% with normal aggregate (20 mm of 60% aggregate and 10 mm of 40% aggregate) nominal mix is given in Table 15

Table No 15 Compressive strength of M30 having Quarry dust

Compressive strength of M30 (N/mm²)				
Days	**0 %**	**10 %**	**20 %**	**30 %**
7	24.96	26.32	23.38	22.50
14	31.63	35.35	30.56	29.63
28	37.52	39.23	35.69	34.23
50	41.30	45.23	42.23	38.56

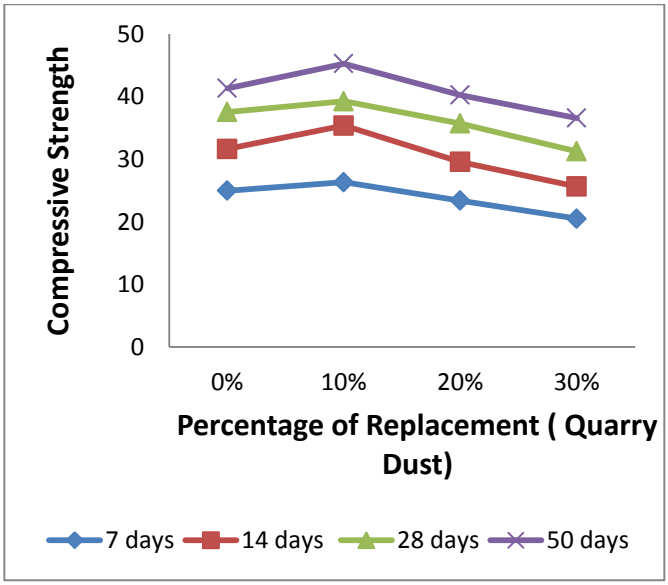
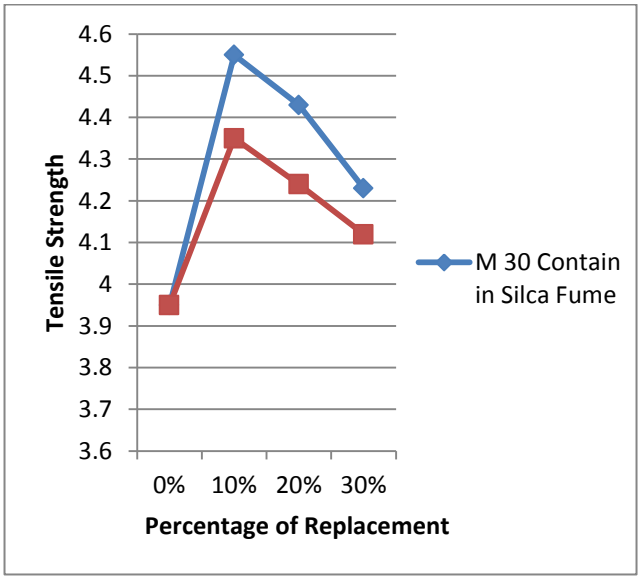


Figure 10: Compressive Strength of M30 Grade Contain of Quarry Dust

6 SPLIT TENSILE STRENGTH TEST

The result of the Split tensile strength determine by compression testing machine, with the fractional replacement of silica fume and quarry dust by cement with level of 10%, 20% and 30% with result determine the age of 28 days are appeared in the fig. 11 for M-30 concrete.

4.3.6.1 Split Tensile strength of cylinder concrete contain wood ash and silica fume

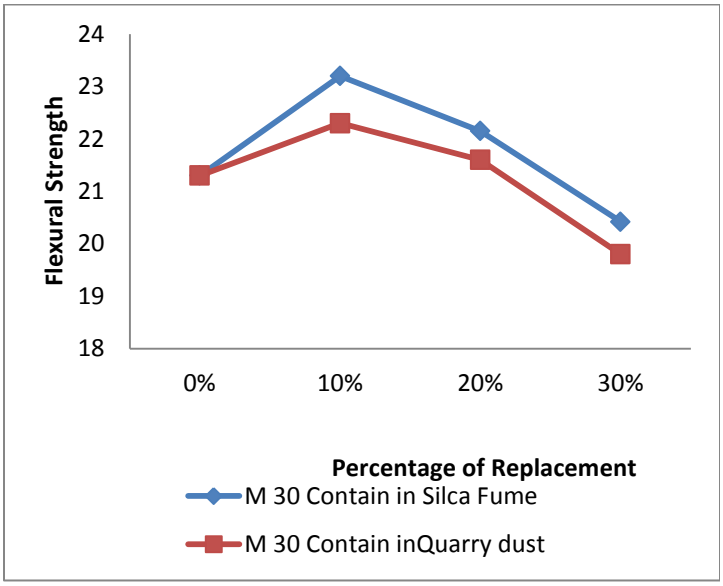


Flexural Strength Test

Flexural power furthermore called as modulus of satisfaction. In solid flexure is the bowing moment brought about by the applied burden, wherein a solid pillar has pressure at top and elastic concern at the base side. Shafts on testing will bomb in strain in light of its property and shear will appear on concrete.

In this test works completely 24 light emissions 700 x 100 x 100 are casted of M30 grades concrete and other degree of substitutions concerning 10%, 20% and 30% by silica smoke and quarry dust with concrete. By then examine the estimations of both arrangement mixes. The flexural estimations of different mixes.

Flexural strength of cylinder concrete contain silica fume & quarry dust



Conclusions

From the above analyses, the assessment communities the general execution of cement by using the silica smoke, and quarry dust as incomplete replacement of security. In the current work the quality assessment is finished which is explained in the going with centers:

- All of the solid containing silica smoke and quarry dust demonstrated ordinary consistency equivalent and higher than the control concrete. Up to 10%, and 20%replacement the typical consistency was for the most part steady minor contrasts, at 30% substitution the ordinary consistency had demonstrated a slight augmentation to 35%.
- Slump shows that the functionality increments with the expansion in the rates of contain silica smoke and quarry dust. All explored containing silica smoke and quarry dust blends had tallness droop esteems and worthy usefulness.
- The compressive quality outcomes speaks to that as the level of silica rage increments for M30 grade, compressive quality is increment, when the degree of the silica seethe increase from 0% to 30% at 7, 14, 28 and 50 days.
- The compressive quality outcomes speaks to that solid threw with M30 evaluation of cement at 7, 14, 28 and 50 days are lessen with substitutions of 20% to 30%, and increases, when the degree of the silica rage increase from 0 to 20% at 7, 14, 28 and 50 days.
- Flexural quality is augmentations when the 0 to 20% of level of the silica seethe increase and lessening from 30% utilized of silica rage with the age of 28 days. Flexural quality is additions when the 10% of level of the quarry dust augmentation and decrease from 20% to 30% utilized of quarry dust with the age of 28 days.
- Tensile quality of cement is reduces with the substitution of quaary dust on 30% substitution. Be that as it may, rigidity is extended with the substitution of quarry residue and silica smolder increases, with the level of 0 to 20% and 30% additionally on silica seethe at age of 28 days.

References

[1] Bayasi, Zing, Zhou, Jing, "Properties of Silica Fume Concrete and Mortar", ACI Materials Journal, vol. 90 , no.4, pp.349 – 356, 1993.

[2] DL. VenkateshBabu, SC. Nateshan, Investigations on silica fume concrete, The Indian concrete Journal, September, pp. 57-60, 2004.

[3] S.A.Khedr, M.N.Abou - Zeid, "Characteristics of Silica-Fume Concrete", Journal of Materials in Civil Engineering, vol.6, no.3, pp.357– 375, 1994.

[4] BhanjaSantanu, and Sengupta, Bratish, "Optimum Silica Fume Content and its Mode of Action on Concrete," ACI Materials Journal, vol.100, no.5, pp. 407-412, 2003.

[5] GR Sensualle, "Strength development of concrete with rice husk ash", Cement and Concrete Composites, 2006.

[6] Silica fume manual by Oriental TreximPvt. Ltd. (2003).

[7] M.S. Shetty, Concrete Technology, S. Chand and Company Pvt Ltd. New Delhi, India, 1999.

[8] Ha-Won Song, Seung-Woo Pack, Sang-Hyeok Nam, Jong-Chul Jang and VeluSaraswathy, Estimation of the permeability of silica fume cement concrete, Construction and building material, vol.24, pp.315-321,2010.

[9] A.Abdullah, Almusallam, Hamoud Beshr, Mohammed Maslehuddin and Omar S.B. Al-Amoudi, Effect of silica fume on the mechanical properties of low quality coarse aggregate concrete, Cement and Concrete Composites, vol.26, pp.891–90 , 2004.

[10] S.Bhanjaa and B.Sengupta, Influence of silica fume on the tensile strength of concrete, Cement and Concrete Research, vol.35, pp.743–747, 2005.

[11] Papayianni, G. Tsohos, N. Oikonomou, P. Mavria, "Influence of superplasticizer type and mix design parameters on the perfo rmance of them in concrete mixtures", Cement & Concrete Composite, vol.27, pp.217-222, 2005.

[12] V.Bhikshma, K.Nitturkarand Y.Venkatesham, "Investigations on mechanical properties of high strength silica fume concrete." Asian journal of civil engineering (building and housing), vol. 10, no. 3, pp.335-346, 2009.

[13] N.P.Rajamane, J.A. Peter, M.Neelamegam, J. K. Dattatreya and S. Gopalkrishnan, "Studies on compressive strength and porosity of high performance concrete containing silica fume", 22 -23 may, Madras, pp TS1-TS10, (conference proceedings).

[14] S.VishalGhutke, Prof. PranitaBhandari, Influence of silica fume on concrete, iosr journal of mechanical and civil engineering, pp 44-47,2014.