International Journal of Research
Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue14
November 2017

Experimental Study On The Effects Of Replacement Of Cement By Silica Fume Admixture And Pumice

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ABSTRACT:-*The aim of the project work is to study the behavior of conventional aggregate concrete replaced with pumice aggregates in volume percentages of 0%, 20%, 40%, 60%, 80% and 100% and cement replaced with the silica fume in weight percentages of 0%, 5%, 8%, 10%, 15% and 20%. The conventional mix has been designed for M20 grade concrete. In this investigation cubes, cylinders, beams and slabs of standard size have been cast and tested after 28days of curing period. Three specimens have been cast for each variable and thus totally 540 specimens are tested. With 20% pumice stone in the normal coarse aggregate and cement replaced with silica fume in weight percentages of 0%, 5%, 8%, 10%, 15% and 20%, compressive strength, split tensile strength, flexural strength and moment carrying capacity of concrete specimens increase upto 5% of silica fume and then decrease. With 40% pumice stone in the normal coarse aggregate and cement replaced with silica fume in weight percentages of 0%, 5%, 8%, 10%, 15% and 20%, compressive strength, split tensile strength, flexural strength and moment carrying capacity of concrete specimens increase upto 8% of silica fume and then decrease. With 60% pumice stone in the normal coarse aggregate and cement replaced with silica fume in weight percentages of 0%, 5%, 8%, 10%, 15% and 20%, compressive strength, split tensile strength, flexural strength and moment carrying capacity of concrete specimens increase upto 8% of silica fume and then decrease. With 80% pumice stone in the normal coarse aggregate and cement replaced with silica fume in weight percentages of 0%, 5%, 8%, 10%, 15% and 20%, compressive strength, split tensile strength, flexural strength and moment carrying capacity of concrete specimens increase upto 8% of silica fume and then decrease. With 100% pumice stone in the normal coarse aggregate and cement replaced with silica fume in weight percentages of 0%, 5%, 8%, 10%, 15% and 20%, compressive strength, split tensile strength, flexural strength and moment carrying capacity of concrete specimens increase up to 10% of silica fume and then decrease.*

I. INTRODUCTION

Solid, so normally accepted in structures, spans and in various different structures, is taken for granted as massive and profound development material. Not necessarily so! A broad range of lightweight cements is being manufactured nowadays. Initially, Romans established durability of lightweight cement by utilizing natural aggregates from volcanic stores. After the advancement of Portland bond in the early 1800s, however, it took the discovery and improvement of manufactured lightweight aggregates in the early 1900s to convey structural lightweight cement to full maturity. The primary aim of lightweight cement is to lessen the dead weight of cement to be utilized as a part of a structure which then allows an architect to diminish the measure of structural components (sections/beams) and size of foundation as well. Lightweight material has high potential to decrease the seismic mass of the structure and along these lines diminish the level of seismic powers acting on a structure.

Light weight cement has turned out to be more popular as of late attributable to the enormous advantages it offers over the conventional cement yet at the same time sufficiently solid to be utilized for the structural reason. The most important characteristic of light weight cement is its low thermal conductivity. This property enhances with decreasing density. Concrete with a density somewhere around 1350 and 1900 kg/m3 and a base compressive quality of 17 MPa is characterized as structural lightweight cement (ACI 213R-87, 1998).

Increasing utilization of lightweight materials in common organizing applications is making pumice stone an exceptionally popular raw material as a lightweight rock. Because of its having a decent ability for making the diverse items based on its physical, chemical and mechanical properties, the pumice aggregate finds a large usage in common industry as a development material.

Lightweight aggregates, because of their cellular structure, can absorb more water than normal weight aggregates. In a 24-hour absorption test, they generally absorb 5 to 20% by mass of dry aggregate, contingent upon the pore structure of the aggregate. Normally, under states of open air storage in stockpiles, total moisture substance does not surpass 66% of that value. This means that lightweight aggregates usually absorb water when placed in a solid blend, and the subsequent rate of absorption is important in proportioning lightweight cement. Because of this more absorption of water of light weight aggregate, internal curing will be maintained for a long stretch.

Pumice is a natural wipe like material of volcanic beginning formed from liquid lava rapidly cooling and trapping a huge number of small air bubbles. Pumice aggregates are abundant at the edges of volcanic mountains, particularly in Mediterranean area, Rocky Mountains in US, and most part of Turkey and Indonesia

Pumice is a natural aggregate of abundant asset around the world and it is environmentally well disposed. On the other hand, pumice is far from being completely used in lightweight cement at the time being. Solid structures are generally intended to take advantage of its compressive quality. The primary structural property of cement that a solid creator is generally concerned is the compressive quality of cement at a particular age.

II. EXPERIMENTAL METHOD

From the brief literature overview directed in this investigation it has been watched that despite the fact that parcel of research work was led on light weight concrete and in particular pumice concrete, extremely constrained work has been accounted for on the solid made with pumice (a light weight aggregate) as coarse aggregate along with the addition of an admixture in partial replacement of bond. Henceforth it is planned to concentrate on and evaluate the impact of distinctive replacements of natural coarse aggregate by light weight (pumice) aggregates and replacing the bond by silica rage admixture in various percentages. A M20 Concrete with constant water bond ratio of 0.50 has been adopted study various properties. 3D squares (of size 150 x 150 x 150mm), cylinders (of size 150 x 300mm), beams (of size 150 X 150 X 1500 mm) and slabs (of size 600 x 600 x 75mm) are cast and tried to know the compressive quality, split rigidity, flexural qualities, modulus of elasticity and minute carrying capacity.

To start with blend configuration has been led for M20 solid making utilization of ISI system for blend outline utilizing normal constituents of cement. Over the span of investigation, normal granite aggregate has been replaced by 0%, 20%, 40%, 60%, 80% and 100% of light weight aggregate namely pumice. In the present investigation the normal bond has been replaced by admixture (Silica Fume) in equal extents in six percentages i.e. 0, 5, 8, 10, 15, 20. For the investigation of various properties, diverse examples have been cast and tried. Here a constant water bond ratio of 0.50 has been adopted along with the usage of super plasticizer (SP-430) to maintain pretty much same workability all through the investigation.

Crack Pattern:

The vicinity of cracks is a characteristic structural feature of most concrete based materials. Miniaturized scale cracking may take place first as an outcome of the partial segregation of the aggregates and plastic shrinkage while the crisp cement is setting. Temperature contrasts and drying shrinkage advance further cracking of cement. After the solid hardens, various factors aggravate the already existing smaller scale cracks and cause the initiation of new ones. It is imagined that cracks, whatever their inception is (mechanical, thermal, chemical and so forth.), can act as major pathways for water or aggressive chemical particles to penetrate into concrete, enabling its deterioration.

The yield line hypothesis is a ultimate load hypothesis for outline of R.C Slabs. The yield line hypothesis is characterized as a line in the plane of the slab across which fortifying bars have yielded and about which exorbitant deformation under constant ultimate minute, keeps on happening leading to failure.

The improvement of yield lines and their propagation in case of a two way fortified slab contrast from that of restricted slab. In case of two way slab, on initial loading, the slab behaves elastically. In any case, as the load continues increasing cracking of cement on strain side starts in the course parallel to the more extended span at mid span area which is subjected to maximum bowing minute.

The lines of serious cracking, across which strain steel gets yielded, keep on developing and reach the sides of the slab shaping a collapse mechanism at ultimate state. The arrangement of yield lines or fracture lines which isolate the slab into fragments, framing a collapse mechanism is called Yield line pattern. At failure, the steel gets already yielded along the yield lines and the plastic deformations which are much greater than the elastic deformations happen along the yield lines.

The elastic deformations are small. Therefore it is reasonable to assume that the slab sections between the yield lines remain plane and all over the top deformations take place in the yield lines just.

In the present investigation two way square slabs with equal fortification on both bearings have been tried under consistently distributed load with all edges being just upheld. In case of slabs the initial crack has been produced at focus and propagated to all supporting edges. Afterwards the square bit of slab with in backings is seen to twist, punch through' and fail.

In case of beams the first crack created at bowing zone on pressure side of beam. In case of light weight aggregate (pumice) solid beams the first moment crack is produced at shear zone and propagates to bowing zone. The moment cracks are seen by magnifying lens. The major cracks are produced at twisting zone just.

The breaking sound of aggregate is more for 100% replacement of natural aggregate by pumice than 20% replacement of natural aggregate by pumice. Natural aggregate does not have any solid while pounding.

The crack widths are more in light weight aggregate cement than normal weight aggregate cement.

A. Cube Compressive Strength of silica fume

pumice concrete:

The Cube compressive quality results with various percentage replacements of natural aggregate by pumice are exhibited. The graphical variations of compressive quality versus percentage replacement of natural aggregate by pumice are From the above Table and Figure it may be watched that there is a decrease in compressive quality of 77% with 0% to 100% replacement of natural aggregate by pumice and at 20% replacement of natural aggregate by pumice with 10% replacement of silicafume by concrete the composed quality is achieved and the compressive quality is seen to be around 24.1 N/mm2.

The 3D square compressive quality results with 100% natural aggregate or 0% pumice stone and with diverse percentage replacement of concrete by silica smoke. The comparing graphical variation of compressive quality versus percentage replacement of bond by silica smoke is exhibited. it may be watched that there is an increase in compressive quality with the replacement of concrete by silica smoke up to 8% and afterwards the quality gets decreased.

The solid shape compressive quality results with 80% natural aggregate being replaced by 20% pumice and with distinctive percentage replacements of bond by silica smoke are introduced. The variation of compressive quality versus percentage replacement of bond by silica smoke is displayed. From the above it may be watched that there is an increase in compressive quality with replacement of bond by silica smoke up to 5% and afterwards the quality gets decreased.

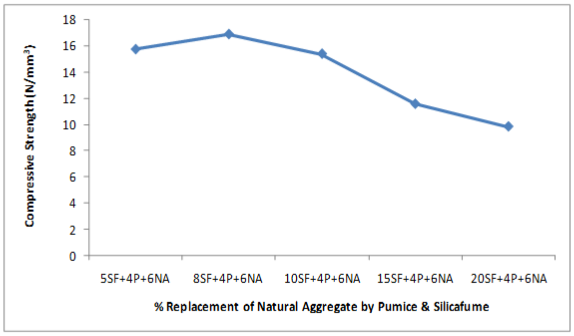
The block compressive quality results with 60% natural aggregate being replaced by 40% pumice and with diverse percentage replacements of bond by silica smoke are exhibited. The variation of compressive quality versus percentage replacement of concrete by silica smoke is displayed. From the above it may be seen there is an increase in compressive quality with replacement of concrete by silica smoke up to 8% and afterwards the quality gets decreased.

The block compressive quality results with 40% natural aggregate being replaced by 60% pumice and with diverse percentage replacements of bond by silica smoke are exhibited. The variation of compressive quality versus percentage replacement of concrete by silica smoke is displayed. From the above it may be watched that there is an increase in compressive quality for replacement of concrete by silica smoke up to 8% and from that point the quality gets decreased.

The solid shape compressive quality results with 20% natural aggregate being replaced by 80% pumice and with distinctive percentage replacements of concrete by silica smoke are displayed. The variation of compressive quality versus percentage replacement of bond by silica smoke is exhibited. From above it may be watched that there is an increase in compressive quality for replacement of bond by silica smoke up to 8% and from that point the quality gets decreased.

The solid shape compressive quality results with 0% natural aggregate being replaced by 100% pumice and with distinctive percentage replacements of concrete by silica smoke. The variation of compressive quality versus percentage replacement of bond by silica smoke. There is an increase in compressive quality for replacement of bond by silica smoke up to 10% and from that point the quality gets decreased.

Henceforth, from the above discussions it can be closed the 20% replacement of natural aggregate by 20% pumice and bond replacement with 5% silica seethe admixture should be ideal percentage as for compressive quality inside of the extent of present investigation, since for this combination target mean quality of the solid is achieved. Also pumice substance of 20% and 5% to 10% of silica smoke should be the recommendable range of percentage of silica smoke as with 10% outline quality of cement is achieved



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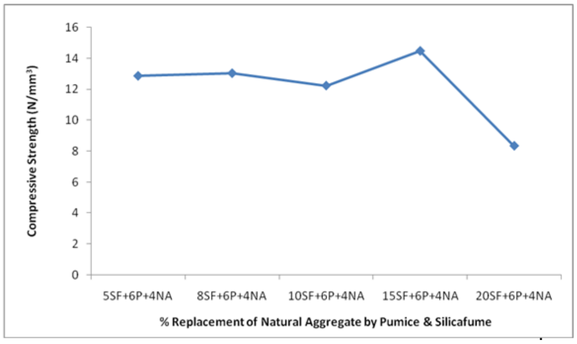

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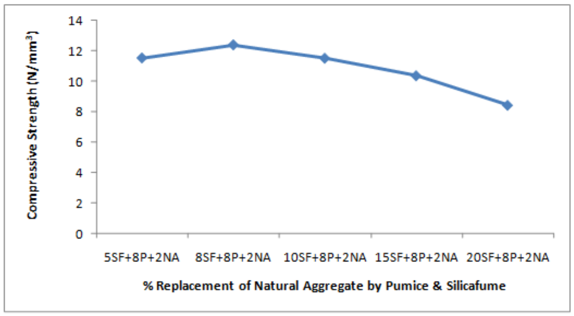


(c)

Fig1a, 1b, 1c: Cube compressive strength Vs Replacement of natural aggregate by Pumice

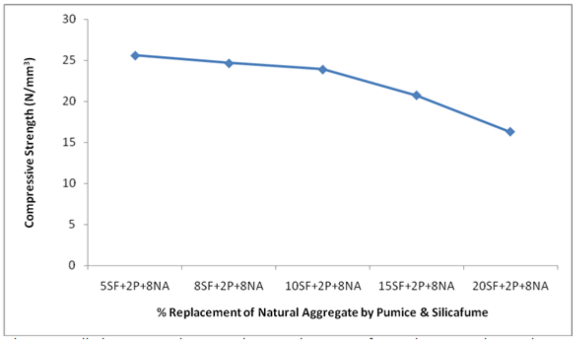
B. Cylinder Compressive Strength of silica fume pumice concrete:

In ASTM C39 (2001), the standard example for measurement of quality is a 150 mm (diameter)×300 mm (tallness) cylinder. In the event that the stature of the example is adequate, the anxiety distribution in the center is accounted for to be free of the end impacts and is in fairly uniform pressure.

The cylinder compressive quality results with various percentage replacements of natural aggregate by pumice are introduced. The graphical variations of compressive quality versus percentage replacement of pumice are exhibited. From the above it may be watched that there is a decrease in compressive quality of 73% for 0% to 100% replacement of natural aggregate by pumice.

The cylinder compressive quality results with 100% natural aggregate being replaced by 100% pumice and with distinctive percentage replacements of concrete by silica smoke. There is an increase in compressive quality for replacement of concrete by silica smoke up to 10% and from that point the quality gets decreased.

Consequently, from the above discussions it can be finished up the 20% replacement of natural aggregate by 20% pumice and bond replacement with 5% silica smolder admixture should be ideal percentage as for compressive quality inside of the extent of present investigation since for this combination target mean quality of the solid is achieved. Also pumice substance of 20% and 5% to 10% of silica smoke should be the recommendable range of percentage of silica smoke as with 10% outline quality of cement is achieved.



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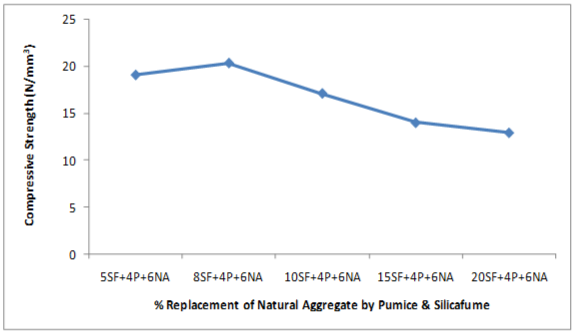

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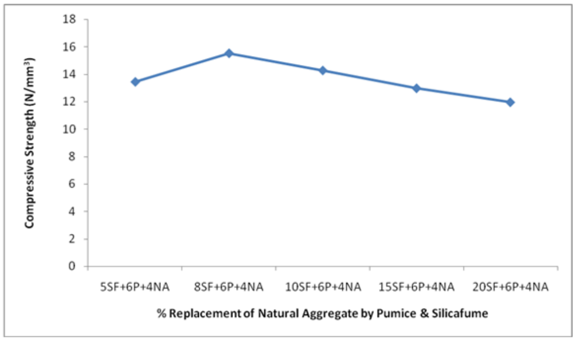


2(c)

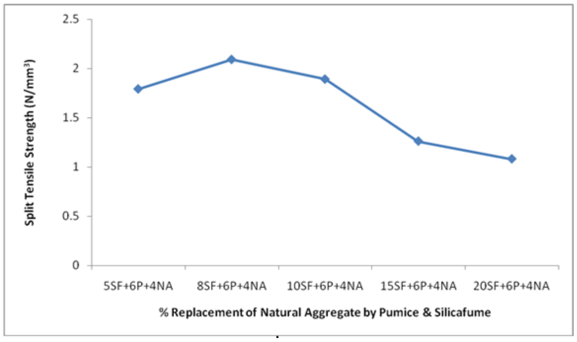
Fig.2a, 2b, 2c. .Cylinder compressive strength Vs Replacement of natural aggregate by Pumice

C. Split tensile Strength of silica fume pumice concrete:

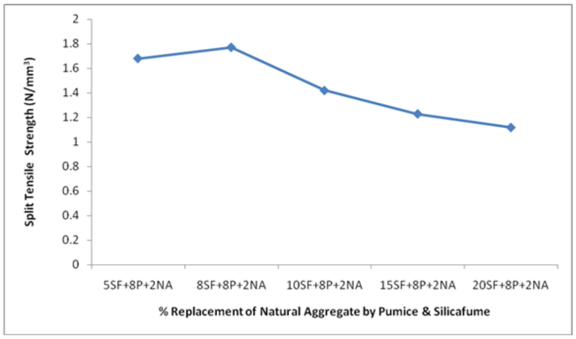
The split elasticity results with various percentages replacements of natural aggregate by pumice are introduced. There is a decrease in split rigidity of 65 % for 0% to 100% replacement of natural aggregate by pumice.

The split elasticity results with 100% natural aggregate and with distinctive percentage replacements of concrete by silica smoke are exhibited. There is an increase in split rigidity for replacement of bond by silica smoke up to 8% and from that point the split elasticity gets decreased.

Thus, from the above discussions it can be finished up the 20% replacement of natural aggregate by 20% pumice and bond replacement with 5% silica rage admixture should be ideal percentage regarding compressive quality inside of the extent of present investigation, since for this combination target mean quality of the solid is achieved. Also pumice substance of 20% and 5% to 10% of silica smoke should be the recommendable range of percentage of silica smoke as with 10% configuration quality of cement is achieved.



3(a)



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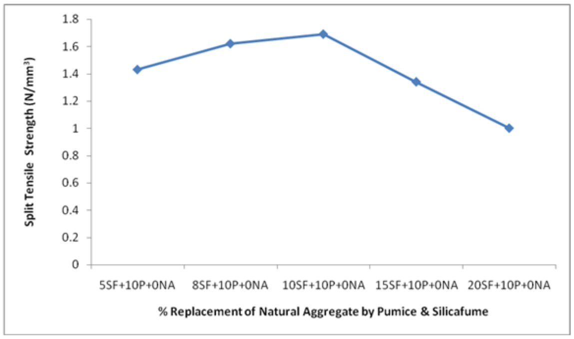


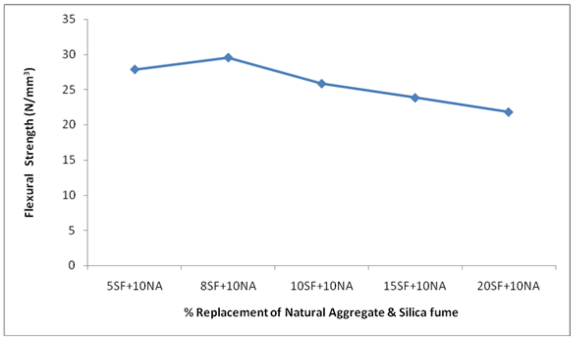
3(c)

Fig.3a,3b,3c..Split tensile strength Vs Replacement of natural aggregate by Pumice

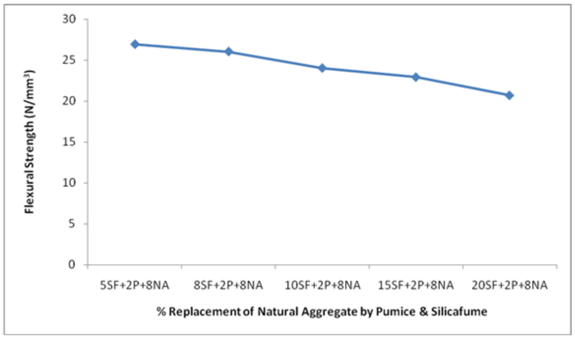
D. Flexural Strength of silica fume pumice concrete:

The flexural strength results with various percentage replacements of natural aggregate by pumice are presented. The variation of flexural strength versus percentage replacement of pumices is presented. From the above it may be observed that there is a decrease in flexural strength from 0% to 100% replacement of natural aggregate by pumice.

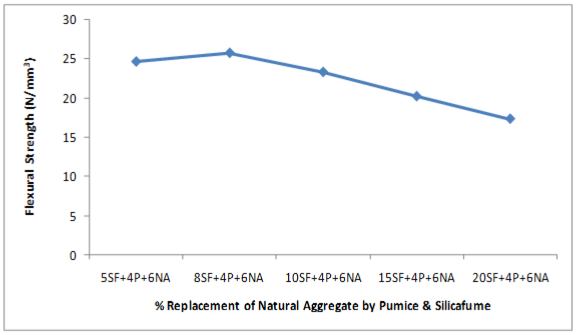
it may be observed that there is an increase in flexural strength for replacement of cement by silica fume up to 5% and from there the flexural strength gets decreased.



4a



4b



4c

Fig 4a,4b,4c .Flexural Strength Vs Replacement of natural aggregate by Pumice

III. CONCLUSION

The density of cement is found to decrease with the increase in percentage replacements of natural aggregate by pumice aggregate. It also takes after pretty much same pattern for cement made with replacement of bond by mineral admixture (silica fume).The compressive quality of cement is found to decrease with increase in pumice content. It is found to decrease from 39.648 to 9.166 MPa as the pumice substance is increased from 0 to 100 percent. The target mean quality of cement is obtained with 20percent replacement of coarse aggregate by pumice aggregate and with 5 percent of bond replaced with silica fume. However the compressive quality of pumice cement is seen to increase with the silica fume content and reaches an ideal values between 5 to 10% and afterwards gets decreased for various substance of pumice. Cylinder Compressive quality is seen to vary from 32.92 to 9.03MPa with the replacement of natural aggregate by pumice from 0 to 100 percent. However the chamber compressive quality of pumice cement is seen to increase with the silica smoke content and reaches an ideal values between 5 to 10% and afterwards gets decreased for various substance of pumice.

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