Effect of Partial Replacement of Cement and Sand by Silica Fume and Stone Dust in Concrete"- A Literature Review

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Abstract— In the ongoing past, there have been significant endeavors for enhancing the properties of cement as for quality and toughness, particularly in forceful conditions. The improvement of solid innovation can diminish the utilization of common assets and vitality sources and lessen the weight of toxins on condition. Proper introduction of silica fume and stone-dust in concrete improves both the mechanical and durability characteristics of the concrete. A large amount of by-product or wastes such as fly-ash, copper slag, silica fume, stone-dust etc. are generated by industries, which causes environmental as well as health problems due to dumping and disposal. The waste materials which can be utilized as extra cementitious material, appropriate presentation of silica smolder in cement enhances both the mechanical and toughness qualities of the solid. This paper present literature review on replacement of Cement by Silica Fume and sand by stone-dust which includes current and future trends of research.

Key words: Silica Fume, Stone Dust, PPC, Compressive, Splitting Tensile and Flexural Strength, Durability

I. INTRODUCTION

Leaving the waste materials to the setting specifically will cause ecological downside. In this manner the use of waste issue from Industries has been pushed. Waste will be wont to turn out new item or will be utilized as admixtures so common assets are utilized a ton of with proficiency and furthermore the setting is secured against waste. These mechanical squanders are drop inside the close land and furthermore the regular ripeness of the dirt is ruined. Silica Fume (smolder) is also called little oxide or dense oxide rage is utilized as a man-made pozzolanic admixture. It is a material resulting from decrease of quartz with coal in an electrical circular segment chamber inside the produce of synthetic component or ferrosilicon compound. Substance organization of oxide seethe Chemical composition of silica fume contains more than 90 percent silicon dioxide; other constituents are carbon, Sulphur and oxides of aluminum, iron, calcium, magnesium, sodium and potassium. The physical composition of silica fume Diameter is about 0.1micron to 0.2 microns, Surface area about 30,000 m²/kg and Density varies from 150 to 700 kg/m and Stone dust is a waste material obtained from crusher plants. It has widely to be used as partial replacement of natural river sand in concrete. Use of stone dust in concrete not only improves the quality of concrete but also conserve the natural river sand for future generations. Substitution of normal sand by stone dust will serve both solid waste minimization and waste recovery, it is also used in concrete now a days as a partially or fully replacement of sand. Quarry or stone dust has been used for different activities in the construction industry such as road construction and manufacture of building materials like lightweight aggregates, bricks, tiles and autoclave blocks. Use of quarry dust as fine aggregate in concrete draws serious attention of researchers and investigators.

II. REVIEWS OF ARTICLES

A. K. Perumal R. Sundararajan (2004):

Effect of Partial Replacement of Cement with Silica Fume on the Strength and Durability Characteristics of High Performance Concrete. Observe the effect of partial replacement of cement with silica fume on the strength and durability properties of high grade concrete. Strength and durability properties for M60, M70 and M110 grades of HPC trial mixes and to arrive at the maximum levels of replacement of cement with Silica fume, investigations were taken. The strength and durability characteristics of these mixes are compared with the mixes without Silica Fume. Compressive strengths of 60 N/mm^2, 70 N/mm^2 and 110 N/mm^2 at 28 days were obtained by using 10% replacement of cement with Silica Fume. The results also show that the Silica Fume concretes possess superior durability properties.

B. H. Katkhuda, B. Hanayneh and N. Shatarat (2009):

Influence of Silica Fume on High Strength Lightweight Concrete. Reviewed of this paper is to see the inaccessible impact of oxide fume on tensile, compressive and flexural strength on high strength light-weight concrete numerous experiments are applied by substitution cement by small oxide on 0%, 5%, 10%, 15%, 205 and 25% for a water-cement magnitude relation vary from 0.6 to 0.42. for each combine, split tensile, compressive and flexural strength were determined at 28 days. The results show that the tensile, compressive and flexural strength improved with silica fume inclusion however the optimum replacement share isn't constant because it depends on the water–cement ratio. The most effective doable share of SF replacement will increase with the rise of w/c ratio. This share is sort of a singular for durability wherever it s noted 15% for w/c 0. 6 and 0.30 and 25% for w/c 0.34, 0.38 and 0.42.

C. Nagabhushana and Sharadabai H (2011):

Use of crushed rock powder as replacement of fine aggregate in mortar and concrete''. The natural sand can be replaced by Crushed Rock Powder (CRP). The strength of mortar containing 40% CRP is much higher than normal mortar containing only sand as fine aggregate. The strength of CCRP mortar is less than that of CRP mortars. It is better to use CRP without removing the finer particles. For lean mortar mixes, CRP can be replaced up to 100%. For rich mortar mixes, CRP can be replaced up to 40%. It is concluded that the compressive strength, split tensile strength and flexural strengths of concrete are not affected with the replacement of sand by CRP as fine aggregate up to 40%. Hence, CRP can

be effectively used to replace natural sand, without reduction in the strength of concrete with CRP replacement level up to 40%.

D. Mukesh B. Patel, S. D. Charkha (2012):

Effect of silica fume and partial replacement of ingredients on flexural and split tensile strength of concrete (M20). It is observed that the flexure strength and split tensile strength for mix designations F00 (100% cement & 0% fly ash) is about 35-40 % higher than the conventional concrete. The increase in replacement of cement with fly ash results in gradual decrease in the strength of concrete. Crushed Stone dust can be partially used as fine aggregate with conventional river sand in concrete. Replacement of even PPC cement with fly ash is possible up to 30%. Combination of Silica fume and fly ash makes the concrete more cohesive and dense, thus reduces the permeability. There will be a good reduction in the cost of concrete by the usage of fly ash.

E. Faseyemi Victor Ajileye (2012):

Investigations on Micro Silica (Silica Fume) as Partial Cement Replacement in Concrete. Reviewed on the strength property of silica fume concrete. The particular gravity and chemical composition of silica fume and cement were replaced with silica fume from 0% to 25% and w/c ratio 0.50. The mix proportion was supported 1:2:4. Cubes (150 x 150 x 150 mm) be fashioned and cured during a solidification tank for 3, 7, 14 and 28 days.

F. N. K. Amudhavalli, Jeena Mathew (2012):

Studied the Effect of silica fume on the strength and durability characteristics of concrete. The main parameter investigated during this study is M35 grade concrete with partial replacement of cement by silicon dioxide fume by 0, 5, 10, 15 and 20%. An in depth experimental study in Compressive strength, split durability, flexural strength at age of 7 and 28 days were carried out. Results Shows that silicon dioxide fume in concrete has improved the performance of concrete in strength yet as in sturdiness side.

G. Dilip Kumar Singha Roy, Amitava Sil (2012):

Effect of Partial Replacement of Cement by Silica Fume on Hardened Concrete. They study on the strength parameters of concrete created with partial replacement of cement by Silica fume. Compressive strength, Flexural strength, Split Tensile strength have been determined for totally different trial mixtures of materials and these values are compared with the connected values of standard concrete. From the study it has been discovered that most compressive strength (both cube and cylinder) is noted for 10% substitute of cement with micro silicon dioxide and also the values are higher (by 19% and16.2% respectively) than those of the traditional concrete (for cube and cylinder) wherever as split tensile strength and flexural strength of the SF concrete are inflated by regarding 38.58% and 21.13% severally over those (2.6 N/mm^2 and 4.7 N/mm^2 respectively) of the traditional concrete once tenth of cement is replaced by SF.

H. Verma Ajay, Chandak Rajeevand Yadav R.K (2012):

Effect of Micro Silica on the Strength of Concrete with Ordinary Portland Cement, In this investigation using silica fume as a non-natural Pozzolanas. On adding 0%, 5%, 10% and 15% by weight of cement in concrete. Silica fume improves concrete through two mechanisms: Pozzolanic effect: & Micro filler effect: Silica fume increases the strength of concrete more than 25%. Silica fume is a material which can be an explanation of air Pollution this is a byproduct of some Industries use of micro silica with concrete decrease the air pollution. Silica fume also reduce the voids in concrete. Addition of silica fume reduces capillary absorption and porosity as fine particles of silica fume reacts by lime present into cement.

I. Vikas Srivastava, V.C. Agarwal and Rakesh Kumar (2012):

Effect of Silica Fume on Mechanical Properties of Concrete. They explained the use of micro silica will not significantly vary the unit mass of concrete. Silica fume will produce a much fewer permeable also high strength concrete, however it will not manufacture a concrete with a high mass for each unit volume. The addition of silica fume reduces workability. However, in some cases improved workability were also reported. Silica fume inclusion increases compressive strength significantly (6-57%) and increase in compressive strength depends upon replacement level. Tensile strength and flexural strength of silica fume concrete is similar to that of conventional concrete. Addition of silica fume improves bond strength of concrete. Modulus of elasticity of silica fume concrete is similar to that of conventional concrete.

J. H S Jadhav and R R Chavarekar (2013):

Role of Fly Ash and Silica Fume on Compressive Strength Characteristics of High Performance Concrete. The main objective of this paper is primarily deals with the compressive strength in high performance concrete of different concrete mixtures are cast and tested with different cement replacement levels with silica fume as (0%, 2.5%, 5%, 7.5%, 10%, 12.5%) by the weight of cement and water-cement (w/c) ratio is 0.30.

K. Dr. P. B. Sakthivel, C. Ramya, M. Raja (2013):

An Innovative Method of Replacing River Sand by Quarry Dust Waste in Concrete for Sustainability, In order to protect the natural resources such as river sand, this study has identified quarry dust, which is a waste product from stone crushing industry and available almost free-of-cost, as partial replacement for river sand. This study has brought out positive results that quarry dust can be effectively used as a partial replacing material up to 10% of natural river sand in M35 concrete. The study gives the greater compressive, flexural and split tensile strength.

L. Chandana Sukesh, Katakam Bala Krishna, P.Sri Lakshmi Sai Teja, S.Kanakambara Rao(2013):

Partial Replacement of Sand with Quarry Dust in Concrete, the test are carries dot at 7, 14, 21 and 28 days for ordinary mix and for the partial replaced samples. As the replacement of the sand with quarry dust increases the workability of the concrete is decreasing due to the absorption of the water by the quarry dust. The ideal percentage of the replacement of sand with the quarry dust is 55% to 75% in case of compressive strength. The further increasing the percentage of replacement can be made useful by adding the fly ash along

with the quarry dust so that 100% replacement of sand can be achieved.

M. I. B. Muhit, S. S. Ahmed, M. M.Amin and M. T. Raihan (2013):

Effects of Silica Fume and Fly Ash as Partial Replacement of Cement on Water Permeability and Strength of High Performance Concrete. This paper investigates the individual effects of micro silica as a partial replacement of Portland cement on water permeability, compressive strength, split tensile strength and flexural tensile strength of High Performance Concrete (HPC). The replacement levels of OPC by Silica Fume were 0%, 2.5%, 5%, 7.5%, 10%, 15% and 20%. 1% super-plasticizer is used in all the test specimens for better performance and to recognize the quick special effects of SF on the property of concrete. Water-cement ratio was kept 0.42 for every cases and the specimens be tested at ages of 7, 14 and 28 days. 7.5% Silica Fume were found to be optimum for maximum compressive strength, maximum split tensile strength the same as maximum flexural tensile strength.

N. Prof. Vishal S. Ghutke, Prof. Pranita S. Bhandari (2014):

Influence of Silica Fume on Concrete. It has been seen that when cement is replaced with silica fume compressive strength increases up to definite percentage (10% replacement of cement by silica fume). However higher replacement of cement with silica fume gives lesser strength. Since the results it is conclude with the aim of the silica fume is a superior replacement of cement. The rate of strength increase in silica fume concrete is high. They concluded that increase in w/c ratio strength of concrete decreases, As strength of 15% replacement of cement with SF be more than normal concrete. Compressive strength decreases when the cement replacement is above 15% of silica fume.

O. Amar Devendra Shitole, Sandhya Mathapati (2014):

The Use of Micro-Silica to improve the Compressive and Flexural Strength of Concrete. This present research work is mostly focused on one of such technique in which silica fume is used to get better the compressive and flexural strength of concrete. It gives the short information about how exactly silica fume affect strength and durability parameter like compressive strength, flexural strength of concrete. Different samples of M20 grade concrete be taken with water binder ratio as 0.5 to illustrate the effect of micro silica additions as 0%, 7.5% and 10% of cement replacement. For all mixes compressive strength was determined at 3, 7 and 28 days designed for 150 mm cubes. The experimental results showed that compressive strength for definite replacement of silica fume (i.e. at 7.5% is higher than conventional concrete).

P. J. Karthick, T.Rama, IIIN.Mani Bharathi (2014): An Experimental Study on usage of Quarry Rock Dust as Partial Replacement for Sand in Concrete M20. Based on the experimental investigation conducted following conclusions are made-

The compressive strength of cubes with 28 days curing of controlled specimen Q0 is observed as 23.25 N/mm2. For 20% quarry dust replaced specimen i.e., Q20, the strength has been increased to 19.18% and for 40% quarry dust replaced specimen i.e., Q40, the strength has been increased to 35.26% but for 60% quarry dust replaced specimen i.e., Q60, the strength has been increased only up to 12.73%

The split tensile strength of cylinders with 28 days curing of controlled specimen Q0 is observed as 1.66 N/mm2. For 20% quarry dust replaced specimen i.e., Q20, the strength has been increased to 60.24% and for 40% quarry dust replaced specimen i.e., Q40, the strength has been increased to 85.72% but for 60% quarry dust replaced specimen i.e., Q60, the strength has been increased only up to 12.05%

The flexural strength of beams with 28 days curing of controlled specimen Q0 is observed as 7.14 N/mm2. For 20% quarry dust replaced specimen i.e., Q20, the strength has been increased to 16.39% and for 40% quarry dust replaced specimen i.e., Q40, the strength has been increased to 21.98% but for 60% quarry dust replaced specimen i.e., Q60, the strength has been increased only up to 13.73%

Q. Poonam, Anoop Bishnoi, Manju Bala (2015):

Effect of Quarry Dust as Partial Replacement of Sand in Concrete, The Replacement of the sand with quarry dust shows an improved in the compressive strength of the concrete. The results show the decrease in the workability of concrete when the percentage of the replacement is increasing. The test conducted at 50% replacement showed that the water-cement ratio increased to 1.6 at which the slump cone failed completely. The ideal percentage of the replacement of sand with the quarry dust is 55% to 75% in case of compressive strength. The further increasing the percentage of replacement can be made useful by adding the fly ash along with the quarry dust so that 100% replacement of sand can be achieved.

R. Hanumesh B M, B K Varun, Harish B A (2015):

The Mechanical Properties of Concrete Incorporating Silica Fume as Partial Replacement of Cement. An experimental program has been carried out to study the produce of super plasticizer only and in conjunction with silica fume on some of the properties of fresh and harden of concrete. The major purpose is to calculate the compressive strength of control concrete of grade M20 and silica fume concrete formed by replacing cement in various percentages. To calculate the split tensile strength of control concrete of grade M20 and micro silica concrete formed by replacing cement in different percentage.

S. Nadeem Pasha, Mohammed Muqueem Ahmed, Mohammed Azeemuddin, Shaikh Minhajuddin, Waseem Ali (2015):

Study on Strength Characteristics of Silica Fume and Fly Ash as Partial Replacement of Cement. This paper presents a comparison of Compressive Strength, Split Tensile Strength, and Flexural Strength of the concrete made by Silica Fume replacing cement at different levels. A concrete mix of M30 grade is prepared through hand mixing (IS: 10262-2009). The Portland cement be partially replaced by Silica Fume at 0%, 12.5%, 15%, 17.5% respectively. For each mix 15 samples be casted, 12 cubes (150mm × 150mm × 150mm) 6 cubes used for compressive strength, 12 cylinders (150mm diameter ×300mm height), used for split tensile strength and 12 prisms

(100mm × 100mm × 500mm) used for flexural strength test at 7 and 28 days respectively.

T. S. Sundararaman and S Azhagarsamy (2015):

A Study on Performance of Concrete by Partial Replacement of Cement with Rice Husk Ash and Silica Fume. The main object of this study to investigate the mechanical properties of concrete with various substitute levels of cement by micro silica. Cement has been replaced by silica fume accordingly in the range of 5%, 10%, 15% & 20% by the weight of cement for M-20 mix. The compressive strength at 3 days, 7days and 28days have been obtained with normal curing condition. The optimum increase of strength with 10% replacement of silica fume.

U. Pranshu Saxena (2018):

Experimental Study on Mechanical Properties of M30 Concrete with Partial Replacement of Cement and Fine Aggregate with Silica Fume. The main purpose of this research work was to carry out the experiment on M30 concrete whose compressive, tensile and flexural strength was determined. For this investigation, the amount of silica fumes 0%, 5%, 10%, 15% & 20% are taken and replaced by the weight of cement. From the above results, following remarks may be concluded:

1) The compressive strength of the fresh concrete better with the increase in silica fume content up to a replacement level of 15%.
2) The tensile strength of the fresh concrete has increased up to a replacement % of 20%.
3) Maximum flexural strength of the fresh concrete increased by 15% substitution of cement by Silica Fume.
4) Beyond the replacement level of 20% of cement with SF in concrete, a decrease in strength was determined.

V. Anurag Jain, P. Y. Pawade (2015):

Characteristics of Silica Fume Concrete. The physical properties of high strength micro silica concrete and their sensitivity to curing procedures be evaluate and compare with reference Portland cement concretes, having either the same concrete content as the micro silica concrete or the similar W/C ratio. Besides, the compressive strength results obtained on concrete core in use after a 4-year period from an investigational column build with a very high-strength concrete also complete that there be no trend for strength loss in silica-fume concretes. The experimental program comprised 6 levels of micro silica contents (as partial replacement of cement by weight) at 0% (control mix), 5%, 10%, 15%, 20%, and 25%, by super plasticizer.

W. B Anusha Priya and U. Vamsi Mohan (2015):

Experimental Studies on the Effect of Silica Fume and Quarry Dust in Concrete. The main parameter investigated in this study is M20 grade concrete with partial replacement of cement by silica fume by 0, 10 and 15% and Quarry dust by 20, 30, and 40%. Silica Fume and Quarry Dust are used in production of concrete cubes by replacement levels of 10% and 15% by weight of cement and 20%, 30%and 40% by weight of sand respectively. These cubes were cured and tested for compressive strength for 7, 14, 28, 56 and 90 days and results were noted.

Based on the experimental investigation conducted following conclusions are made-

- By replacement of 15% silica fume with cement and 30% Quarry Dust with sand, observed that the compressive strength for cubes increases by 9.93%, 14.30%, 22.55%, 27.28% and 30.97% for 7, 14, 28, 56 and 90 days respectively.
- By replacement of 15% silica fume with cement and 30% Quarry Dust with sand, observed that the split tensile strength for cylinders attains maximum strength of 3.02 N/mm2 which increases by 23.26%.
- By replacement of 15% silica fume with cement and 30% Quarry Dust with sand, observed that the compressive strength for cylinders attains maximum strength of 30.18 N/mm2 which increases by 27.02%. By replacement of 15% silica fume with cement and 30% Quarry Dust with sand, observed that the Ultrasonic pulse velocity strength of cubes indicates the quality of concrete is excellent.

X. Alok Kumar, Shubham Jain, Shubham Gupta, Sonaram, Sanjay Merawat (2016):

A Research Paper on Partial Replacement of Cement in M-30 Concrete from Silica Fume and Fly Ash. This study investigate the performance of concrete mix in terms of Compressive strength for 7 and 28 days, Flexural strength of beam 28 days and Splitting tensile strength of Cylinder for 28 days respectively of M30 grade concrete. The replacement levels of OPC with Silica Fume were 0%, 2.5%, 5% and 7.5%. 1% super-plasticizer is used in the entire test specimen for improved workability at lesser W/C ratio and to classify the sharp special effects of SF on the properties of concrete. W/C ratio was kept 0.43 for every case. These Concrete specimens are deep cured in water below standard atmospheric temperature. On the beginning of result that partial replacement of cement in M30 concrete from Silica Fume was found to increase in all strength (Compressive, Flexural & Splitting Tensile strength) and durability of various mix of concrete on all age when compared to ordinary concrete its use should be promote for improved performance as well as for environmental sustainability.

Y. Sasikumar & Tamilvanan (2016):

Performed an Experimental Investigation on Properties of Silica Fumes as a Partial Replacement of Cement. Main parameter investigated in this study is M30 grade concrete with partial replacement of cement by silica fume 0%, 25%, 30%, 40% and 50%. The normal consistency increases about 40% when silica fume percentage increases from 0% to 25%.The optimum 7 and 28-day compressive strength has been obtained in the 25 % silica fume replacement level. Also the split tensile strength is high when using 25% silica fume replacement for cement.

Z. Nagaradona Mahaboob Basha and C Rajamallu (2016):

An experimental study on the properties of cement concrete made by replacing cement by silica fume and fine aggregate by stone dust. The compressive strength and flexural strength for M20 concrete for both 28 days and 56 days is higher than the other proportions; the compressive strength for M10 concrete is 47.84 N/mm^2 and 54.84 N/mm^2 for 28 and 56 days respectively. The flexural strength for M10 concrete is 3.30

N/mm^2 and 3.66 N/mm^2 for 28 and 56 days respectively; the compressive strength for M20 concrete is 49.00 N/mm^2 and 56.22 N/mm^2 for 28 and 56 days respectively. The flexural strength for M20 concrete is 3.37 N/mm^2 and 3.75 N/mm^2 for 28 and 56 days respectively. This is higher than M10 and M30; the compressive strength for M30 concrete is 43.72 N/mm^2 and 53.53 N/mm^2 for 28 and 56 days respectively. The flexural strength for M30 concrete is 3.01 N/mm^2 and 3.57 N/mm^2 for 28 and 56 days respectively. The compressive strength of cement mortar with replacement of 10% silica fume got the value of 27.14 N/mm^2 and 32.63 N/mm^2 for 28 and 56 days respectively.

III. Conclusion

Based on the experimental investigation conducted following conclusions are made. Industrial waste materials are used as partial replacement of cement at different levels produced concrete with high strength and acceptable structural grade concrete. Curing conditions adopted in this research produced significant changes in the properties of concretes especially those containing different replacement levels. Silica Fume retards the initial setting time and accelerates the final setting time of concrete. High volume Silica Fume replacement is not appropriate because of its high water absorption capacity. Researchers presented various different suggestions and all are not unique in connection with the usage of quarry dust the crushed rock material as an alternative to natural sand. Most of them investigated normal mechanical properties like compressive, flexural and split tensile strength of quarry dust as fine aggregate in concrete. Due to higher strength than control concrete they suggested that the quarry dust may be utilized in place of sand up to some extent. Least number of investigations was carried out on concrete durability if sand was replaced by quarry dust and cement by silica fume. This research is planned to investigate in addition to normal mechanical properties flexural strength of RCC beam, temperature effect and permeability with and without super plasticizer. From the above study it is concluded that the quarry dust may be used as a replacement material for fine aggregate. Quarry dust has been used for different activities in the construction industry such as road construction and manufacture of building materials. As the properties are good as sand, the quarry dust is used as fine aggregate in replacement with sand in cement concrete.

References

[1] K. Perumal R. Sundararajan (2004): Effect of Partial Replacement of Cement with Silica Fume on the Strength and Durability Characteristics of High Performance Concrete 29th Conference on Our World in Concrete & Structures: 25 - 26 August 2004, Singapore Article Online Id: 100029050.

[2] H. Katkhuda, B. Hanayneh and N. Shatarat (2009): Influence of Silica Fume on High Strength Lightweight Concrete International Journal of Civil, Environmental, and Structural, Construction and Architectural Engineering, 2009, Vol.: 3, Issue: 10.

[3] Nagabhushana and Sharadabai H (2011): "Use of crushed rock powder as replacement of fine aggregate in mortar and concrete ", Indian Journal of Science and Techno, Vol. 4, No. 8, pp1698-1724, 2011.

[4] Mukesh B. Patel, S.D. Charkha (2012): Effect of silica fume and partial replacement of ingredients on flexural and split tensile strength of concrete (M20). International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 2, Issue 3, May-Jun 2012, pp.1782-1785

[5] Faseyemi Victor Ajileye (2012): Investigations On Micro Silica (SF) As Partial Cement Replacement In Concrete Global Journal Of Researches in Engineering Civil And Structural Engineering Version 1.0 Jan 2012 Type: Double Blind Peer Reviewed International Research Journal Publisher: Global Journals Inc. (USA) Online ISSN: 2249-4596, Volume 12 Issue 1.

[6] N. K. Amudhavalli, Jeena Mathew (2012): Effect of SF on Strength & Durability Parameters of Concrete International Journal of Engineering Sciences & Emerging Technologies, Aug 2012. ISSN: 2231–6604, Vol.3, Issue1, pp: 28-35.

[7] Dilip Kumar Singha Roy, Amitava Sil (2012): Effect of Partial Replacement of Cement by Silica Fume on Hardened Concrete International Journal of Emerging Technology and Advanced Engineering, Aug 2012, ISSN 2250-2459, Volume 2, Issue 8.

[8] Verma Ajay, Chandak Rajeevand Yadav R.K.(2012): Effect Of Micro Silica On The Strength Of Concrete With Ordinary Portland Cement, 15th June 2012, ISSN 2278 – 9472 Vol. 1, Issue 3, pp. 1-4, Sept. (2012).

[9] Vikas Srivastava, V.C. Agarwal And Rakesh Kumar (2012): Effect Of SF On Mechanical Properties Of Concrete J. Acad. Indus. Res., Sept 2012, Issn: 2278-5213, Vol. 1, Issue 4.

[10] H S Jadhav and R R Chavarekar (2013): Role of Fly Ash and SF on Compressive Strength Characteristics of High Performance Concrete, Feb 2013, ISSN 2319 – 6009, Vol. 2, Issue 1.

[11] Dr. P.B.Sakthivel, C.Ramya, M.Raja (2013): An Innovative Method of Replacing River Sand by Quarry Dust Waste in Concrete for Sustainability, International Journal of Scientific & Engineering Research Volume 4, Issue 5, May-2013 ISSN 2229-5518

[12] Chandana Sukesh, Katakam Bala Krishna, P.Sri Lakshmi Sai Teja, S.Kanakambara Rao(2013): Partial Replacement of Sand with Quarry Dust in Concrete,International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-6, May 2013

[13] B. Muhit, S. S. Ahmed, M. M. Amin and M. T. Raihan (2013): Effects of Silica Fume and Fly Ash as Partial Replacement of Cement on Water Permeability and Strength of High Performance Concrete Proc. of Int. Conf. On Advances In Civil Engineering, Aetace Department Of Civil Engineering, Chittagong University Of Engineering & Technology, Chittagong-4349, Bangladesh

[14] Prof. Vishal S. Ghutke, Prof. Pranita S.Bhandari (2014): Influence Of Silica Fume On Concrete Iosr Journal Of Mechanical And Civil Engineering (Iosr - Jmce), E-Issn: 2278-1684, P-ISSN: 2320-334.

[15] Amar Devendra Shitole, Sandhya Mathapati (2014): The Use of Micro-Silica to Improve the Compressive and Flexural Strength of Concrete. International Journal of Mechanical and Production Engineering, Aug.-2014, ISSN: 2320-2092, Volume- 3, Issue-6.
[16] J. Karthick, T.Rama, IIIN.Mani Bharathi (2014): An Experimental study on Usage of Quarry Rock Dust as Partial Replacement for Sand in Concrete. International Journal of Advanced Research in Education Technology (IJARET) Vol. 1, Issue 1 (July - Sept. 2014)
[17] Poonam , Anoop Bishnoi , Manju Bala (2015): Effect of Quarry Dust as Partial Replacement of Sand in Concrete, International Journal of All Research Education and Scientific Methods (IJARESM) ISSN: 2455-6211, Volume 3, Issue 6, June- 2015
[18] Hanumesh B M, B K Varun, Harish B A (2015): The Mechanical Properties of Concrete Incorporating Silica Fume as Partial Replacement of Cement International Journal of Emerging Technology and Advanced Engineering, September 2015, ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 5, Issue 9.
[19] Nadeem Pasha, Mohammed Muqueem Ahmed, Mohammed Azeemuddin, Shaikh Minhajuddin, Waseem Ali (2015): Study On Strength Characteristics Of Silica Fume And Fly Ash As Partial Replacement Of Cement, IJSRD - International Journal For Scientific Research & Development, 2015, ISSN (online): 2321-0613, Vol. 3, Issue 02.
[20] S Sundararaman and S Azhagarsamy (2015): A Study on Performance of Concrete by Partial Replacement of Cement with Rice Husk Ash and Silica Fume ISSN: 2394 - 658X, Volume 4, Issue 1.
[21] Pranshu Saxena (2015): Experimental Study on Mechanical Properties of M30 Concrete with Partial Replacement of Cement and Fine Aggregate with Silica Fume. IJRET: International Journal of Research in Engineering and Technology, ISSN: 2319-1163, ISSN: 2321-7308 Volume 4, Issue 7.
[22] Anurag Jain, P. Y. Pawade (2015): Characteristics of Silica Fume Concrete International Journal of Computer Applications, ISSN: 0975-8887, Volume 7, Issue 5.
[23] B Anusha Priya and U.Vamsi Mohan (2015): Experimental Studies on the Effect of Silica Fume and Quarry Dust in Concrete. International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 9, September 2015
[24] Alok Kumar, Shubham Jain, Shubham Gupta, Sonaram, Sanjay Merawat (2016): A Research Paper on Partial Replacement of Cement in M-30 Concrete from Silica Fume and Fly Ash, ISSN (p): 2319 – 1805, Volume 2, Issue 2, pp. 47-52.
[25] Sasikumar, A. (2016): Experimental Investigation on Properties of Silica Fumes as a Partial Replacement of Cement. International Journal of Innovative Research in Science,, 5 (3), 4392-4395.
[26] Nagaradona Mahaboob Basha and C Rajamallu (2016): ''An experimental study on the properties of cement concrete made by replacing cement by silica fume and fine aggregate by stone dust''. International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2763 Issue 06, Volume 3 (June 2016)

