EXPERIMENTAL STUDY ON THE BEHAVIOR OFCONCRETE BY REPLACEMENT OF FINE AGGREGATE WITH GRANITE POWDER AND CEMENT WITH ALCCOFINE 1203

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ABSTRACT:-**Environmental concerns caused by the extraction of raw materials and CO_2 emissions in the production of Portland cement led to pressures to reduce the consumption of this constituent of concrete, combined with the need to increase its durability. The cement is the most costly and energy intensive component of concrete. The unit cost of concrete can be reduced as much as possible by partial replacement of cement with other waste pozzolanic materials. Certain materials of mineral origin are also added to concrete to enhance their strength and durability properties of concrete materials such as Granite Powder needles and other by product like Alccofine-1203. Granite powder and alccofine can be used in a combination as supplementary cementitious material as partial replacement of cement and Fine aggregate. 15% alccofine with 15% Granite powder (K3) gives 32% increase in compressive strength which is 31.65N/mm^2 of this newly modified concrete in comparison with conventional concrete of M35 grade which is optimum amongst other combinations within 7 Days. 15% alccofine with 15% Granite powder (K3) gives 34% increase in compressive strength which is 38.45 N/mm^2 of this newly modified concrete in comparison with conventional concrete of M35 grade which is optimum amongst other combinations within 14 Days. 15% alccofine with 15% Granite powder (K3) gives 42% increase in compressive strength which is 48.07 N/mm^2 of this newly modified concrete in comparison with conventionalconcrete of M35 grade which is optimum amongst other combinations within 28 Days. 15% alccofine with 15% Granite powder (K3) gives increase in Tensile strength which is 2.76N/mm^2, 3.23N/mm^2 and 3.89N/mm^2 within 7 Days, 14 Days and 28 Days alternatively. 15% alccofine with 15% Granite powder (K3) gives increase in Flexural strength which is 8.6N/mm^2, 9.1N/mm^2 and 10.5N/mm^2 within 7 Days, 14 Days and 28 Days alternatively. Percentage increase in Granite Powder results in**

decrease of strength parameters i.e. combination having 20%, 25%, 30% of Granite Powder gives less increase in results for this mix proportion.

Index Terms: — Granite Powder, Alccofine-1203, Compressive strength, Tensile Strength, Flexural Strength, Specific gravity, Concrete, Cement.

I INTRODUCTION

Concrete is the most widely used man made construction material in the world. It is obtained by mixing cement materials, water and aggregates, and sometimes admixtures in required proportions. The mixture when placed in forms and allowed to cure hardens into a rock – like mass known as concrete. The hardening is caused by chemical reaction between water and cement and continues for a long time, and consequently the concrete grows stronger with age. Concrete is generally classified as a normal strength concrete, high strength concrete and ultra-high strength concrete etc. As per Indian standard a recommended method of mix design denotes the boundary of 35Mpa between Normal strength concrete and high strength concrete. But as per international forum, the high strength concrete label was applied to concrete having strength above 40MPa. Now it have been rose to 55MPa as per IS 456-2000.

The strength, durability and other characteristics of a concrete depend upon the properties of its ingredients, on the proportion of mix, the method of compaction and other controls during placing, compaction and curing. The key to producing a strong, durable and uniform concrete i.e. high performance concrete lies in careful control of its basic and process components i.e. cement, aggregate, water, chemical admixtures and other supplementary cementing materials. Certain materials of mineral origin are also added to concrete to enhance their strength and durability properties of concrete materials such as Granite powder and other byproduct like Alcofine and silica fumes which are generally very fine, may be finer than cement, when added to concrete in right proportion can improve the strength and durability of concrete drastically and high strength and high performance concrete is obtained in this manner. So modern concrete can have more ingredients mentioned earlier and like many other composites, property of concrete can be suitably tailored for specific construction related performance.

Cement production is the most energy intensive material produced after steel and aluminum. More than 7 per cent of world's carbon dioxide emissions are attributed to Portland cement. In addition to CO_2 emissions, the burning of Portland cement at high temperature (1450^0C) is costly in terms of fossil fuel usage. Moreover by some estimate concrete industry is the largest consumer of natural resources such as water, sand, gravel and crushed rock. Thus for sustainable development it is recognized that considerable improvements are necessary in productivity, energy efficiency and environmental performance.

MATERIAL USED

Following Material are used for studying the mechanical properties for his study used agriculture waste, eco-friendly material. Materials to be used are as follows:

Granite Powder

Granite power if formed by igneous rock composed mostly of quartz, alkali feldspar and plagioclase. It forms magma with a high content of silica and alkali metal oxide that slowly solidifies underground. It is common in Earth's continental crust, where it is found in various kinds of igneous intrusions. Granites powder can be predominantly white, pink, or gray in color, depending on their mineralogy. Granitic rocks are classified according to the QAPF diagram for coarse grained plutonic rocks and are named according to the percentage of quartz, alkali feldspar (orthoclase, sanidine, or microcline) and plagioclase feldspar on the A-Q-P half of the diagram. True granite (according to modern petrologic convention) contains between 20% and 60% quartz by volume, with 35% to 90% of the total feldspar consisting of alkali feldspar. Granitic rocks poorer in quartz are classified as syenites or monzonites, while granitic rocks dominated by plagioclase are classified as granodiorites or tonalites. Granitic rocks with over 90% alkali feldspar are classified as alkali feldspar granites. Graniticrock with more than 60% quartz, which is uncommon, is classified simply as quartz-rich granitoid or, if composed almost entirely of quartz, as quartzolite.

True granites are further classified by the percentage of their total feldspar that is alkali feldspar. Granites whose feldspar is 65% to 90% alkali feldspar are syenogranites, while the feldspar in monzogranite is 35% to 65% alkali feldspar. A granite containing both muscovite and biotite micas is called a binary or two-mica granite.

ALCCOFINE:- Alccofine is manufactured in the controlled conditions with special equipment to produce optimized particle size distribution which is its unique property. Alccofine 1203 and Alccofine 1101 are two types with low calcium silicate and high calcium silicate respectively. The computed blain value based on PSD is approximately 12000cm^2/gm and is truly ultra- fine. Due to its ultra-fineness of Alccofine 1203, it provides reduced water demand for a given workability, even up to 70% replacement level as per requirement. There are many byproducts which are generated from industries and factories, dumped openly which cause environmental problems and also spread diseases. These byproducts can be utilized in useful way to save the environment. These by-products or so called waste materials are fly ash, silica fume, ground granulated blast furnace slag and alccofine which are being reused now a days in construction industries for soil stabilization or concrete production mainly by making few stabilized changes in these waste materials.

- Alccofine Micro Materials are a range of products of Counto Microfine Products Pvt. Ltd (CMPPL) – a joint venture between ACL and the Goa-based, Alcon Group, launched in the year 2013.

  The two products that have been launched are Alccofine 1203 (a supplementary cementitious material suitably replaces Silica fume used in high performance concrete); and Alccofine 1101 (a micro-fine cement based product used for injection grout in underground tunnels and soil stabilization etc)

- It is a new-generation, ultrafine product whose basic raw material is slag of high glass content with high reactivity obtained through the process of controlled granulation.
- The raw materials are composed primarily of low calcium silicates. The processing with other select ingredients results in controlled particle size distribution (PSD). Due to its unique chemistry and ultra-fine particle size, ALCCOFINE 1203 provides reduced water demand for a given workability, and can also be used as a high range water reducer to improve compressive strength or as a super workability aid to improve flow.

A. Packing effect of Alccofine

1) Effectiveness of packing depends upon differences in particle size between cement and additives and extent of hydrated products generated during hydration.
2) The secondary hydrated products formed due to pozzolanic and cementitious hydration reaction fills the pores. This reduces the permeability of hydrated product to great extent.
3) Packing effect retards ingression of aggressive agents in concrete even by diffusion and thus enhances durability concrete. Many deteriorating effects like corrosion, carbonation, sulfate attack etc. may be minimized or stopped.

B. Applications - Alccofine 1101 Micro fine Cement - Grout

1) Used in Tunnels, caverns, mines, etc. as Rock injection.
2) Used for pre-and post-excavation injection.
3) Soil stabilization and sealing of ground water.
4) Soil injection
5) Pre-packed injection
6) Contact injection

C. Benefits of Alccofine 1101

1) Standard cement injection equipment can be used
2) Better penetration in tight joints, fissures and pore spaces
3) Greater penetration imparts greater water tightness
4) Fast setting
5) Better working environment and no hazardous components
6) Durable
7) Economical solution

II LITERATURE SURVEY

T. Felixkala *et al.* [1] had obtained the test results that granite powder of marginal quantity as partial sand replacement has beneficial effect on the mechanical properties such as compressive strength, split tensile strength, modulus of elasticity. They also indicated that the values of both plastic and drying shrinkage of concrete in the granite powder concrete specimens were nominal than those of ordinary concrete specimens. They examine the possibility of using granite powder as replacement of sand and partial replacement of cement with fly ash, silica fume, slag and superplasticiser in concrete. The percentage of granite powder added by weight was 0, 25, 50, 75 and 100 as a replacement of sand used in concrete and cement was replaced with 7.5% silica fume, 10% fly ash, 10% slag and 1% superplasticiser. The effects of water ponding temperatures at 26℃ and 38℃ with 0.4 water- to-binder (w/b) ratios on mechanical properties, plastic and drying shrinkage strain of the concrete were studied and compared with natural fine aggregate concrete. **Kanmalai Williams *et al.* [2]** reported the results of an experimental study on the high performance concrete made with granite powder as fine aggregate. The percentage of granite powder added by weight a range viz. 0, 25, 50, 75 and 100% as a replacement of sand used in concrete and cement was replaced with 7.5%Silica fume, 10% fly ash, 10% slag and 1% super plastiziser. The effects of curing temperature at 32 Sand 0.40 water-to-binder (w/b) ratio for 1, 7, 14, 28, 56 and 90 days on compressive strength, split tensile strength, modulus of elasticity, drying shrinkage and water penetration of concrete were studied. Their results indicated that the increase in the proportions of granite powder resulted in a decrease in the compressive strength of concrete. The highest compressive strength was achieved in samples containing 25% granite powder concrete, which was 47.35 kPa after 90 days. The overall test performance revealed that granite powder can be utilized as a partial replacement of natural sand in high performance concrete. **M. G. Shaikh *et al.* (2011) [3]** has found that the mixes with the artificial sand with dust as fine aggregate gives consistently higher strength than the mixes with natural sand. The sharp edges of the particles in artificial sand provide better bond with the cement than the rounded part of the natural sand. It was found that the weight loss of artificial sand block is considerably same with respect to natural sand blocks at 20, 40, and 60 and 90 days, immersed in sulphuric acid solution during the experimental period and maintains pH 4 across it. Both concrete made using artificial sand and natural sand are moderate to chloride permeability. In water absorption test we observed after 24 hours curing, the increase in weight of both natural sand and artificial sand blocks are less than 3% that means both concrete are low absorber hence concretes are good quality. The test result obtained fromwell planned and carefully performed experimental program encourage the full replacement of natural sand by artificial sand with dust considering the technical, environmental and commercial factor. **R. Ilangovana *et al.* (2008) [4].** The Durability of Quarry Rock Dust concrete under sulphate and acid action is higher inferior to the Conventional Concrete. Permeability Test results clearly demonstrates that the permeability of Quarry Rock Dust concrete is less compared to that of conventional concrete. The water absorption of Quarry Rock Dust concrete is slightly higher than Conventional Concrete Therefore; the results of this study provide a strong support for the use of Quarry Rock Dust as fine aggregate in Concrete Manufacturing. Thus, it can be concluded that the replacement of natural sand with Quarry Rock Dust, as full replacement in concrete is possible. **B. B. Patel *et al.* (2012) [5].** The compressive strength of concrete increases with increase in HRM content up to 7.5%. Thereafter there is slight decline in strength for 10%, 12% and 15%due excess amount of HRM which reduces the w/b ratio and delay pozzolanic activity. The higher strength in case of 7.5% addition is due to sufficient amount of HRM available to reactwith calcium hydroxide which accelerates hydration of cement and forms C-S-H gel. The 7.5% addition of high reactivity metakaolin in cement is the optimum percentage enhancing the compressive strength at 28 days by 7.73% when compared with the control mix specimen. The 7.5% addition of high reactivity metakaolin in cement is enhanced the resistance to chloride attack. The compressive strength of concrete incorporated with 7.5% HRM isreduced only by 3.85% as compared with the reduction of strength of control mix specimen isby

4.88%. The 7.5% addition of high reactivity metkaolin in cement is also enhanced the resistance to sulphate attack. The compressive strength of concrete incorporated with 7.5% HRM is reduced only by 6.01% as compared with the reduction of strength of control mix specimen by 9.29%. **B.Vidivelli *et al.* [6]** had studied on flyash concrete using SEM analysis as partial replacement to cement and had reported a significant increase of 20% compressive strength respectively. **Lalit Gamashta *et al.* [7]** developed the concrete strength by using masonry waste material in concrete mix in construction to minimize the environmental damages due to quarrying. It is highly desirable that the waste materials of concrete and bricks are further reutilized after the demolition of old structures in an effective manner especially realizing that it will help in reducing the environmental damages caused by excessive reckless quarrying for earth materials and stones. Secondly, this will reduce pressure on finding new dumping ground for these wastes, thus further saving the natural environment and eco-systems. Durability, reliability and adequate in service performance of these reused waste materials over the stipulated design life of designed structures are of paramount importance to Structural Designers. This paper critically examines such properties in reused concrete and brick masonry waste materials and suggests suitable recommendations for further enhancing life of such structures, thereby resulting in sufficient economy to the cost of buildings. **M. Mageswari *et al.* [8]** using the combination of waste Sheet Glass Powder (SGP) as fine aggregate and Portland cement with 20% optimum replacement of fly ash as cementations binder offers an economically viable technology for high value utilization of industrial waste. Using of SGP in concrete is an interesting possibility for economy on waste disposal sites and conservation of natural resources. Natural sand was partially replaced (10%, 20%, 30%, 40% and 50%) with SGP and 20% optimum replacement of fly ash in Portland cement. Compressive strength, Tensile strength (cubes and cylinders) and Flexural strength up to 180 days of age were compared with those of concrete made with natural fine aggregates. Fineness modulus, Specific gravity, Moisture content, Water absorption, Bulk density, Percentage of voids, Percentage of porosity (loose and compact) state for sand and SGP were also studied. The test results indicate that it is possible to manufacture low cost concrete containing SGP with characteristics similar to those of natural sand aggregate concreteprovided that the percentage of SGP as fine aggregate up to 30% along with fly ash 20% optimum in cement replacement can be used respectively. **Ustev.J *et al.* [9]** determined the performance of concrete made with coconut shell as a replacement of cement. Cement was replaced with coconut shell in steps of 0%, 10%, 15%, 20%, 25% and 30%. The results obtained for compressive strength was increased from 12.45 N/mm2 at 7days to31.28 N/mm2 at 28 days curing and it met the requirement for use in both heavy weight and light weight concreting. **Ankit Nileshchandra Patel et al. [10]** examined the possibility of using stone waste as replacement of Pozzolana Portland Cement in the range of

5%, 10%, 30%, 40% and 50% by weight of M 25 grade concrete. They reported that stone waste of marginal quantity as partial replacement to the cement had beneficial effect on the mechanical properties such as compressive strength values for 7, 14, 28 days were less than the ppc cement. **Venkata Sairam Kumar *et al.* [11]** investigated the effect of using quarry dust as a possible substitute for cement in concrete. Partial replacement of cement with varying percentage of quarry dust (0%, 10%, 15%, 20%, 25%, 30%, 35%, 40%) by weight of M 20, M 30 and M 40grade of concrete cubes were made for conducting compressive strength. From the experimental studies 25% partial replacement of cement with quarry dust showedimprovement in hardened of concrete. **Jayesh kumar *et al.* [12]** studied the performance of fly ash as partial replacement of cement. The values of compressive strength and split tensile strength are found by partial replacement of cement with varying percentage of 0%, 10%, 20%, 30% and 40% by weight of cement of M 25 and M 40 mix. The compressive strength of the samples was recorded at the curing age of 7, 14, 28 days and for split tensile strength of the sample were conducted test on age of 56 days. It was observed that the compressive strength was better on age of 14 days than the other proportions of cement. **Debarata Pradhan *et al.* [13]** determined the compressive strength of concrete in which cement was partially replaced with silica fume (0%, 5%, 10%, 15%, and 20%). The compressive strength test was conducted on age of 24 hours, 7 days and 28 days for 100 mm and 150 mm cubes. The results indicated that the compressive strength of concrete increased with additional of silica fume up to 20% replaced by weight of cement further addition of silica fume was found that the compressive strength may increase or decrease. **Amudhavalli *et al.* [14]** examined the performance of concrete made with silica fume as the partial replacement of cement. Cement was replaced with silica fume in steps of 0%, 5%, 10%, 15% and 20% by weight by M 35 mix. The reported from this percentage mixes in compressive strength, split tensile strength and flexural strength at age of 7 days and 28 days. The results indicated that use of silica fume in concrete has improved the performance of concrete in strength and durability aspects. **Md Moinul Islam *et al.* [15]** investigated the usage of fly ash as substitutes for the cement was replaced with fly ash in steps of 10%, 20%, 30%, 40%, 50% and 60%. Compressive strength and tensile strength were determined at 3, 7, 14, 28, 60 and 90 days. The reported from this paper sows the results that strength increased with increased of fly ash up to an optimum value, beyond which the strength value starts decrease from with further addition of fly ash. The six fly ash motors, the amount of optimum amount of cement replacement in motors is about 40% higher compressive strength and 8% higher tensile strength as compared to Ordinary Portland Cement mortar. **D.Gowsika *et al.* [16]** investigated the usage of eggshell powder from egg production industry as partial replacement for Ordinary Portland Cement in cement mortar of mix proportions 1:3 in which cement is partially replaced with egg shell powder as 5%, 10%,15%, 20%, 25% and 30% by weight of cement. The compressive strength was determined at curing ages 28 days. There was a sharp decrease in compressive strength beyond 5% egg shell powder substitution. The admixtures used are Saw Dust ash, Fly Ash and Micro silica to enhance the strength of the concrete mix with 5% egg shell powder as partial replacement for cement. In this direction, an experimental investigation of compressive strength, split tensile strength, and Flexural strength was undertaken to use egg shell powder and admixtures as partial replacement for cement in concrete. **Ghassan K. Al-Chaar *et al.* [17]** determined the use of natural pozzolanic cement substitute in concrete materials. By means of a test series, four mixes using three types of natural pozzolanic, as well as a Class F fly ash, are evaluated. The effectiveness of each pozzolanic in controlling alkali-silica reactions has been studied. Correlations have been revealed between the mechanical properties of the proposed mixes and a Portland cement control mix. The results are also compared with industry standards for mortars made with fly ash and silica fume. It is findings to indicate that one type of pozzolanic may be used as a substitute for fly ash, but not for silica fume. **Biruk Hailu *et al.* [18]** investigated the usage of sugar bagasse ash is as by-product of sugar factories as a possibilities for the cement was replaced with sugar bagasse in steps of 0%, 5%,15% and 25% of the Ordinary Portland Cement were prepared with water to cement ratio of 0.55 and cement content 350 kg/m3 for the control mix. The test results indicated that up to10% replacement of cement by bagasse ash results in better or similar concrete properties and further environmental and economic advantages can also be exploited by using bagasse ash as a partial cement replacement material. **Seyyedeh Fatemeh Seyyedalipour *et al.* [19]** investigated the usage of paper waste as a partial replacement of cement to controlling environmental aspects has become a major priority. The concrete mixes prepared with adequate amount of these wastes, cement, aggregate and water compared in terms of some tests especially strength with the conventional concrete. At the end, the advantages and disadvantages of the use of pulp and paper industry wastes in concrete formulations as an alternative to landfill disposal were discussed. The research on use of pulp and paper industry wastes can be further carried out in concrete manufacturing as a new recycled material. **Y. Yaswanth Kumar *et al.* [20]** examined the usage of granite powder as a partial replacement of cement in concrete. Cement was replaced with granite powder in steps of 0%, 5%, 10%, 15% and 20%. The compressive strength and of the samples was recorded at the curing age of 7 and 28 days. The results indicated that the compressive strength of concrete increased with additional of granite powder up to 10% replaced by weight of cement further addition of granite powder was found that the compressive strength will be decreasing from 10% replacement of cement. **Prof. Vishal S. Ghutke1 *et al.* [21]** examined the usage of silica fume as a partial replacement of cement in concrete. It is suitable for concrete mix and improves the properties of concrete i.e., compressive strength etc. The objectives of various properties of concrete using silica fume have been evaluated. Further to determine the optimum replacement percentage comparison between the regular concrete and concrete containing silica fume is done .It has been seen that when cement is replaced by silica fume compressive strength increases up to certain percentage (10% replacement of cement by silica fume). But higher replacement of cement by silica fume gives lower strength. The effect of Silica fume on various other properties of Concrete has also been evaluated. **Dilip Kumar Singha Roy *et al.* [22]** investigate the strength parameters of concrete made with partial replacement of cement by Silica Fume. Very little or no work has been carried out using silica fume as a replacement of cement. Moreover, no such attempt has been made in substituting silica fume with cement for low/medium grade concretes (viz. M 20, M 25). Properties of hardened concrete viz Ultimate Compressive strength, Flexural strength, Splitting Tensile strength has been determined for different mix combinations of materials and these values are compared with the corresponding values of conventional concrete. It has been found that utilization of recycled waste water in concrete construction have lately gained worldwide consideration and attention. **G.Murali, C.M. Vivek Vardhan *et al.* [23]** studied the influence of various effluents on concrete structures. Laboratory scale concrete blocks of M 25 grade were moulded and used for strength analysis. Effluents from automobile industry (E1), powder coating industry (E2) and chocolate factory (E3) were used for curing concrete and its strength parameters like compression, tension and flexure were tested after 28 days. It was observed that E3 enhanced the compressive strength of concrete by 3.84%, tensile strength by 2.46% and flexural strength by 1.96% compared to conventional water curing, indicating its direct applicability in concrete curing sector.

III. CONCLUSIONS

1. Granite powder and alccofine can be used in a combination as supplementary cementitious material as partial replacement of cement and Fine aggregate
2. 15% alccofine with 15% Granite powder (K3) gives 32% increase in compressive strength which is 31.6N/mm^2 of this newly modified concrete in comparison with conventional concrete of M35 grade which is optimum amongst other combinations with in 7 Days.
3. 15% alccofine with 15% Granite powder (K3) gives 34% increase in compressive strength which is 39.6 N/mm^2 of this newly modified concrete in comparison with conventional concrete of M35 grade which is optimum amongst other combinations within 14 Days.
4. 15% alccofine with 15% Granite powder (K3) gives 42% increase in compressive strength which is 49.08 N/mm^2 of this newly modified concrete in comparison with conventionalconcrete of M35 grade which is

optimum amongst other combinations within 28 Days.

5. 15% alccofine with 15% Granite powder (K3) gives increase in Tensile strength which is 2.76N/mm^2, 3.23N/mm^2 and 3.89N/mm^2 within 7 Days, 14 Days and 28 Days alternatively.
6. 15% alccofine with 15% Granite powder (K3) gives increase in Flexural strength which is 8.6N/mm^2, 9.1N/mm^2 and 10.5N/mm^2 within 7 Days, 14 Days and 28 Days alternatively.
7. Percentage increase in Granite Powder results in decrease of strength parameters i.e. combination having 20%, 25%, 30% of Granite Powder gives less increase in results for this mix proportion.

IV. REFERENCES

[1] T. Felixkala, P. Partheeban, "Granite powder concrete" *Indian Journal of Science and Technology,* volume 3, Issue No. 3 (Mar 2010) ISSN: 0974-6846.

[2] Kanmalai Williams C., Partheeban. P, Felixkala. T, "Mechanical properties of high- performance concrete incorporating granite powder as fine aggregate" *International Journal on Design and Manufacturing Technologies*, volume 2, Issue No. 1, July 2008.

[3] M.G. Shaikh, S.A. Daimi "Durability studies of concrete made by using artificial sand with dust and natural sand" *International Journal of Earth Sciences and Engineering*, Volume 04, Issue No. 06, Oct 2011,

[4] R. Ilangovana, N. Mahendran, Nagamani, "Strength and durability properties of concrete containing quarry dust as fine aggregate" *ARPN journal of Engineering and Applied Sciences*, Volume 3, Issue No.5, Oct 2008, ISSN 1819-6608.

[5] H. Binici, M.Y. Durgun, T. Rizaoglu, M. Kolucolakb "Investigation of durability properties of concrete pipes incorporating blast furnace slag and ground basaltic pumice as fine aggregates" *Scientia Iranice A* (2012) 19 (3), 366-372.

[6] B.Vidivelli and M. Mageswari, Study on flyash concrete using SEM analysis, *J. of Environ. Res. Develop.*, **5**(1), 46-52, **(2010).**

[7] Lalit Gamashta and Swarna Gumashta, Reuse of concrete and masonry waste materials in construction to minimize environmental damages due to quarrying, *J. of Environ. Res. Develop.* **1**(1), 65-67, **(2006).**

[8] M. Mageswari* and B. Vidivelli, Innovative concrete using flyash and waste sheet glass, *J. of Environ. Res. Develop.* **4**(2), 476-483, **(2009).**

[9] Utsev, J. T., Taku, J. K., Coconut Shell Ash As Partial Replacement of Ordinary Portland Cement In Concrete Production, *Inter.l J. Scientific & Tech. Res.*, **1**(8), 86-89, **(2012).**

[10] Ankit Nileshchandra Patel, Jayeshkumar Pitroda, Stone Waste: Effective Replacement Of Cement For Establishing Green Concrete, *Inter. J. Innovative Tech. and Exploring Engineering*, **2**(5), 24-27, **(2013).**

[11] Venkata Sairam Kumar N., Dr. B. Panduranga Rao, Krishna Sai M.L.N., Experimental study on partial replacement of Cement with quarry dust, *Inter. J. Advanced Engineering Res. and Studies*, **2**(3), 136-137, **(2013).**

[12] Prof. Jayeshkumar Pitroda, Dr. L.B.Zala, Dr.F.S.Umrigar, Experimental investigations on partial

replacement of cement with fly ash in design mix concrete, *Inter. J. of Advanced Engineering Tech.*, **3**(4), 126-129, **(2012).**

[13] Debabrata Pradhan, D. Dutta, Influence of Silica Fume on Normal Concrete, *Int. J. of Engineering Res. and Application*, **3**(5), 79-82, **(2013).**

[14] N. K. Amudhavalli, Jeena Mathew, Effect of silica fume on strength and durability parameters of concrete, *Inter. J. Engineering Sciences & Emerging Tech.*, **3**(1), 28-35, **(2012).**

[15] Md. Moinul Islam and Md. Saiful Islam, Strength Behaviour of Mortar Using Fly Ash as Partial Replacement of Cement, *Concrete Research Letters*, **1**(3), 98-106, **(2010).**

[16] D.Gowsika, S.Sarankokila, K.Sargunan, Experimental Investigation of Egg Shell Powder as Partial Replacement with Cement in Concrete, *Inter. J. Engineering Trends and Tech.*, **14**(2), 65-68, **(2014).** [16]

[17] Ghassan K. Al-Chaar, Mouin Alkadi and Panagiotis G. Asteris, Natural Pozzolan as a Partial Substitute for Cement in Concrete, *The Open Construction and Building Tech. J.*, **7**, 33- 42, **(2013).**

[18] Biruk Hailu, Abebe Dinku, Application of sugarcane bagasse ash as a partial cement replacement material, *J. EEA*, **29**, 1-12, **(2012).**

[19] Seyyedeh Fatemeh Seyyedalipour, Daryosh Yousefi Kebria, Nima Ranjbar Malidarreh, Ghasem Norouznejad, Study of Utilization of Pulp and Paper Industry Wastes in Production of Concrete, *Int. J. Engineering Res. and Applications*,**4**(1), 115-122, **(2014)**.

[20] Y.Yaswanth Kumar et..al, Investigations on Granite powder As Partial Cement Replacement in Concrete, *Intern. J. Engineering Res. and Applications*, **5**(4), 25-31, **(2015)**

[21] Prof. Vishal S. Ghutke, Prof. Pranita S.Bhandari, Influence of silica fume on concrete, *IOSR J. Mech. and Civil Engineering*, 44-47, **(2014).**

[22] Dilip Kumar Singha Roy1, Amitava Sil, Effect of Partial Replacement of Cement by Silica Fume on Hardened Concrete, *Inter. J. Emerging Tech. and Advanced Engineering*, **2**(8), 472-475, **(2012)**.

[23] G.Murali, C.M. Vivek Vardhan, Siji Raju, C.Mahalakshmi , G.Srinidhi and Deepthi Susan Zachariah, Influence of various industrial effluents on concrete structures, *Intern. J. Engineering Res. and Applications*, **2**(2), 704- 709, **(2012).**