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Effect of Fly Ash, Marble Dust and Glass Fibres in the Physical Properties of Concrete : A Review

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Abstract*— Using Industrial rejects as alternatives to conventional materials is becoming the most attractive option for sustainability in concrete production. Fly ash is a waste material obtained from thermal power plant during combustion of pulverized coal. The marble industry produces a huge amount of waste which is marble dust. The marble dust is generally a highly polluting type of industrial waste due to its alkaline nature and its manufacturing and processing techniques, all of which impose serious health threats to the surrounding. Glass fibres are also a waste product obtained by glass industries. To produce a concrete having low cost by combining different ratios of fly ash with cement and to lower the problems caused by the fly ash on disposal and environmental aspects. The unusual use of fly ash in concrete formation as a supplementary material of cement must be checked as an alternative material to the traditional one. Also, we must seek an alternative for the fine aggregate materials like sand as they are the earth materials which are non-renewable sources by their nature. So, as to find the best replacement of the sand we can use the marble dust. Since, both of the materials we are focusing about are fly ash and marble dust are the wastes or the by product and hence need to be dump somewhere which will cause more problems to the environmental as well as aesthetic aspects. So as to be more optimistic, one must try the alternatives to replace the construction or building materials like cement and sand by fly ash, and marble dust. And here in this project. A series of experiments have been done in a row to detect the optimum percentage of replacement of cement by fly ash whereas sand is to be replaced by marble dust for determining the mechanical properties of concrete. The grade of concrete taken was M30 and grade of cement was 43 OPC. The experimental works carried out for the research were done to find the feasible percentage replacements of constituent materials by supplementary materials. Cement was partially replaced by fly ash at 20%, 30%, 40% and fine aggregate (sand) is partially replaced by marble dust by 20%, 40%, and 60%. Glass fibres were kept constant 1% by concrete and compressive strength, tensile strength and flexural strength will be compared by conventional concrete.

Keywords*— fly ash, marble dust, glass fibres.

I. INTRODUCTION

In these times of economic and environmental concerns over concrete in field of construction, fly ash concrete is of critical importance. Studies indicate that replacement of fly ash in OPC is viable in terms of strength and durability, and thus contributes to cheaper concrete along with positive utilization of fly ash which is an industrial by product. But the mechanism of strength attainment of such a mix relies on the pozzolanic action of the fly ash particle, which is rather slow process. High fineness and low carbon content fly ash reduce the water demand of concrete as compared to conventional concrete. Use of fly ash also improves the cohesiveness and reduces segregation of concrete. Adding fly ash gives low heat of hydration. During hot weather fly ash acts as retarders and is likely to be benefit in many cases.Concrete without any fibre will develop the crack due to plastic shrinkage & drying shrinkage so glass fibres will control cracks due to shrinkage and bleeding of waters. Plain concrete is a brittle material and having the low value of modulus of ruptures and strain capacity so by adding glass fibres these can be control. We are using glass fibres o increase flexural strength of concrete. Glass fibre is a waste material obtained from glass industries. It is easily available, it has high thermal resistance, resistance to impact, blast and shock load, high flexural, shear and tensile strength.

In India mega tones of marble resources still left to be exploited. In sawing, grinding and polishing the marble slurry generated is about 10% - 20% of the stone block. The generated slurry is indiscriminately dumped on vacant lands, rivers bank or forest areas. These slurry particles are fine enough to fill the pores of the soil, which can prevent water percolation and reduce fertility. On drying these particles are lifted by air and can result in respiratory problems in human. Uncontrolled disposal of marble industrial effluents had also led to increase in pollutants in groundwater, endangered aquatic biodiversity and cause skin, eye and kidney disease in human. Replacement of fine aggregate (sand) by marble dust in a concrete is a step towards sustainable development. It will help construction industries to reduce their dependency on river sand. Replacement of river sand by marble dust in optimum amount shows better result because they have dense microstructure which is a consequence of reduced water requirement and formation of superior quality of hydration products

II. LITERATURE REVIEW

S.Anandaraj et.al. (2018) concluded experimental study investigates structural distress in glass fibre reinforced concrete containing marble and granite dusts exposed to various loadings. Marble dust and granite dust was replaced by fine aggregate from 0% to 80% and glass fibre by 1% addition to concrete. E glass fibres with 0.5mm diameter and 25mm length aspect ratio of 50 were used. Concrete mix design of M25 was designed and it was concluded that 20% marble dust as fine aggregate replacement and 1 % glass fibre addition produced higher compressive strength properties than the control concrete. Compressive strength of control concrete for 7 , 14 , 28 days were (21, 26, 32)N/mm and Tensile strength of control concrete for 7 , 28 days were (2.25, 3)MPA and tensile strength with 20% replacement of marble dust with fine aggregate and 1% glass fibres is (2.6, 3.4) Mpa.

Kasagani et.al. (2018) conducted study on effect of graded fibres on reinforced concrete in tension. Effective blending of short length and long length fibres in concrete is termed as graded fibre reinforced concrete. The experimental work was carried out under uni- axial tension for M30 grade of concrete with the 0.1%,0.2%,0.3%,0.4% &0.5% fibre volume of mono glass fibres (3mm,6mm,12mm and 20mm length fibres.) in 0.3% fibre volume, different fibre volume combination of glass fibres in short graded from (3mm + 6mm length fibre) combination of glass fibres in long graded from (12mm + 20mm length fibre) and combination of short graded + long graded fibres to form combined graded fibres (3mm + 6mm + 12mm + 20mm length fibres) were studied. The result shows that the strength, deformation capacity and energy absorption capacity is higher for graded glass fibre reinforced concrete than mono glass fibre reinforced concrete. Graded fibres improved the workability. Specimen with long length fibres has contributed more deformation capacity

Mohammod et.al. (2017) studied on utilization of fly ash in cement concrete as an additive so as to provide an environmental consistent way of disposal and reuse. In this paper cement was replaced by fly ash by (0%, 10%, 20%, 30%, 40%,50%) and 7 days compressive strength was (26.7, 27.4, 28.3, 30.25, 27.75, 25.5) similarly 28 days compressive strength was (40.2, 41.9, 43.23, 45.28, 42.0, 39.15). it was stimulated that the replacement of cement in any proportions earlier higher the compressive strength of concrete and later lowers the compressive strength as well as slow its hardening and also increases the workability and setting time of concrete. From above study it was found out that maximum compressive strength was obtained at 30% replacement of cement.

Priyatham et.al.(2017) studied on partial replacement of cement with marble powder. In this paper series of test was conducted to study the effect of 5%, 10% and 15% replacement of cement with marble powder on compressive strength & split tensile strength and compare it with the conventional concrete. In this paper they prepared the mix design for M25 grade and casted different dosage (0%, 5%, 10% and 15%) of marble powder and conducted test for 7days and 28 days. Result was (22.3, 22.65, 23.2, 21.6) Mpa and (26.5,27.2,28.4,25.8) Mpa. When 10% cement was replaced by marble powder the compressive strength was increasing, when further replacement was increasing the compressive strength was found decreasing.

Dehghan et.al. (2017) conducted research on recycled glass fibres reinforced polymer addition to Portland cement concrete. They have adopted grinding and sorting technology to recover glass fibres from waste fibre reinforced polymers of diameter 3 to 20 micron length 25mm. They use E glass fibres. Substitution of 5% by weight of coarse aggregate was adopted and concluded that compressive strength was not improved after 7 and 28 days but tensile strength was improved. Tensile strength of conventional concrete 7 and 28 day was 2.5 and 3 Mpa and after adding glass fibres tensile strength for 7 and 28 day was 3.2 and 4.3mpa

George & A. Sofia (2017) conducted study on Enhancement of fly ash concrete by hydrated lime and steel fibres. Utilization of fly ash as partial replacement for cement often results in low early strength of the concrete. An effective pozzolanic reaction of fly ash particles is hindered due to unsatisfactory quantities of lime in most fly as compositions, and this is the cause of low early strength in fly ash concrete. This lack is overcome by addition of hydrated lime (calcium hydroxide). The studies are carried out on two main mixes, one of ordinary fly ash concrete (OFC) with 30% substitution of OPC with fly ash alone and other is Lime fly ash concrete (LFC)i.e. with 5% lime , 25% fly ash and rest opc. Compressive strength between OFC and LFC, LFC is found to be superior at both 7 and 28 day. OFC compressive strength 7 and 28 day is (22.50, 36.34) N/sq.mm and OFC with steel fibres was (26.07, 41.23) N/sq.mm. LFC compressive strength 7 and 28 day is (25.77, 40.97) N/sq.mm and LFC with steel fibres is (32.50, 45.40) N/sq.mm. OFC tensile strength for 28 day is 2.67 N/sq.mm and OFC with steel fibres was 3.04 N/sq.mm. LFC compressive strength 28 day is 3.04 N/sq.mm and LFC with steel fibres is 3.47 N/sq.mm.

Siddique (2016) conducted study on performance characteristics of high volume class f fly ash concrete. In this study Portland cement was replaced with 40%, 45%, and 50% of class f fly ash. Unit cost of concrete can be reduced by partial replacement of cement with fly ash. Test results indicates that the use of high volumes of class f fly ash as partial replacement of cement in concrete decreased its 28 day compressive strength but significant improvement at the age of 91 and 365 days which is due to pozzolanic reaction of fly ash and slow heat of hydration. Conventional concrete 365 days compressive strength was 42.1mpa and by replacing cement.

Kizilkant et.al. (2015) concluded study on mechanical properties of basalt fibres and glass fibres reinforced concrete. A basalt fibre is inorganic fibre which is manufactured from the extrusion of melted basalt rock. Glass fibre and basalt fibres were added at various percentages (0.25%, 0.50%, 0.75%, and 1%) by volume of concrete. Diameter of fibres was 13-20micronmeters and length was 12mm. It was concluded that fibre content greater than 0.25% resulted in slight increase in compressive strength for both basalt and glass fibre. Basalt fibre reinforced concrete showed the higher compressive strength of 66.6mpa at 0.50% inclusion, whereas glass fibre reinforced concrete showed the highest compressive strength of 67.6mpa at 0.75% inclusion and compressive strength of conventional concrete was 63.4mpa. Tensile strength of control concrete for 7 , 28 days were (2.25, 3)MPA and tensile strength with 20% replacement of marble dust with fine aggregate and 1% glass fibres is (2.6, 3.4) MPA.

Kishore et.al.(2015) studied the influence of partial replacement of fine aggregate with marble dust and compare its compressive and tensile strength of high strength concrete mix with conventional concrete mix. They prepare the mix design of M40 grade with replacement of fine aggregate with marble dust of (0%, 10%,15% and 20%) for 7days and 28days and the result obtained the result were (28.75,31.80,34.2,32.92) Mpa for 7days similarly the strength for 28days were (28.75,31.80,34.2,32.9)Mpa. Finally it was observed that when 15% of marble dust was replaced with fine aggregate optimum compressive strength was obtained .

Hifzurrahman et.al. (2007) conducted study on glass fibre reinforced with partial replacement of cement with fly ash. In this study glass fibre is added at various percentages 0%, 1%, 1.5% , 2% by mass of cement and 20%, 30%, 40%, replacement of cement by fly ash. M30 concrete was adopted and 28 days compressive strength was calculated. Maximum compressive strength for 28 days was obtained at 20% replacement of cement with fly ash and 2% glass fibre by achieving targeted strength which was 30N/sq.mm.

Ahmet B. kizilkant et.al. (2015) concluded study on mechanical properties of basalt fibers and glass fibers reinforced concrete. A basalt fiber is inorganic fiber which is manufactured from the extrusion of melted basalt rock. Glass fiber and basalt fibers were added at various percentages (0.25%, 0.50%, 0.75%, and 1%) by volume of concrete. Diameter of fibers was 13-20micronmeters and leent and 20%, 30%, 40%, replacement of cement by fly ash. M30 concrete was adopted and 28 days compressive strength was calculated. Maximum compressive strength for 28 days was obtained at 20% replacement of cement with fly ash and 2% glass fiber by achieving targeted strength which was 30N/sq

III. CONCLUSIONS

Based on the study done it can be concluded that by using industrial waste fly ash, marble dust and glass fibres unit cost of concrete can be decreases without compromising with the strength of concrete. Optimum amount of marble dust replacement of sand in concrete helps to increase compressive strength because of the dense microstructure of concrete. Whereas optimum amount of glass fibres helps to increase tensile and flexural strength of concrete and also control micro cracks in concrete. Fly ash gives low heat of hydration so in initial days it gives low strength but gives more strength then conventional concrete in later days. It was found from above study that fly ash and marble dust concrete mix proved to be very useful and to solve environmental problems and up to some extend one can minimise the requirement of cement in large quantity

REFERENCES

1. S.Anandraj, Jessy Rooby, P.O Awoyera and R.Gobinath structural Distress in glass fibre-reinforced concrete under loading and exposure to aggressive environment" *ELSEVIER) 2018*
2. Hanuma kasagani and C.B.K Rao "effect of graded fibers on stress strain behavior of glass fiber reinforced concrete in tension (*ELSEVIER)* 183 (2018) 592-604
3. Mohammad Abushad and Misbah Danish Sabir "Comparative Study of Compressive Strength of Concrete with Fly Ash Replacement by Cement" *(IRJET)* Vol-4, Issue-7, july 2017
4. B. P. R. V. S. Priyatham, D. V. S. K. Chaitanya and Bimalendu Dash" Experimental Study on Partial Replacement of Cement with Marble Powder*"(IJCIET)* Vol-8, Issue-6,June 2017
5. Alireza Dehghan, Karl Peterson and Asia Shvarzman "Recycled Glass fibre reinforced polymer additions to PortlandCement" *(ELSEVIER)* 146-2017,238-250
6. Siddharth George, A. sofia "enhancement of fly ash concrete by hydrated lime and steel fibers" (*ELSEVIER*) 4 (2017) 9807-9811
7. Rafat Siddique " performance characteristic of high volume class f fly ash concrete" (*PERGAMON*) 34(487-493)
8. Ahmet B. kizilkanat, Nihat kabay , veysel akyuncu, swaptik chowdhury, Abdullah h. akca (*Elsevier)* 100 (2015) 218-224
9. I Siva Kishore and Ch Mallika Chaudhary "A study on waste utilization of marble dust in high strength concrete mix"(*IJCEIT)* Vol-6, Issue-12, Dec 2015
10. Hifzurrahman, zeeshan khan, mizra aamir baig " glass fiber reinforced with partial replacement of cement with fly ash (*IJARIIT)* (Volume 3, Issue 3) ISSN: 2454-132X Impact factor : 4.295