Effect of Mineral Admixtures on Strength and Workability of Concrete

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ABSTRACT

Concrete is one of the frequently used constructions material on the civil sites because it has high stability, durability and structural strength. A verity of waste material are disposed of to the environment directly thereby causing huge environment impacts an emphasis is laid on reuse of the water material waste material can be used in wide variety of ways such as an admixture. This may reduce the extensive use of natural resources. There are lots of researches going on for the constructive use of waste materials. In this paper the investigation is carried out for use of fly ash and marble powder in concrete. The grade of concrete used M-25 mix with cement replacements of 5%, 10%, 15%, 20% and 30% with fly ash and marble powder simultaneous use of fly ash in civil engineering applications is gaining momentum day by day. it can be used in concrete as well as manufacture of fly ash blocks. It ultimately leads to improvement in long term durability of concrete as well as environmental benefits. The grade of cement as classified by bureau of Indian standards is OPC-53. After the experimental investigation was done it was observed that the fly ash and marble powder improves concrete properties up to certain percentage of replacements.

Keyword: *compressive strength, fly ash, marble powder, concrete.*

I. INTRODUCTION

Due to the extraction of natural resources many wastes are generated each year. By the beginning of 1920s coal firing began at a very rapid speed for the purpose of generation of electricity. This lead to the generation of millions of tons of ash and other bi-products. Today the generation of coal ash is estimated to be around 600 tonnes annually with fly ash constituting around 75% of the total ash produced i.e. 500 tonnes annually. The fly ash is being generated by thermal power plants and factories at very rapid pace and hence its disposal is causing very serious environmental problems. The fly ash utilized in the world varies widely from 3% to maximum of 56% of the total ash being produced, average being 15%. This leads to huge amount of fly ash being unutilized and is therefore being disposed of in landfill or lagoons which costs very high to the utilizing companies, customers and has negative impacts on environment too. For the generation of electricity, coal is being preferred throughout the world. In thermal power plants, fuel lignite is being used in pulverized form which is a source of energy. On burning coal, a tremendous % of coal that numbers to 48 % is left as fly ash or bottom ash. In construction of civil structures fly ash can be used as partial substitution the cement in concrete. Even after using fly ash in civil structures there is still substantial amount of fly ash that is not being used. This unused fly ash can be utilized in road construction as a sub grade chemical additive. The lignite coal after burning give rise to fly ash which comprises about 27%. If the amount of free lime content in fly ash is more than 10% then this type of fly ash is classified as class-F fly ash. As per ASTM the self cementing period of class-F fly ash is longer when compared to that of class-C fly ash. In terms of environmental pollution, class-f fly ash causes more acute problems than class-c fly ash. A lime of about 5%-20% is added to class-f fly ash to increase the strength and make hardening process quicker. The recent studies reveal that, Turkey contains around 4 billion m^3 of marble reserves, which constitutes of about 40% of the worlds potential marble reserves. With the development of modern production techniques, the process of marble treatment is ever increasing thus helping in reducing waste marbles. If the two waste products i.e. marble powder and flyash are used with OPC, it can help in enhancing the strength and durability of concrete. In India large quantities of marble powder and flyash are being generated, these waste materials if properly segregated, collected and used properly can help in reducing the disposal of fly ash and marble powder and can also help in reducing the use of large amounts of cement which consumes energy and many natural resources. Different grades of OPC are available in market and bureau of Indian standard (BIS) classifies OPC into three grades i.e. grade 33, grade 43 and grade 53. There are no comparative studies about the effect on concrete properties when cement of varying grades is partially replaced by fly ash or marble powder. Thus this study is to investigate the effect of these two supplementary cementing waste materials on the properties of concrete.

II. LITERATURE REVIEW

2.1 Baboo Rai [1], the effect of waste marble powder on concrete by replacing cement with different percentage of waste marble powder. It was observed that on increasing replacement quantity of marble powder (replacing cement) the compressive strength falls reduces up to 10 N/mm2 when the marble powder percentage in cement is between 15% to 20%. The strength reduction was observed to be constant up to 15% replacement quantity. Also the fine aggregates were replaced partially by different proportions and it was observed that the compressive strength of the concrete increased after different curing ages when the marble granule percentage was less than 10% and beyond 10% the strength of the concrete decreased.

2.2 Vaidevi [2] studied the use of waste materials generated from different manufacturing units in the making of concrete and mortar mix. The concrete of grade M-20 was prepared by replacing cement with marble powder. The mix was prepared by replacing the cement by marble powder in proportions of 55, 10%, 15% and 20%. After 14 days and 28 days of curing period the compressive strength and tensile strength were calculated and it was observed that up to substitution of 10% of marble powder in cement, the strength increases and with the increase in curing days the strength keeps on increasing.

2.3 N. Gurumoorthy [3] studied the performance of concrete by partial replacement of cement by marble dust in percentages of 10%,15%, 20%, 25% and 30%. The compressive strength increased up to 25% replacement of cement by marble powder. Beyond 25% the strength began to decrease. So it was observed that the optimum concentration of cement replacement was 25%.

2.4 Prof. Veena G.Pathan and Prof. Md.Gulfam Pathan [4], the investigation about the use of waste marble powder in preparing concrete mix was done. The study reveals that on replacing cement with marble powder up to 20% reduces the slump of the concrete mixes. Also it was observed that replacing cement by marble powder up to 5% gives identical compressive as well as flexural strength but beyond 5% the strength decreased.

2.5 Abdullah Anwar [5] studied the effect of marble dust powder by replacing the (OPC & PPC) cement accordingly in the proportions of 0% , 5% , 10% , 15% , 20% , 25% in M-20 mix. Concrete cubes were tested at the end of 7 days of curing period and 28 days of curing period and compressive strength was determined. It was concluded that by testing cubes after 28 days of curing that compressive strength decreased if the cement was replaced by marble powder in excess of 10% replacement proportion.

2.6 Jashandeep Singh and Er R.S Bansal [6], studied the effect on compressive strength by partially replacing cement with waste marble powder. The cement was replaced by marble powder in proportions of 0% , 4% , 8% , 12% , 16% and 20%. The cube specimens of size 150mm x 150mm x 150mm and cylindrical specimens of size 150mm x 300mm were tested. The compressive strength of concrete was determined at the end of 7days,14 days,28 days of curing respectively. The slump of fresh concrete with these concentrations was also determines and it was observed that slump values decreased on increasing waste marble powder concentrations. It was also concluded that with 12% partial replacement of cement with marble powder the compressive strength attained was maximum.

2.7 G. Latha [7], investigated the effect on fresh and hardened properties of concrete by partial replacement of cement by waste marble powder. In this study concrete of grade M-20, M-30 and M-40 were prepared .Cement was replaced by WMP in proportions of 0%, 5%, 10%, 15% and 20%. It was observed that the compressive strength and workability increased at the proportions between 10% and 15% respectively.

2.8 DishaSingh, Mohd. Afaque Khan, Abhishek Kumar [7] carried the research on replacing cement by various percentages partially with marble dust powder, the compressive strength of the concrete was determined and it was observed that on inclusion of marble dust powder the compressive strength gradually increased to some proportions but afterwards it began to decrease gradually. It was concluded that increase in curing days will increase the strength of marble dust concrete. The test was carried out after 7 days,14 days and 28 days respectively

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2.9 Chockalingam [9] in this experimental work different percentage of marble powder (MP) and silica fume (SF) are added. Experiments are carried out for the effective replacement of cement with silica fume (0%, 15%, 20%, 25%,30%) and Marble powder (15%). Several tests such as slump flow, V-funnel, L-box, U-box are carried out to determine optimum parameters for the self-compactability of mixtures. Test on Compressive strength, flexural

strength and deformation characteristics of the specimens are studied. The results obtained from these tests are compared with conventional concrete specimens. The load deflection curves are also drawn. The results show that 15% to 20% replacement of cement with silica fume and 15% marble powder improves the properties of SCC.

III. COMPRESSIVE STRENGTH OF CONCRETE

Definition

Compressive strength of any material or structure may be defined as its ability to withstand loads on its surface without developing cracks or undergoing any deflection. Any material that is under compression usually tends to reduce the size whereas in tension the size elongates.

Compressive strength test results

Table 1: Compressive strength of fly ash and cement concrete after 7 days

MIX	WEIGHT (KG)	LOAD (KN)	COMPRESSIVE STRENGTH 7 DAYS(N/MM^2)
Conventional	8.100	420	18.66
95% cement,5%FA	8.170	300	13.33
90% cement, 10%FA	8.230	320	14.22
85% cement, 15%FA	8.130	350	15.55
80% cement, 20%FA	8.080	370	16.44
70% cement, 30%FA	8.140	310	13.77

Table 2: Compressive strength of fly ash and cement concrete after 28 days

MIX	WEIGHT (KG)	LOAD (KN)	COMPRESSIVE STRENGTH 28 DAYS(N/MM^2)
Conventional	8.100	630	28
95% cement,5%FA	8.210	490	21.77
90% cement, 10%FA	8.110	500	22.22
85% cement, 15%FA	8.210	530	23.55
80% cement, 20%FA	8.060	550	24.44
70% cement, 30%FA	8.160	470	20.88

Table 3: Compressive strength of MP and cement concrete after 7 days

MIX	WEIGHT (KG)	LOAD (KN)	COMPRESSIVE STRENGTH 7DAYS(N/MM^2)
Conventional	8.100	420	18.66
95% cement,5%MP	8.070	300	13.33
90% cement, 10%MP	8.200	310	13.77
85% cement, 15%MP	8.120	340	15.11
80% cement, 20%MP	8.110	320	14.22
70% cement, 30%MP	8.040	270	12

Table 4: Compressive strength of MP and cement concrete after 28 days

MIX	WEIGHT (KG)	LOAD (KN)	COMPRESSIVE STRENGTH 28 DAYS(N/MM^2)
Conventional	8.100	630	28
95% cement,5%MP	8.170	470	20.88
90% cement, 10%MP	8.190	490	21.77
85% cement, 15%MP	8.090	510	22.66
80% cement, 20%MP	8.210	460	20.44
70% cement, 30%MP	8.260	400	17.77

IV. RESULTS AND DISCUSSIONS

- The slump of fresh concrete increases with increase in the fly ash content.
- The slump of fresh concrete decreases with increase in marble powder percentages.
- The workability of concrete increases with increase in proportions of fly ash.
- The workability of concrete decreases with increase the percentage of marble powder.
- There is no negative impact on workability of concrete by using fly ash.
- The workability of concrete when marble powder is used as partial replacement is acceptable up to 15% partial replacement of cement.
- The use of fly ash powder therefore improved the performance of the concrete.
- The compressive strength increases with increase in the fly ash and marble powder concentrations with respect to the conventional cement concrete up to certain percentage.
- The fly ash can be used up to proportions of 20% partial replacement of the cement in concrete.
- The marble powder can be used up to proportions of 15% replacement of the cement in concrete.

V. CONCLUSIONS

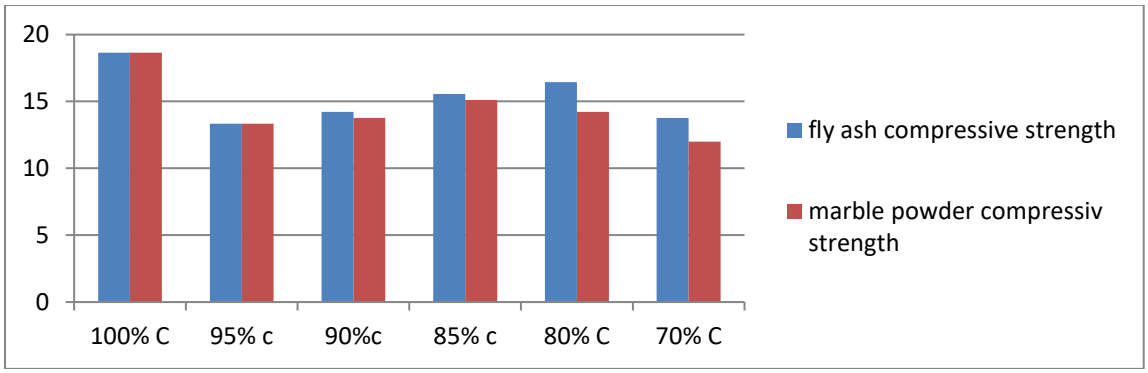

Fig 1: comparison of compressive strength of fly ash concrete and marble powder concrete at 7Days

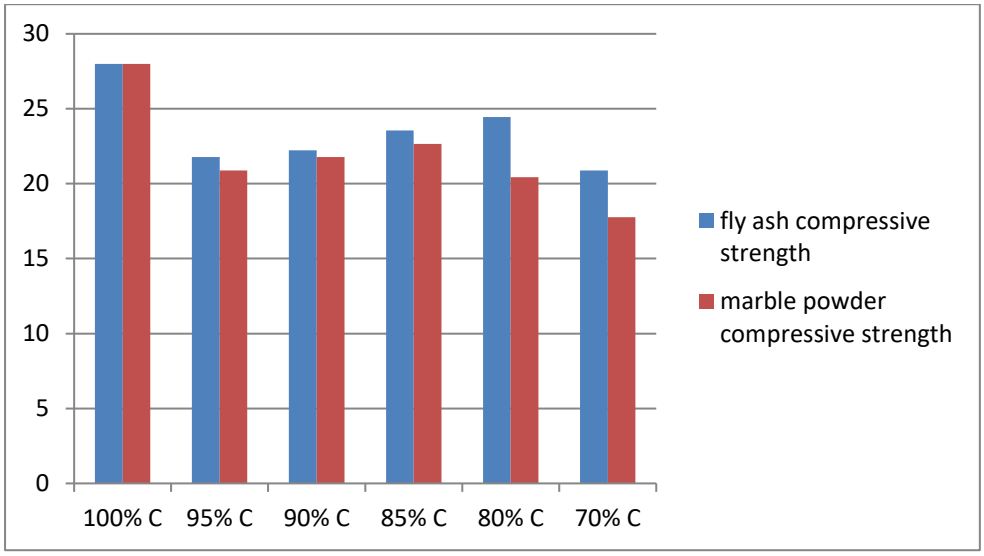

Fig 2: comparison of compressive strength of fly ash concrete and marble powder concrete at 28 Days

- The compressive strength of concrete when fly ash is used as partial replacement increases with age and can be used up to 20% proportion.
- The compressive strength of concrete when marble powder is used as partial replacement increases with age and can be used up to 15% proportion.
- The cost of concreting can be minimized when these materials are used.
- The properties of fresh and hardened concrete are enhanced when fly ash and marble powder are used simultaneously in concrete up to certain limit.
- The environmental pollution caused due to manufacture of cement can be reduced to a considerable extent.
- The decomposition of the waste supplementary materials, which is a serious concern, can be averted to a large extent.
- The early strength is less when fly ash and marble powder is used as partial replacement to cement.
- The compressive strength of concrete increases with age up to certain proportions of fly ash and marble powder

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