Experimental Investigation on Concrete by Partial Replacement of Cement with Cow Dung Ash & Granite Powder

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Abstract— The consumption of cement in concrete industries has been increasing day by day to fulfil the pressing needs of infrastructure due to growing population, industrialization and urbanization. The production of cement poses environmental problems due to emission of gaseous pollutants. Huge amount of granite powder generation have been causing waste disposal problems. Cow dung is used as fuel for the domestic purpose, which generates solid waste as ash. In this study, an attempt was made to replace the cement using granite powder and cow dung ash.M25 grade concrete is considered. These sets were prepared using different proportions of cement, granite powder and cow dung ash. Then the cubes were estimated to cure for the period of 7 days, 21 days and 28 days. The mechanical properties of concrete were tested by means of various tests like compressive strength, Split tensile and Flexural Strength test. Workability tests were also considered for the study.

Key words: Cement, Concrete, Cow Dung Ash, Granite Powder

I. INTRODUCTION

It is well known that sustainable development, one of the most important issues in the world at present days, involves to build our communities in such a way that we can all live comfortably without consuming all of our resources, we make an impact on the environment through how we survive our lives. In fact, it is well accepted by everyone that concrete executes outstanding responsibilities for the construction of modern infrastructures, industrialization. Besides, it is relevant to mention that the concrete industry today is the largest consumer of natural resources water, sand, gravel, and crushed rock. For these reasons, sustainable concrete and sustainable mortar is one of the prime topics in concrete industry all over the world and its main objective is to reduce the amount of polluting and carbon dioxide (CO_2) gases emitted during the manufacture of concrete more efficient use of waste materials. Development of a low-energy, long-lasting, flexible buildings and structures, exploiting the thermal mass of concrete in a structure to reduce energy demand. Approximately, one ton of CO_2, a greenhouse gas, is delivered into the atmosphere for each ton of cement production. Worldwide, the cement industry is responsible for about 1.4 billion tons in 1995, which caused the emission of as much CO_2 gas as 300 million automobiles statistically for almost 7% of the total world production of CO_2. Hence environmental pollution and global warming is increasing continuously and, natural resources and energies are being reducing day by day. Since global warming has known as the most crucial environmental issue at present time and sustainability is becoming an important issue of economic and political debates. And for the next developments in the concrete industry will not be the new types of concrete produced with expensive materials and special methods but low cost and highly durable concrete mixtures containing largest possible amounts of industrial and agricultural waste/byproducts that are suitable for supplementary use of Portland cement, virgin aggregate, and drinking water Supplementary cementitious materials can be used for improved concrete performance in its fresh and hardened state. For use in concrete, supplementary cementitious materials, sometimes referred to as mineral admixtures, need to meet requirements of established standards. They may be used individually or in combination in concrete. They may be added to the concrete mixture as blended cement or as a separately batched ingredient at the ready mixed concrete plant. They are primarily used for improved workability, durability and strength. These materials allow the concrete producer to design and modify the concrete mixture to suit the desired application. Concrete mixtures with high Portland cement contents are susceptible to cracking and increased heat generation. These effects can be controlled to a certain degree by using supplementary cementitious materials. Supplementary cementitious materials such as fly ash, slag and silica fume enable the concrete industry to use hundreds of millions of tons of byproduct materials that would otherwise be land filled as waste. Furthermore, their use reduces the consumption of Portland cement per unit volume of concrete. Portland cement has high energy consumption and emissions associated with its manufacture, which is conserved or reduced when the amount used in concrete is reduced.

II. LITERATURE REVIEW

Felixkala T and Partheeban P (2010) examined the possibility of using granite powder as replacement of sand along with partial replacement of cement with fly ash, silica fume and blast furnace slag. They reported that granite powder of marginal quantity as partial replacement to sand had beneficial effect on the mechanical properties such as compressive strength, split tensile strength and modulus of elasticity. They also reported that the values of plastic and drying shrinkage of concrete with granite powder were less than those of ordinary concrete specimens.

Oyekan G.L and Kamiyo O.M (2008) studied the performance of hollow sandcrete blocks containing cement, sharp sand and granite fines in varying propositions to determine their structural and hygro thermal properties. The percentage of granite fines by volume of the total fine aggregate was varied in steps of 5% to a maximum of 30%. Results of the tests indicated that the inclusion of granite fines in the sand-cement matrix has a very significant effect on the compressive strength of sandcrete blocks. It was also, observed that for both mix propositions, 15% granite fines content was the optimum value for improved structural performance.

Baboo Rai et al (2011) investigated the effect of using marble powder and granules as constituents of fines in concrete by partially reducing quantities of cement as well as other conventional fines. The values of workability, compressive strength and flexural strengths were found. Partial replacement of cement and usual fine aggregates with varying percentage of marble powder (0%, 5%, 10%, 15%, 20%) and marble granules revealed that increased waste marble powder (WMP) or waste marble granule (WMG) resulted in increase in workability and compressive strength of mortar concrete.

Shahul Hameed M and Sekar A.S.S (2009) investigated the usage of quarry rock dust and marble sludge powder as possible substitutes for natural sand in concrete. They also carried out durability studies on green concrete and compared with the natural sand concrete. They found that the compressive, split tensile strength and the durability concrete were good when the fine aggregate was replaced with 50% Marble sludge powder and 50% Quarry rock dust (Green concrete).The resistance of concrete to sulphate attack was enhanced greatly.

III. MIX PROPORTION

Mix no.	Cement (kg)	% Replacement	wt. of CDA+GP	W/c ratio	C.A (Kg)	F.A (Kg)	Water (Ltrs)	Extra water
1	384	0	0	0.5	1087	800	191.3	18.93
2	346	10	76.8	0.5	1087	800	191.3	18.52
3	308	20	153.6	0.5	1087	800	191.3	18.93
4	269	30	230.4	0.5	1087	800	191.3	18.93

IV. RESULTS

A. Consistency Limits

The following are the results obtained in various laboratory tests carried out in this study:

CDA + Granite Powder %	Consistency Limit
10	0.40
20	0.66
30	0.82

Table 1: Consistency Limits of Cow Dung Ash

Mix no.	% CDA + GP by wt. of Cement	Workability(mm)
1	10	45
2	20	76
3	30	92

Table 2: Slump Determination

Mix no.	% CDA +GP by wt. of Cement	Compressive Strength (MPa)	
		14 Days	28 Days.
1	0	22.42	29.24
2	10	22.22	26.42
3	20	23.32	28.24
4	30	22.20	26.72

Table 3: Compressive Strength Results

Mix no.	% CDA + GP by wt. of Cement	Split Tensile Strength	
		14 Days	28 Days.
1	0	4.64	12.84
2	10	3.12	10.02
3	20	4.98	11.96
4	30	4.32	11.92

Table 4: Split Tensile Strength

Mix no.	% CDA + GP by wt. of Cement	Flexural Strength	
		14 Days	28 Days.
1	0	5.64	5.62
2	10	4.56	6.84
3	20	5.75	6.82
4	30	4.74	5.62

Table 5: Flexural Strength

V. STRENGTH SEVERITY INDEX

Strength Activity Index was determined using equation:-

$$= F_{c.d.a} \times 100$$
$$F_{o.p.c}$$

FRc.d.aR =Average compressive strength of the three specimen made with 20% CDA.

= (28.24 x 100 / 29.24) = 96.58 %

VI. CONCLUSION & FUTURE SCOPE

A. Conclusion

On the source of available information, general conclusions derived from experimentation for studying the effects of CDA + GP in concrete from the present study are stated. The new IS: 10262:2009 code preamble was used for mix proportioning of CDA + GP induced concrete. The following conclusions are arrived at on the basis of present investigation.

1) Slight bleeding was observed in all the trial mixes.
2) By increasing the percentages of ash initial and final setting time is increasing, up to maximum of 490 minutes for 30%.
3) It was found that due to high percentage of water requirement the workability value increases by increasing the cow dung ash percentages.
4) When CDA + GP was replaced with cement was 20 percent the compressive strength was almost equal to conventional when compared to 20% replacement.
5) Split tensile strength also showed good results when replaced with 20% of cement.
6) Flexural tensile strength also showed good results when replaced with 20% of cement.

7) The strength activity index of Cow dung ash was determined to be 96.58% which is than the 75% minimum specified by ASTM C 618 which indicates that Cow dung ash may react well with ordinary Portland cement to produce concrete of acceptable strength levels.

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