A Review on Cow Dung Ash as Partial Replacement of Binder in Cement Mortar

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Abstract— Experimental investigations carried out to study the cow dung ash on the strength of mortar. Cement was partially replaced with six percentages (5%, 10%, 15%, 20%, 25% and 30%) of cow dung ash by weight. Test performed on the mortar mix are compressive strength, workability, initial and final setting time. The compressive strengths of the mortar specimens were determined at 7, 14, 21 and 28 days respectively. The tests were performed on the moulds of size 70.6mmX70.6mmX70.6mm. The test results revealed that addition of CDA to cement paste prolonged the setting time. The compressive strength of the mortar is reduced with the increase in CDA. It has been observed in mortar, 10% replacement of cement by CDA may be used as a partial replacement to cement in mortar. Thus 10% replacement of cement by CDA gives satisfactory result.

Key words: CDA, Cement Mortar, Cow Dung Ash

I. INTRODUCTION

A. General

It is well accepted by everyone that concrete executes outstanding responsibilities for the construction of modern infrastructures and industrialization. Cement is the main binder in the production of concrete. The production of strong and durable concrete is fundamental to building better roads, bridges, houses, and civil infrastructure. The cement industry has one of the highest carbon footprints which make traditional concrete unsustainable in the future. Materials such as Cow Dung Ash, Fly Ash, Slag, and Silica Fume, can be used as partial replacement for cementing material. Cow Dung Ash is obtained from cow excreta which is dried by sunlight and subjected to burning as a result, ash is obtained in black colour. It is bulky and contains a Nitrogen rich material, Potassium, Phosphorous and Calcium

B. Importance and Scope of Project

The experimental program was planned to quantify the consistency and compressive strength of mortar using cow dung ash as replacement of cement. Cement replacement at various percentages levels were used in this investigation to observe the effects of different cow dung ash levels in cement to find the compressive strength of mortar at various ages of curing. Utilization of some of these by products as partial replacement of cement will in addition to improving the properties of mortar also generate income and employment. The problem of disposal of these by-products is minimized and the amount of green gases released into the atmosphere through cement-production processes is also greatly reduced.

II. MATERIALS

A. Cement

The cement used in investigation should be fresh, of uniform consistency and free of lumps and foreign matters. It should be stored under dry conditions and for as short duration as possible. Ordinary Portland cement (43 Grade) conforming to IS 8112 -1989 were used in this study. This cement was tested and the physical properties of cement were computed, results obtained were within limit as specified in Indian Standard and are as follows: Specific Gravity 3.09, fineness 2602 cm^2/g, normal consistency 30%, initial and final setting time 34 minutes and 540 minutes respectively.

B. Fine Aggregate

The fine aggregate – sand used should be strong and hard to resist loads applied, chemically inert so it is not broken down by reactions with substances it comes in contact with, has a stable volume so that it does not shrink or swell, bonds tightly with Portland cement paste. Contains no impurities or weak particles, would be the perfect size and gradation for the application intended, would be locally available and economical. The sand was sieved using 4.75mm and the fraction passing 4.75mm was used for all experiments. The sand belongs to zone – II as per IS: 383-1970. The physical properties of fine aggregate were computed according to IS 383 – 1970 and results obtained are as follows: Fineness Modulus – 2.83, Silt Content – 0.5%, Specific Gravity – 2.65.

C. Cow Dung Ash (CDA)

Cow dung is basically the rejects of herbivorous matter which is acted upon by symbiotic bacteria residing within the animal's rumen. The cow dung ash was collected from nearby locality as today also most of the people use cow dung cakes in hand made stoves for preparing their food. Cow dung comprises of organic matter including fibrous material that passed through the cow's digestive system, among other liquid digest that has been left after the fermentation, absorption and filtration, then acidified, then absorbed again. Tests were conducted and physical properties of the cow dung ash are as follows: specific gravity 2.55, fineness 3380 cm^2/g.

D. Water

Water is an important component of cement mortar. When cement comes in contact with water, an exothermic reaction occurs and setting of cement starts. Water used in the mixing is to be fresh and free from any organic and harmful solution which will lead to deterioration in the properties of the mortar. Salt water is not acceptable but chlorinated drinking water can be used. Potable water is fit for use as mixing water as well as for curing.

III. DESIGN MIX METHODOLOGIES

A. *Proportioning of Cow Dung ash with Cement*

For the experimental purposes different proportions of the CDA were used to replace the cement from 0% to 30% by weight with the interval of 5 per cent.

B. *Tests and Results*

1) *Compressive Strength Test*

Steel mould of cast iron of dimension 70.6mm x 70.6mm x 70.6mm is used for casting mortar cubes of 0%, 5%, 10%, 15%, 20%, 25% and 30% replacement of cement with CDA respectively. The mould and its based are rigidly clamped together so as to reduce leakage during casting. The sides of cube are thinly oiled before casting so as to prevent the development of bond between the mortar and the mould. Stipulates that the cubes should be filled in three layer is compacted. The ramming is done efficiently to ensure full compaction. The free surface is finish using hand trowel. The cubes are stored 24 hours undisturbed at temperature 18º C to 22ºC and relative humidity of not less than 90 per cent. The mould is stripped off after 24 hours and the cubes are to be stored in water for curing in a curing tank at 19ºC to 21ºC.

% CDA in cement	Water Content	Cube Strength (N/mm^2)
0%	0.5	14.85
5%	0.5	13.46
10%	0.5	13.23
15%	0.5	12.75
20%	0.5	09.07
25%	0.5	06.02
30%	0.5	05.11

Table 1: Cube strength of CDA varying the percentage for replacement of cement at 07days of curing

% CDA in cement	Water Content	Cube Strength (N/mm^2)
0%	0.5	15.78
5%	0.5	13.95
10%	0.5	12.07
15%	0.5	11.02
20%	0.5	9.50
25%	0.5	7.47
30%	0.5	5.54

Table 2: Cube strength of CDA varying the percentage for replacement of cement at 14 days of curing

% CDA in cement	Water Content	Cube Strength (N/mm^2)
0%	0.5	17.46
5%	0.5	15.29
10%	0.5	14.02
15%	0.5	13.87
20%	0.5	11.14
25%	0.5	7.85
30%	0.5	5.05

Table 3: Cube strength of CDA varying the percentage for replacement of cement at 21 days of curing

% CDA in cement	Water Content	Cube Strength (N/mm^2)
0%	0.5	21.88
5%	0.5	21.46
10%	0.5	21.13
15%	0.5	17.85
20%	0.5	11.07
25%	0.5	6.02
30%	0.5	5.79

Table 4: Cube strength of CDA varying the percentage for replacement of cement at 28 days of curing

Curing Period (Days)	0%	5%	10%	15%	20%	25%	30%
7	14.85	13.46	13.23	12.75	9.07	6.02	5.11
14	15.78	13.95	12.07	11.02	9.50	7.47	5.54
21	17.46	15.29	14.02	13.87	11.14	7.85	5.05
28	21.88	21.46	21.13	17.85	11.07	6.02	5.79

Table 5: Results obtained for cube strength of cubes for each curing periods

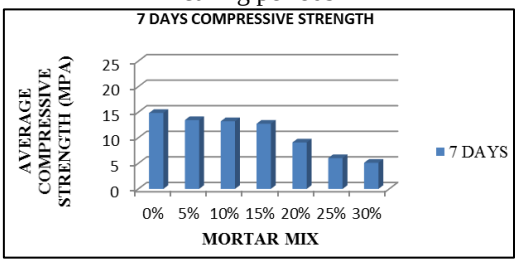

Fig. 1: Showing Variation in Compressive Strength of Different Modified Mortar Sample after 7 Days Curing Period

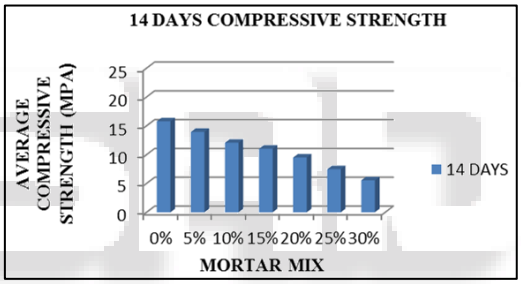

Fig. 2: Showing Variation in Compressive Strength of Different Modified Mortar Sample after 14 Days Curing Period

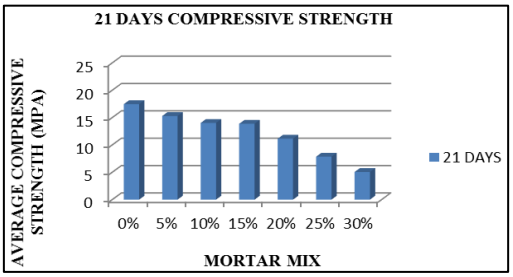

Fig. 3: Showing Variation in Compressive Strength of Different Modified Mortar Sample after 28 Days Curing Period

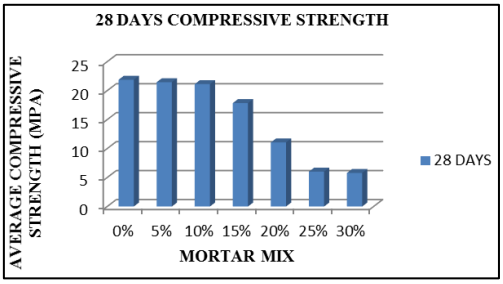

Fig. 4: Showing Variation in Compressive Strength of Different Modified Mortar Sample after 56 Days Curing Period

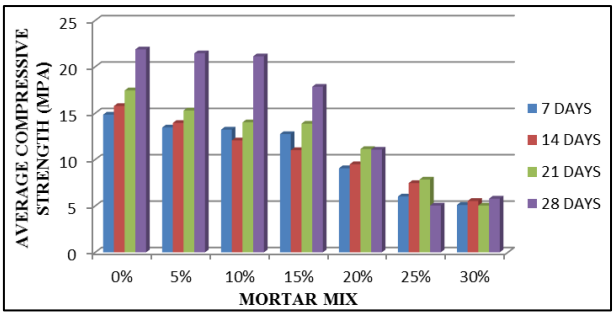

Fig. 5: Showing Variation in Compressive Strength of Different Modified Mortar Sample

2) Workability

The workability of the concrete is tested for different cow dung ash percentage mixed in cement. The high demand for water as CDA increases is due to increased amount of silica in the mixture. The general behaviour pozzolanic cement concrete in which the silica – lime reaction would require more water in addition to the water needed during hydration of cement.

Percentage of Mortar Mix	Compaction Factor
0%	0.91
5%	0.89
10%	0.87
15%	0.86
20%	0.82
25%	0.81
30%	0.8

Table 6: Compaction Factor for different Percentage Replacement

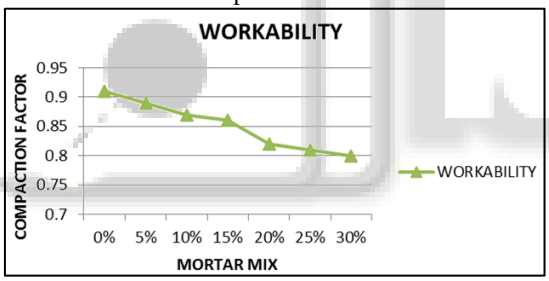

Fig. 6: Showing Variation in Workability of Different Modified Mortar Sample

3) Initial and Final Setting Time

Setting, which refers to the development of rigidity in fresh concrete, is an extremely important process. Before setting the concrete, it is plastic and behaves like a fluid, and after setting the concrete is rigid and behaves like a solid. This transition from fluid to solid is gradual and progressive. Initial set marks the end of period in which the fresh concrete can be mixed and moulded. Final set marks the beginning of strength development. Setting is generally recognized to reflect the micro structural changes that take place during hydration of the Portland cement. Test has been conducted on cement by adding different percentages of cow dung ash. It is observed that the setting times have been increased with the increase in % of cow dung ash in cement. This trend may be attributed to the ability of CDA to delay the hydration of cement and consequently prolong the setting time.

% CDA in Cement	Initial Setting Time	Final Setting Time
00%	55	186
05%	88	211
10%	118	240
15%	130	278
20%	145	320
25%	156	355
30%	166	392

Table 7: Initial and Final Setting Time for different Percentage Replacement

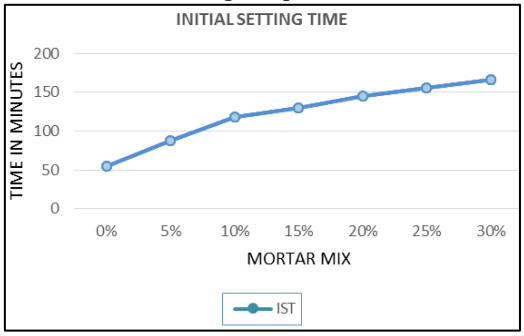

Fig. 7: Showing Variation in Initial Setting Time of Different Modified Mortar Sample

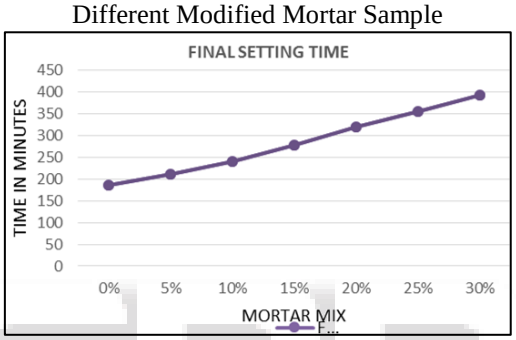

Fig. 8: Showing Variation in Final Setting Time of Different Modified Mortar Sample

IV. Conclusion

1) Cow dung ash (CDA) has pozzolanic traits and thus can be classified as pozzolana.
2) The use of CDA in mortar retards its setting times and hence can be used as a set retarder for mortar in hot weather.
3) Workability is reduced by incorporating CDA in mortar.
4) Compressive strength of a mortar mix increases till 10% replacement by CDA for best results.
5) Compressive strength of CDA/OPC blended mortar decreases as CDA content increases and increases with curing age.

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