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Experimental Study on Concrete Using Cow Dung Powder by Partial Replacement of Cement

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Abstract: *Cement, which is expensive, resource-intensive, and a major source of CO_2 emissions, is used extensively in the construction sector. Cow Dung Powder (CDP) was added to cement in different weight percentages (10%, 13%, 16%, and 20%) and allowed to cure for 1, 14, and 28 days, respectively, before the compressive strengths were tested. Additionally, by combining cow dung powder with Portland cement in different percentages, the setting time, bulk density, and workability are determined. At 28 days, the compressive test results for 0%, 10%, 13%, 16%, and 20% replacement of cement with CDP are 22.00 N/mm2, 20.22 N/mm2, 19.55 N/mm2, 13.78 N/mm2, and 12.13 N/mm2, respectively. According to the workability results, 112 mm.*

Keywords: Cement

I. INTRODUCTION

Using waste products in concrete is good for both construction and the environment. Cement is a key ingredient in concrete, but it uses a lot of natural resources and has a big environmental impact. With more people worrying about this, finding alternative materials—especially recycled ones—has become more important for comparison, a control sample of concrete was prepared without mixture of cow dung powder to compare it with the various samples containing different percentages (5%, 10%, 15% and 20%) of mixture of cow dung powder as a partial replacement of cement and sand in concrete. Results discovered that the usage of mixture of cow dung powder in concrete as a partial replacement of cement and sand increases the concrete strength. Such as compressive strength increases up to 21.96%, age of 7, 14 and 28 days. In this research work the mixture of cow dung ash were used in concrete as a partial cement and sand replacement, to study its effect upon concrete strength. The mix proportion of 1:1.85:3.2 was selected for all the concrete samples with water to binder ratio of

0.5. Utilization of M20 grade concrete and maintaining the same mould size. Cow Dung Powder concrete is recommended for use only when a thirteen percentage (10%) of Cow Dung Powder is added.

II. OBJECTIVE

- To lessen the harm that cement production causes to the environment
- To examine the impact on concrete's durability and compressive strength.
- To use resources that are readily available locally to support environmentally friendly construction technologies.
- To evaluate the concrete mixed with cow dung's thermal insulation and setting time characteristics.
- To use locally accessible resources to support environmentally friendly construction technologies

III. METHODOLOGY

- Literature view
- Material collection
- Mix design
- Casting and curing

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- Testing
- Result and conclusion

IV. MATERIAL USED

COW DUNG POWDER

Cow dung is dried and ground into a fine powder to create cow dung powder. Because of its high nutrient content, it is frequently used as an organic fertiliser in agriculture. It also acts as a natural soil conditioner and insecticide. It is also utilised in religious ceremonies and in the production of environmentally friendly goods like biodegradable materials and incense sticks.

CEMENT:

One of the primary binding ingredients in concrete is cement. The aggregates are held together by a paste that is created when it reacts with water. Ordinary Portland cement, or OPC, is the most popular kind; it sets quickly and has a good compressive strength. It also strengthens the concrete and has good durability. However, during production, it emits a lot of carbon dioxide.

FINE AGGREGATE:

The mix's fine aggregate is sand. It bridges the spaces between cement paste and coarse aggregates. The main reasons natural river sand is used are its strength and cleanliness. Typically, the particle size is less than 4.75 mm. It also aids in concrete workability and finishing. However, the strength will be affected if the sand is not of the right quality.

COARSE AGGREGATE:

The larger stones known as coarse aggregate are what give concrete its strength and volume. Depending on the mix, they typically range in size from 10 to 20 mm. A lot of people use crushed stones. It should be clean, hard, and devoid of organic material or dust. Strength and workability are also influenced by size and shape.

WATER

For cement to hydrate, water is required. It must be hygienic and devoid of any dangerous materials. Concrete's strength may be diminished by unclean water. Water content is also crucial; too little water makes concrete difficult to mix and pour, while too much water weakens it.

V. MIX DESIGN

Cement, fine aggregate, and coarse aggregate are combined in a basic 1:1.5:3 ratio to create M20 concrete for a single 150mm cube. 108g of cement, 162g of fine sand, and 323g of coarse aggregate are combined with 54g of water to create the control mix. However, in this project, we use egg shell powder in place of some of the cement. We use 5.4g of cow dung powder to replace 5% of the cement, reducing the cement to 102.6g. The amount of cow dung powder then rises as cement decreases with replacements of 10%, 15%, and 20%. This enables us to test the effects of cow dung powder on the properties and compressive strength of the concrete.

VI. ARRIVED QUANTITTES

Replacement level	Cement(kg)	Cow Dung powder(kg)	Fine Aggregate(kg)	Coarse Aggregate(kg)	Water(ml)
0%	1.080	0	2.190	4.050	0.540
5%	1.026	0.054	2.190	4.050	0.540
10%	0.972	0.108	2.190	4.050	0.540
15%	0.918	0.162	2.190	4.050	0.540

VII. TEST ON FINE AGGREGATE

In this project, manufactured sand (M-sand) was used as the fine aggregate, and it was in a saturated surface dry (SSD) condition during use. The following tests were conducted on the M-sand in accordance with IS: 2386 – 1968

- Sieve analysis
- Density

SIEVE ANALYSIS TEST:

The experiment is conducted to determine and verify the gradation of fine aggregate, specifically manufactured sand (M-sand). M-sand is classified based on its gradation, and well-graded M-sand has the ability to form a dense, compact structure, leading to greater strength.

IS sieve size(mm)	Weight retained(gm)	Cumulative weight retained(gm)	Cumulative %weight retained	Cumulative %Passing
4.75	16	16	3.2	96.8
2.36	65	81	16.2	83.8
1.18	155	236	47.2	52.8
600	136	372	74.4	25.6
300	98	470	94	6
150	20	490	98	2
pan	10	500	100	0

DENSITY TEST:

In order to determine the mass of aggregate required to fill a unit volume container, this test measures the bulk density of fine aggregate. It also provides information about the percentage of voids in the aggregate, which directly affects the grading of the aggregate, which is essential for creating high-strength concrete. The bulk density is calculated by comparing the bulk density in the loose and compacted states.

Volume of the cylinder used = 9.81×10^{-3} m³

Trial	Weight of compacted aggregate (kg)	Weight of loose aggregate (kg)
Trial I	18.36	17.41
Trial II	18.66	17.55
Average	18.41	17.36

VIII. TEST ON COARSE AGGREGATE

Coarse aggregate was utilised in this project under saturated surface dry (SSD) conditions. To make sure the coarse aggregate was suitable for use in concrete, its qualities were assessed. The following tests were conducted on the coarse aggregate in accordance with IS: 2386 – 1963

- Sieve analysis
- Density

SIEVE ANALYSIS:

The sieve analysis of coarse aggregate is conducted to determine the average particle size, represented by an index number. This is done by measuring the cumulative percentage of material retained on each sieve. The fineness or grading of the coarse aggregate is indicated by subtracting the sum of the cumulative retained values from 100.

Is sieve size (mm)	Weight retained(g)	% of weight retained	Cumulative % retained	% pass
20	290	5.8	5.08	94.2
16	2768	55.36	61.16	38.84
12.5	1454	29.08	90.24	9.76
10	430	8.06	98.84	1.16
6.3	58	1.16	100	0
4.75	0	0	100	0
pan	0	0	100	0

DENSITY TEST:

The purpose of this test is to ascertain the coarse aggregate's bulk density. Calculating the mass of aggregate required to fill a unit volume container is made easier with knowledge of the bulk density. The percentage of voids in the aggregate is also reflected in bulk density, which is important for creating high-strength concrete and has a direct impact on the overall grading. Comparing the aggregate in its loose and compacted states yields the percentage of voids. A higher bulk density for coarse aggregate means there are fewer voids, which means cement paste needs to fill in less space. Thus, the degree of particle packing also affects bulk density.

Trial	Weight of compacted aggregate (kg)	Weight of loose aggregate (kg)
Trial I	17.12	16.11
Trial II	17.36	16.21
Average	**17.24**	**16.16**

IX. TEST ON CONCRETE CUBES

Cow dung powder (CDP), an environmentally friendly and sustainable cement substitute, is used in part to replace concrete cubes in this experiment to examine the impact on concrete performance. By weight of cement, replacement percentages of 5%, 10%, 15%, and 20% are employed. After 7, 14, and 28 days of curing, the following tests were carried out to track water absorption and strength development over time.

- Compressive test
- Water absorption test

COMPRESSIVE TEST:

- Mix concrete with ESP replacing cement at 5%, 10% and 15%
- Cast standard cubes of size 150 mm × 150 mm × 150 mm.
- Demould after 24 hours and cure in water for 7, 14 and 28 days.
- Test the cubes in a CTM at each curing age.
- Record the maximum load at failure and calculate compressive strength using:
- Compressive Strength (N/mm²) = Maximum Load (N) / Area of Cube (mm²) (Area = 150 mm × 150 mm = 22500 mm²)

X. TEST RESULTS

% CDP	7 Days	14 Days	28 Days
0%	14.22	18.52	22.84
5%	18.22	24.04	27.35
10%	16.89	22.68	25.45
15%	15.12	20.89	24.00

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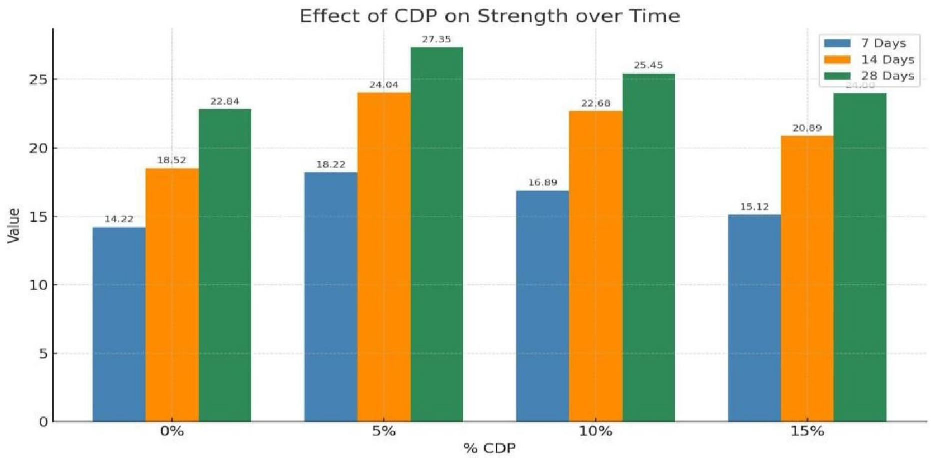
RAPH REPRESENTING A TEST RESULTS:



WATER ABSORPTION TEST:

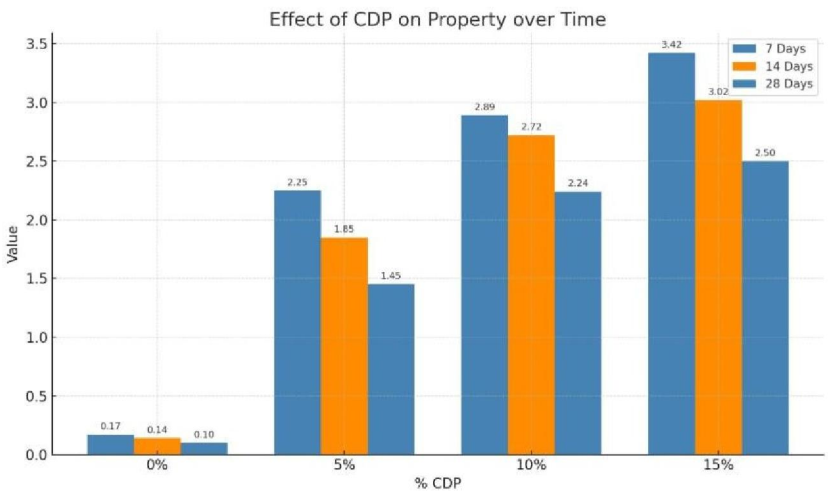
- After curing (7, 14, 28 days), dry the concrete cubes in an oven at 100–110°C for 24 hours.
- Record the dry weight (W1).
- Submerge cubes in water for 24 hours.
- Take out and record the wet weight (W2).
- Calculate water absorption using:

Water Absorption (%) = ((W2 – W1) / W1) × 100

TEST RESULTS

% CDP	7 Days	14 Days	28 Days
0%	0.17	0.14	0.10
5%	2.25	1.85	1.45
10%	2.89	2.72	2.24
15%	3.42	3.02	2.50

GRAPH REPRESENTING TEST RESULTS



XI. CONCLUSION

According to the results of the tests, the use of Cow Dung Powder (CDP) as a partial replacement for cement has an impact on concrete's strength and water absorption. Up to an optimal level of 5% CDP improves compressive strength, with a peak value of 27.35 N/mm² at 28 days compared to 22.84 N/mm² for the control mix. Strength decreases beyond 5%, most likely as a result of interference with cement hydration. Water absorption increases with higher CDP content, indicating greater porosity and decreased durability—rising from 0.10% at 0% CDP to 2.50% at 15% CDP. In summary, 5% CDP offers the best balance between strength and durability, making it a feasible and sustainable partial cement replacement.

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