

Use of Cow Dung Ash as a Partial Replacement for Cement in Mortar

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Abstract—The construction industry has recently seen a considerable shift towards use of sustainable and green materials due to rise in pollution and waste which is created by some of the most basic ingredients during its production which releases harmful gases like carbon dioxide leading to global greenhouse effect and hence results in global warming. Various governmental and international organizations and individuals alike have started working on products that can be used as replacement materials to the ingredients of concrete and mortar such that the use of such materials will increase the strength of the resulting product as well as will be cost effective at the same time. The needs of an ever growing global population leads to an ever increasing demand for buildings, houses and various other facilities and hence the faster we move towards sustainable and green construction practices the better our future will be for us and as well as the environment. In this paper we have tried using cow dung ash as a replacement material for cement that is one the expensive materials among major ingredients of mortar. Cow dung ash is obtained from the when the cow dung is dried for 12 days, heated at around 420-550 degrees Celsius and is cooled and crushed into powder form and then sieved under IS 400 micron sieve. Cow dung ash as a by-product is readily available at cattle farms with negligible price and sometimes is almost free of cost. It has been noted that replacement of cement by cow dung ash has resulted in better strength, durability and workability as compared to conventional mortar mix.

Keywords— Cow Dung Ash; Compressive Strength

I. INTRODUCTION

As we all know throughout history, civil engineering has been an important part of every civilization since time immemorial. From the ancient pyramids of Egypt to the Great Wall of China to the famous Taj Mahal, the use of binding material to hold the stones and bricks together has been a chief constituent since ancient times. Lime mortar was widely used during such times mainly because of its property of slow setting time which gave it high workability. The use of lime mortar continued up to the 19th century thereafter cement mortar came to be used widely. The main difference between them being higher compressive strength, flexural strength and faster setting time. After the industrial revolution, late in the 20th century the importance of global warming and the greenhouse effect came to the fore. Cement in its manufacturing process produces greenhouse gases. Secondly the cost part of cement also was acknowledged. Considering these reasons, many have ventured to find a replacement. In our

experiment we have used Cow Dung Ash with varying percentages as a replacement to cement in binder. Cow Dung Ash is abstracted from raw Cow Dung Cakes through thorough drying and sieving under IS sieve. Cow Dung Ash as a replacement to cement has advantages of being low cost, eco-friendly, low heat conduction, light weight and having high strength when used in concrete. Cow Dung Ash is abstracted from raw Cow Dung Cakes through thorough drying and sieving under IS sieve. Most of the waste products like cow dung, fly ash, glass powder, egg shell powder are readily available as a by-product from various factories, industries or animal waste. Because of this the cost to obtain such products is very negligible and hence its use as a replacement product for cement, or fine aggregate can reduce the cost significantly as products like cement, sand are costly. Replacing cement will all reduce the harmful products which are released in the environment. Most of the time the use of waste products can also increase various properties of the resulting mortar. It has been found that the use of waste products in mortars and even in concrete significantly increases its strength capabilities, its workability and its durability among other properties. A mechanical study of Cow Dung Ash modified concrete shows that strength of concrete decreases with increase in Cow Dung Ash percentage with no change in tensile strength with best percentage being 10% (Aishwarya Suresh 2018). Use of glass fiber and Cow Dung Ash in concrete showed that upto 0.5% and 8% respectively the compressive strength increases (Sruthy B 2017).

II. MATERIALS AND METHODOLOGY

A. Materials

Cow Dung Ash: It is the rejection of herbivorous substances by symbiotic bacteria living in animal digestive tract composed of fibrous waste. The process of Cow Dung Ash is such that it is dried for 12 days after which it is burnt at 500°C. After cooling it is sieved under IS400µ to get the resulting product.

Cement: The grade of cement used in the mix is inversely proportional to the compressive strength of the resultant concrete or mortar. J k cement of OPC grade 43 was used in the experiment.

Sand: Fine aggregates are important as far as stability of the mixture is concerned. River sand obtained from Sonal river in Valpoi was used falling in zone-II.

B. Methodology

Various preliminary tests were done on the ingredients of mortar to find out if the results fall in the permissible limits of the respective tests. Tests such as standard consistency of cement, setting time of cement, specific gravity of cement, specific gravity of Cow Dung Ash, fineness modulus of Cow Dung Ash, silt content of fine aggregate, specific gravity of fine aggregate, water absorption test on fine aggregate, particle size distribution of fine aggregate and bulking of sand were done.

III. TEST RESULTS

TABLE I. COMPRESSIVE STRENGTH OF MORTAR CUBES FOR REPLACEMENT OF CEMENT WITH COW DUNG ASH FOR 7 DAYS

Cow Dung Ash (7 days)							
Percentage %	1st Cube		2nd Cube		3rd Cube		Mean (N/m ²)
	Load (KN)	Strength (N/m ²)	Load (KN)	Strength (N/m ²)	Load (KN)	Strength (N/m ²)	
0	33.2	6.661	35.8	7.182	33.2	6.661	6.835
5	36.8	7.383	28.8	5.778	33	6.621	6.594
10	25.4	5.096	23	4.614	25.8	5.176	4.962
15	27.4	5.497	28.2	5.658	28	5.618	5.591
20	24.2	4.855	22.4	4.494	26.6	5.337	4.895
25	19	3.812	21.2	2.253	19.8	3.972	3.346

TABLE II. COMPRESSIVE STRENGTH OF MORTAR CUBES FOR REPLACEMENT OF CEMENT WITH COW DUNG ASH FOR 28 DAYS

Cow Dung Ash (28 days)							
Percentage %	1st Cube		2nd Cube		3rd Cube		Mean (N/m ²)
	Load (KN)	Strength (N/m ²)	Load (KN)	Strength (N/m ²)	Load (KN)	Strength (N/m ²)	
0	38	7.624	38.2	7.664	46	9.23	8.175
5	43.8	8.787	44.6	8.95	41.6	8.346	8.694
10	45.2	9.068	34.4	6.901	37.6	7.54	7.836
15	34	6.821	46.4	9.309	42.2	8.466	8.198

20	42.6	8.546	47.2	9.469	49	9.83	9.282
25	45.8	9.188	45.2	9.068	36.6	7.343	8.533

TABLE III. COMPRESSIVE STRENGTH OF MORTAR CUBES FOR REPLACEMENT OF CEMENT WITH COW DUNG ASH FOR 56 DAYS

Cow Dung Ash (56 days)							
Percentage %	1st Cube		2nd Cube		3rd Cube		Mean (N/m ²)
	Load (KN)	Strength (N/m ²)	Load (KN)	Strength (N/m ²)	Load (KN)	Strength (N/m ²)	
0	40.4	8.105	39.6	7.945	49	9.831	8.627
5	51.6	10.352	46.4	9.309	49.6	9.951	9.871
10	46	9.228	50.4	10.112	57.8	11.596	10.312
15	54	10.835	50.2	10.072	46	9.229	10.045
20	50.2	10.072	47	9.429	51.8	10.395	9.965
25	40	8.025	48.6	9.750	48.8	9.791	9.189

TABLE IV. VARIATION OF COMPRESSIVE STRENGTH OF MORTAR CUBE

Replacement Of Cow Dung Ash (%)	Strength In 7 Days Of Curing (N/mm ²)	Strength In 28 Days Of Curing (N/mm ²)	Strength In 56 Days Of Curing (N/mm ²)
0	6.8352	8.173	8.627
5	6.594	8.694	9.871
10	4.962	7.836	10.312
15	5.591	8.198	10.045
20	4.895	9.282	9.965
25	3.346	8.533	9.189

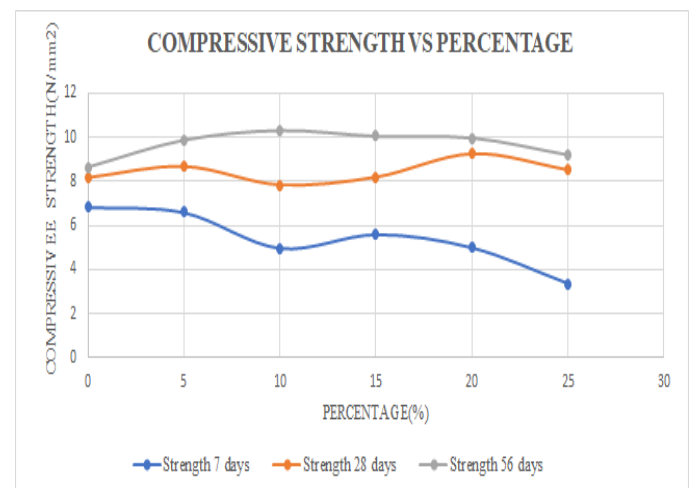


Fig 1. Variation of compressive strength of mortar cube

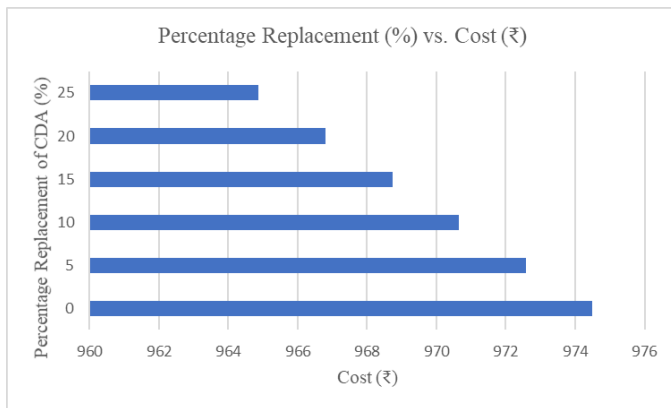


Fig 2. Percentage Replacement (%) v/s Cost (Rs.)

IV. CONCLUSION

The compressive strength of the mortar is important as the stones or the bricks which are stacked above one another should be able to take the load. The compressive strength throughout the testing period of 7, 28 and 56 days with every replacement percentage gives a value higher than 3 N/mm² as per IS 4031-6 (1988). The optimum percentage of replacement of cement with Cow dung Ash across 7, 28 and 56 days was found to be close to around 15% due to higher strength of around 10 N/mm² at 56 days of curing. As far as cost is concerned with the compressive strength and replacement of cement combined, the best percentage was found to be at 25% Cow Dung Ash. The replacement of cement with Cow Dung Ash also reduces the workability of cement. The Cow Dung Ash in mortar retards the setting time therefore it can be used as a retarder in mortar in hot weather conditions.

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