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Partial replacement of cement in concrete using cow dung ash

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Abstract—**In this study, an attempt was made to replace the cement using cow dung ash. Two sets of cubes of M25 grade were prepared separately by replacing cement with cow dung ash (CDA) upto 30% at 5% interval. Then the cubes were cured for the period of 7 and 28 days. The compressive strength of all the cubes was determined using the Universal Testing Machine. The study revealed that Cow Dung Ash can be used as a partial replacement of cement. Among the main conclusions, it should be highlighted that the initial and final setting time of cement increases as the percentage of cow dung ash is added, (CDA) has an advantage that offers lightness of weight and low thermal conductivity. Cow Dung Ash requires more quantity of water as the percentage increases in the concrete therefore it has a serious limitation that must be understood before it is put to use. Cow Dung Ash concrete is recommended for use only up to fifteen percentages (15%) of Cow Dung Ash is added.**

Key Words: cow dung ash, compressive strength, setting times, concrete, Portland cement

I. INTRODUCTION

Concrete is one of the most widely used construction material worldwide and there is an increase in the production of concrete to meet the ever-increasing demand for housing and other infrastructure. Cement, which is the main binder in the production of concrete, mortar, sand crete blocks and other cement products, is very expensive particularly in developing countries. The exorbitant and steadily increasing cost of cement has made concrete, mortar, sand crete blocks and other cement products expensive and consequently increasing the cost of construction of houses and other infrastructure that uses cement. The production of strong and durable concrete is fundamental to building better roads, bridges, houses, and civil infrastructure. The rising cost of cement particularly in the developing countries has made it difficult for majority of the populace whom are low income earners to own houses. Several attempts have been made to reduce the rising cost of cement production in developing countries with very little success. There is the need to seek alternative to conventional cement and to seriously consider the utilization of industrial and agricultural by-products as feedstock for the cement industry to produce blended cement. Utilization of some of these by products as partial replacement of cement will in addition to improving the properties of concrete also generate income (through sales) and Employment [6]. The global warming is caused by the emission of greenhouse gases such as CO2 to the atmosphere

by human activities. Among the greenhouse gases, CO2 contributes about 65% to global warming. The cement industry is responsible for about 6% of all CO2 emissions, because the production of one tonne of Portland cement emits approximately 0.9 tonne of CO2 into the atmosphere (Nazeer and Kumar, 2014).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.

The cow dung is obtained from cow excreta, which is dried in sunlight in the form of cake. In many parts of the developing world, caked and dried cow dung is used as fuel. The fuel ash is obtained in the form of black color. Rayaprolu and Raju (2012) have reported that cow dung is a nitrogen rich material, potassium, phosphorous and calcium. They studied about the use of cow dung ash as supplementary cementing material in mortar and concrete. As these materials can be used for the partial replacement of cement, therefore, the proportions of these materials were replaced by cement and the rock and brick were used as coarse aggregate in the preparation of concrete cubes.

II. REGARDING SUPPLEMENTARY MATERIAL (COW DUNG)

The cow dung ash is obtained from cow excreta which is dried to sunlight and subjected to burning as a result ash is obtained in black color. In many parts of the developing world, caked and dried cow dung is used as fuel. Dung may also be collected and used to produce biogas to generate electricity and heat. Cow dung is also an optional ingredient in the manufacture of adobe mud brick housing depending on the availability of materials at hand. In many parts of the developing world, caked and dried cow dung is used as fuel.

Dung may also be collected and used to produce biogas to generate electricity and heat. In cold places, cow dung is used to line the walls of rustic houses as a cheap thermal insulator.

A. MATERIALS AND METHODS:

Cow dung used for the study was collected from villages near Othakuthirai and Gobi. The cow dung was then sun dried properly, pulverized and afterwards calcined to ash at a temperature of 500°C.The resultant ash was sieved using a sieve of 90µm and stored in an air tight container to prevent it from absorbing moisture. Ramco brand of Ordinary Portland Cement (OPC) was used for study. The coarse aggregate of normal weight with maximum size of 20mm was used for study and river sand was used as fine aggregates. Pipe-borne

B. Experimental studies

PHYSICAL PROPERTIES:

A. Setting times of OPC/CDA blended Cement:

Setting times (initial and final) test was conducted on fresh cowdung ash cement blended paste at cement replacement levels of 5%, 10%, 15%, 20%, 25%, and 30%. The test was conducted in accordance with ASTM C 191- 82.

CDA %	Initial setting time (min)	Final setting time (min)
0%	40	450
5%	45	390
10%	76	440
15%	120	470
20%	146	530
25%	170	570
30%	171	600

Physical properties of cow dung:

a) It is bulky
b) It has large ash content
c) It has low volatile content after burning.
d) Carbon content is low
e) Burning ratio is low

Compressive strength test:

Concrete cubes of 150mmx150mmx150mm were cast using the mix proportion, and cured for 7 and 28 days respectively by complete immersion in water. The compressive strength test was determined using the ELE digital compression machine in accordance with BS 1881: Part 116: 1983 specification. A total of forty two (42) cubes were cast, cured and tested. For each curing period three (3) cubes were produced and the average of the three results recorded.

Workability:

Slump test is used to determine the workability of fresh concrete. Slump test as per IS: 1199 – 1959 is followed. The apparatus used for doing slump test are Slump cone and tamping rod. In this test, the workability of concrete is determined for each different mixed proportions of cow dung ash to cement. In table.4 shows that for 10% of cow dung ash mixing gives workability of 50 mm and for 20% and 30% are 80mm and 100 mm respectively. Due to high percentage of water requirement the workability value increases by increasing the cow dung ash percentages.

Table.1 Workability of CDA in Various Percentages

CDA %	Workability (mm)
0%	40
5%	46
10%	50
15%	65
20%	80
25%	89
30%	100

Consistency limits:

The basic aim is to find out the water content required to produce a cement paste of standard consistency as specified by the IS: 4031 (Part 4) – 1988. The principle is that standard consistency of cement paste when mixed with different percentages of cow dung ash is that consistency at which the Vicat plunger penetrates to a point 5-7mm from the bottom of Vicatmould.Vicat apparatus conforming to IS: 5513 – 1976, balance. Whose permissible variation at a load of 1000g should be +1.0g, Gauging trowel conforming to IS: 10086 – 198. By adding cow dung ash to cement, requires more water content by increasing the ash content. In table.2 shows that for 0%, 5%, 10%, 20%, 25% and 30% of ash percentages the percentage of water is 0.34, 0.42, 0.46,0.54,0.62, 0.70 and 0.78 respectively.

Table.2 Consistency Limits for Different Mix Ratios of CDA

CDA %	Consistency limit
0%	0.34
5%	0.42
10%	0.46
15%	0.54
20%	0.62
25%	0.70
30%	0.78

III. CONCLUSION

Performance of cow dung ash with concrete although seriously limited by its low compressive strength, cow dung ash concrete can be made to perform well in certain floor and wall applications. When CDA is mixed with concrete it requires more quantity of water while increasing the ash content. It performs well in when a limited percentage (up to 10%) can be used for floor applications or as a building component not subject to high structural stresses. It has serious limitations that must be understood before it is put to use. Within these limitations, the advantages of cow dung ash concrete offers lightness of weight, and low thermal conductivity make it a useful construction material. However, the strength of cow dungs ash concrete when made in the most commonly used proportion is only 10 to 15 percent of that of normal concrete. It is not usable where high structural strength is required or where it would be subjected to heavy traffic and severe abrasive action. Its ash content also prohibits installation of lean mixes in environments of excessive moisture. However, strength is drastically reduced as the percentage of cow dung ash is increased. In general, cow dung ash concrete is not recommended for use where water accumulates or where water is constantly present. The specific gravity of cow

dung ash is 2.The compressive and the flexural strengths of CDA concrete for the ages investigated such that the lowest values obtained at 30% additive level of ash. The initial and final setting time increases by increasing the cow dung ash. This paper mainly highlights the significance and necessity of consumption of these waste materials for the manufacturing of sustainable concrete for construction of green buildings in future.

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