EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT WITH COW DUNG ASH

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ABSTRACT

The consumption of cement in concrete industries increasing day by day. Concrete is the most widely used construction material in civil engineering industry because of its high structural strength and stability. The most important part of concrete is the cement. Use of cement alone as a binder material produces large heat of hydration since the production of this raw material emits huge amount of CO2. The carbon dioxide emission from cement is very harmful to the environmental changes. The concrete industry is looking for supplementary cementations material with the objective of reducing the carbon dioxide emission which is harmful to environment. The effective way of reducing CO2 emission from the cement industry is to use the industrial by products or use of supplementary cementing material such as ground granulated blast furnaces slag (GGBS), fly ash, silica fume and metakaolin. In this present experimental work an attempt is made to replace cement by Cow dung ash (CDA) to overcome these problems. The cement has been replaced by CDA in the range of 5%, 10%, 15% and 20% by weight of cement for M20 grade mix. It was tested for compressive strength at the age of 7, 14 and 28 days and compared with those of conventional concrete. Results showed that 10% replacement of cement by cow dung ash makes a considerable increase in compressive strength. The present investigation has shown that an addition of 10% CDA to concrete makes it stronger and more durable than conventional concrete.

KEYWORDS: *Ground Granulated Blast Furnace slag (GGBS), Cow dung ash (CDA), Compressive strength, Carbon dioxide (CO2)*

INTRODUCTION

Concrete is the most popular building material in the world. However, the production of cement has diminished the limestone reserves in the world and requires a great consumption of energy. River sand has been most popular choice for the fine aggregate component of concrete in the past, but overuse of the material has led to environmental concerns, the depleting of securable river sand deposit and a concomitance price increase the material Therefore, it is desirable to obtain cheap, environmentally friendly substitutes for cement and river sand that are preferable by product. Concrete is the world's most utilized construction material. The need for infrastructural development in both the developing and developed countries has placed a great demand on Ordinary Portland Cement (OPC) since its invention in the first half of the 19th century Portland cement has become the most widely available material.

There is need for affordable building materials in providing adequate housing for the teaming populace of the world. The cost of conventional building materials continues to increase as the majority of the population continues to fall below the poverty line. Thus, it is necessary to use a supplementary local material as alternative for the construction of low-cost buildings in both rural and urban areas. A huge amount of concrete is consumed by the construction industry. The production of Portland cement is not only costly and energy intensive, but it also produces large amounts of carbon emission. The production of cement poses environmental

Problems due to emission of gaseous pollutants. The emissions of poisonous gases like CO2, NO., etc. by cement production companies have depleted the natural environment. They have caused environmental pollution and global warming due to the depletion of ozone layer. Some industrial wastes have been studied for use as supplementary cementing materials such as fly ash, silica fume, metakaolin etc. The disposal and management of waste material is a potential challenge.

Sustainable materials are currently widely considered and investigated in construction engineering research. Some examples of sustainable research are the use of recycled concrete aggregates, coal fly ash, ground clay brick and pervious paver block system. Further, substantial research work has been conducted on fiber-reinforced concrete which is a concrete primarily made of a mix of hydraulic cement, aggregates, water and reinforcing fibers. Cow dung is the undigested residue of plant matter which comes from cows gut. In cow dung nitrogen, calcium, carbon, potassium, and phosphorus have a high content. About 10- 15 kg cow dung is produced by a cow in a day, which contains about 28% water in fresh state. 34% of cow dung becomes ash when it is burnt. In the present study, cement was replaced by cow dung ash by 0%, 5%, 10%, 15% and 20%.

COW DUNG ASH (CDA)

Cow are one of the numerous species of cattle family commonly available in all the part on the world they are employed field operations like Ploughing, harrowing, sowing and inter-cultivation etc., while some may looks at cow as source of meat, dairy products and some other use the Michigan state university have found more sustainable and abundant, yet equally useful bovine by produce manure. Surprisingly, the material,

When sterilized, is entirely odorless and offers some wonderful characteristics for the production of variety of fiberboard building materials. The manure essentially replaces the role of sawdust in the production of particle boards, which would cut down wood usage as well as posing a creative solution of huge.

The cow dung is said to have strong antibacterial properties it works as a good disinfectant by keeping house cool in summer and warm in winter cow dung's used as construction material for house encourages utilization of material resources and minimizes wastages. In this CDA was obtained from rural housing the cow dung is collected and dried for an period of 12 days and it is burned to form an ash which is added to cement by partially replacing from 5% to 20% the cow dung is an good.

Cow dung ash that has been obtained from villages are dried under sunlight, burnt at a temperature of 450 to 500°C and cooled. After cooling it was crushed to powder form, sieved under 300 micron sieve was stored in an air tight container preventing moisture ingress. The cow dung is exposed to sunlight to dry in order to have dung cakes which is then subjected to burning after it is dried to have the cow dung ash which is obtained in black color.

Fig: 1 Cow dung ash

Table: 1 Chemical analysis of OPC 53 grade and CDA

CHEMICAL COMPOUNDS, %	O.P.C(53GRADE)	COW DUNG ASH
Loss of ignition (L.O.I)	4.83	4.25
Silica (SiO_2)	18.78	79.22
Alumina (Al_2O_3)	2.87	5.62
Ferric Oxide (Fe_2O_3)	4.03	2.98
Calcium Oxide (CaO)	54.66	3.71
Magnesium Oxide (MgO)	3.46	1.88
Sulphuric Anhydride (SO_3)	1.13	0.19
Insoluble Residue (IR)	9.69	1.65

PHYSICAL PROPERTIES OF COW DUNG:

- It is bulky
- It has large ash content
- It has low volatile content after burning
- Carbon content is low
- Burning ratio is low

PURPOSE OF THE RESEARCH WORK

The application of supplementary material (CDA) to cement in various percentages is to be done by replacing 0%,15%,10%, 15% and 20% individually for achieving,

- To produce and evaluate the products for partial replacement of cement using the byproducts.
- To minimize the overall environmental effects of concrete production using these materials as partial replacement.
- To promote the preservation of the environment and natural resources through a process optimization of waste.
- To develop a cost competitive structural light weight concrete by incorporating supplementary materials.

SCOPE AND OBJECTIVES OF THE EXPERIMENT

The main scopes of the experiment are,

- To examine the effectiveness of using CDA as partial replacement of cement by studying strength parameters.
- To investigate the necessity of consumption of the waste material for manufacturing of sustainable concrete for construction. To use locally available material and to reduce the cost of producing concrete.

- To overcome the problems faced by cement industries to a little extent.

The experimental investigation was work out the suitability of addition of cow dung ash as partial replacement of ordinary Portland cement in concrete with the followingobjective.

- To investigate the compressive strength of concrete with CDA to that of normal concrete.
- To prepare high strength, eco-friendly and cost effective concrete.
- To reduce cost of the concrete material (cement) and economical.
- To attain conventional concrete strength by partial replacement of cement with CDA

LITERATURE REVIEW

P.Thej Kumar, R.Harshini Reddy And Dvs. Bhagavanulu[1]., "A study on the replacement of cement in concrete by cow dung ash". This trend of strength variation may be due to the pozzolanic activity of CDA. It is observed that the 5% CDA can be added in cement as partial replacement where as in concrete 5% CDA can be used as partial replacement to cement. But more detailed study is essential to find the compressive strength at longer ages. O.Y.Ojedokum, A.A.Adeniran, S.B.Raheem and S.J.Aderinto[2] "Cow dung Ash as Partial Replacement of Cementing Material in the Production of Concrete"**.** Presents the result on the study for the use of Cow Dung Ash (CDA) as partial replacement in production of concrete. The experiments were designed to study the effects of adding Cow Dung Ash (CDA) in various percentages by weight (10%, 20% and 30%) of cement and cure for the periods of 7, 14, 21 and 28, days respectively before testing for the Compressive strengths. S. Barathanand and B. Gobinath[3] is used wood ash as partial replacement of cement and found that the compressive strength of cement increases significantly over hydration time. The compressive strength of 20% WA sample shows more strength at 4 weeks than the OPC sample. The water requirement increased with the increase with WA addition, 20% WA sample shows higher degree of hydration and compressive strength than OPC. V.S.R.Pavan Kumar, P.Polu Raju[4] **"**Incorporation of cow dung ash to mortar and concrete"**.** 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. Duna Samson, Omoniyi Toper Moses[5]., **"**Investigation the pozzolanic potentials of cow dung ash in cement paste and mortars". Reports on the investigation into the pozzolanic potentials of cow dung ash. Cow dung was calcined at a temperature range of 400-500, sieved through 212μm sieve and characterized using chemical and physical methods. Cement paste and mortar were produced using CDA as cement replacement at 0, 5%, 10%, 15%, 20%, 25% and 30%. Standard consistency, soundness and setting time test were conducted on the blended cement paste, while compressive strength test was conducted on the hardened mortar samples after curing for 7, 28, 60 and 90days.

EXPERIMENTAL ANALYSIS

SLUMP CONE TEST

The internal surface of the slump cone is thoroughly cleaned and oiled. The given concrete mix is prepared for the volume of the slump cone. The mould is filled with freshly prepared concrete in three layers of concrete and each layer is given with 25 blows using tamping rod. The mould after the tamping the top surface of the concrete is leveled with trowel in level with the top of the mould. The mould is removed from the concrete immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to subside or slump and slump is measured immediately by determining and that of the higher on the subside concrete is measured.

COMPCTION FACTOR TEST

The inner surface of the hooper and cylinder are greased the lot of empty cylinder with base (w/gm.) is taken. The given concrete mix proportion is prepared the concrete mix is gently planed and leveled in the hooper using the hand sloop.

The trap door is opened to that the concrete falls into the lower hooper. Immediately after the concrete has come to rest the trap door of the lower hooper is opened and concrete is allow to fall into the cylinder.

The excess of concrete remaining allow the leveled top of cylinder is remould with trowel outside of cylinder is elemed with print of cylinder (w2 gm.) is determined. The cylinder is refilled with same sample of concrete is approximately equal layer each layer is being heavily rammed or vibrated has detain full compaction. The top surface of cylinder is leveled and outside of cylinder is weight with concrete (w3 gm.) the value of compaction factor is calculated.

TEST ON HARDENED CONCRETE

To evaluate the performance of different mix used in this work, following strength test were performed.

PREPARATION OF SPECIMEN

The cube moulds of size 150mmx150mmx150mm were filled with the mix. The cubes were tamped by tamping rod for around 25 times and the surfaces of moulds were levelled properly. The specimens were kept for 24 hours; de- moulded and then set for curing.Fig-9 shows stages of preparation of specimen. The curing was allowed until the date of testing i.e., for 7th, 14th, and 28th. Then after the days of curing, the cube specimens were taken out and tested under testing machine.

Fig: 2 Mixing

Fig: 3 Casting

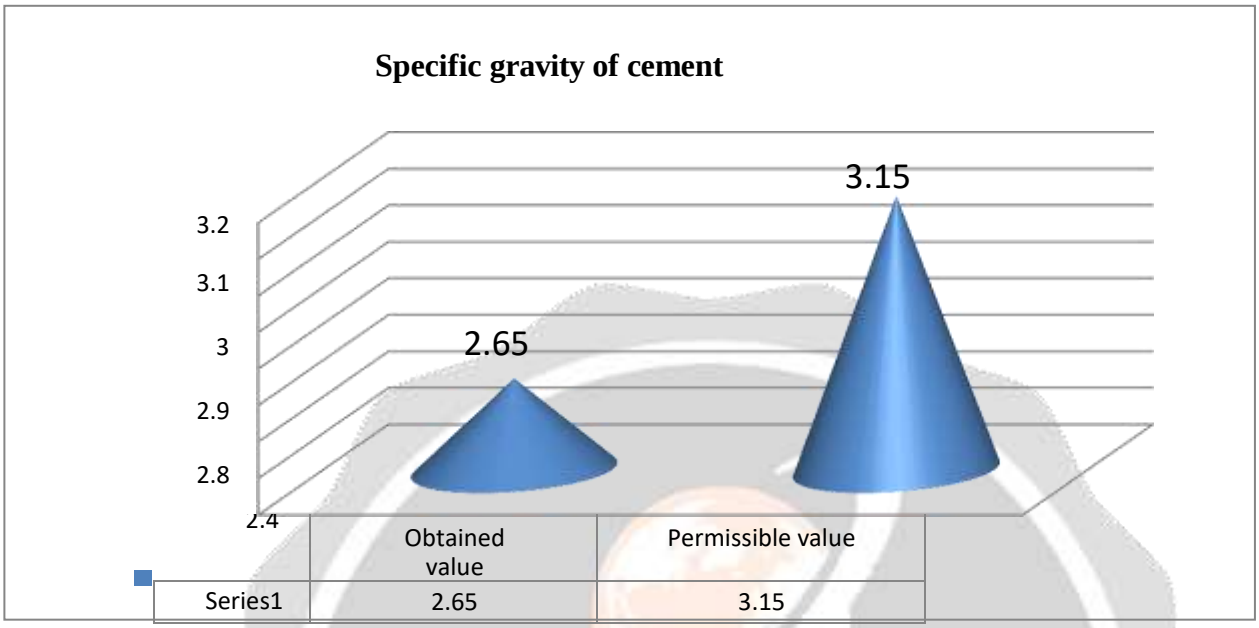
COMPRESSIVE STRENGTH TEST

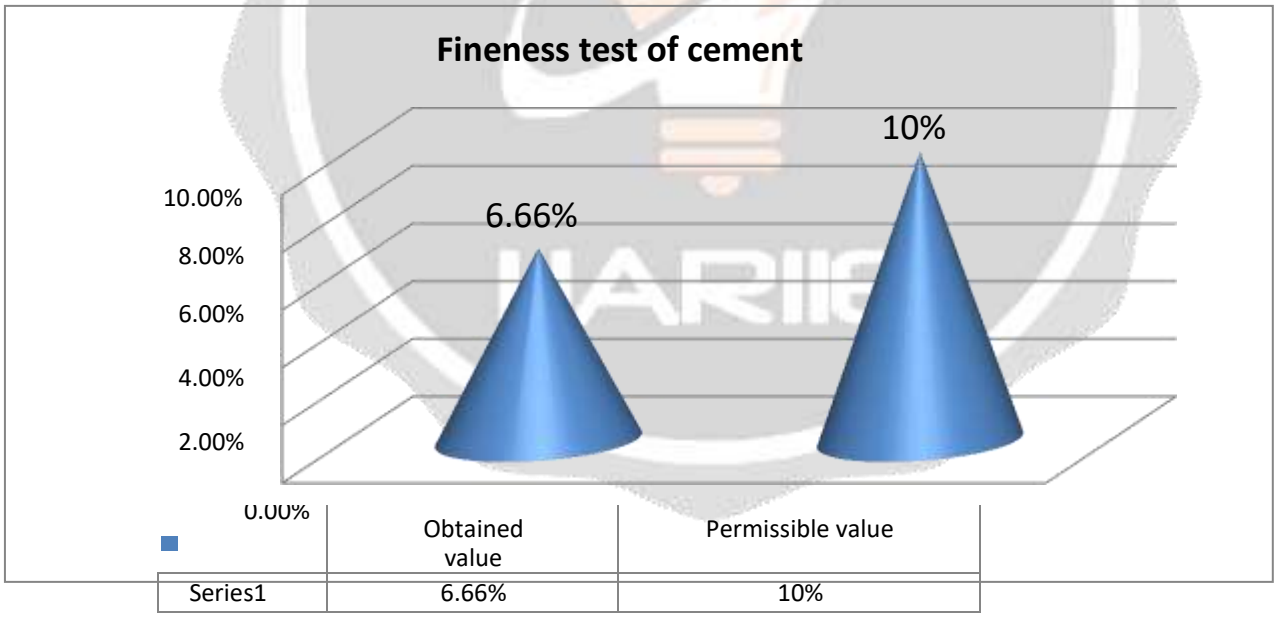
Compressive strength of concrete is a measure of its ability to resist static load. 7, 14 and 28 day compressive strength test were conducted on three specimens having size 150x150 mm and the average strength was taken as the cube compressive strength of concrete. The tests were conducted by using compression testing machine. From the results of the compression tests, the optimum percentage of CDA to be added is determined as the one which renders the maximum compressive strength. The cube specimen was taken out from the curing tank after specified curing time and were allowed for dry and the weight of each specimen as well as measure the dimension of the specimen were noted. The specimens were placed in the machine such that load shall be applied to the opposite sides of the specimen, and the specimens were aligned centrally on the base plate of the machine. The movable portion was rotated gently by hand so that it touches the top surface of the specimen. The load was applied gradually till the specimens failed and the maximum load at failure of specimen were recorded. load was applied at the rate of 140 KN/m^2.The compressive strength of the specimen was calculated by dividing the failure load by the cross-sectional area of the specimen.

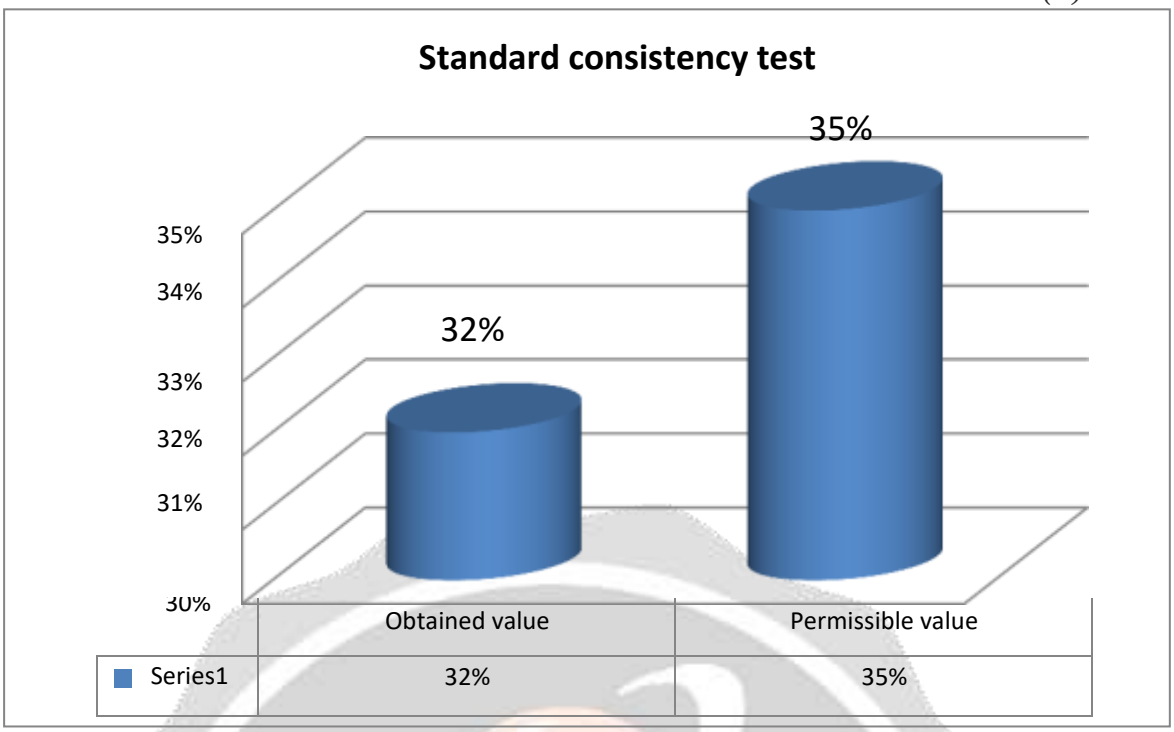
Fig: 4 Testing of Concrete by Compressive Testing Machine

RESULTS AND DISCUSSION

PHYSCIAL PROPERTY TEST



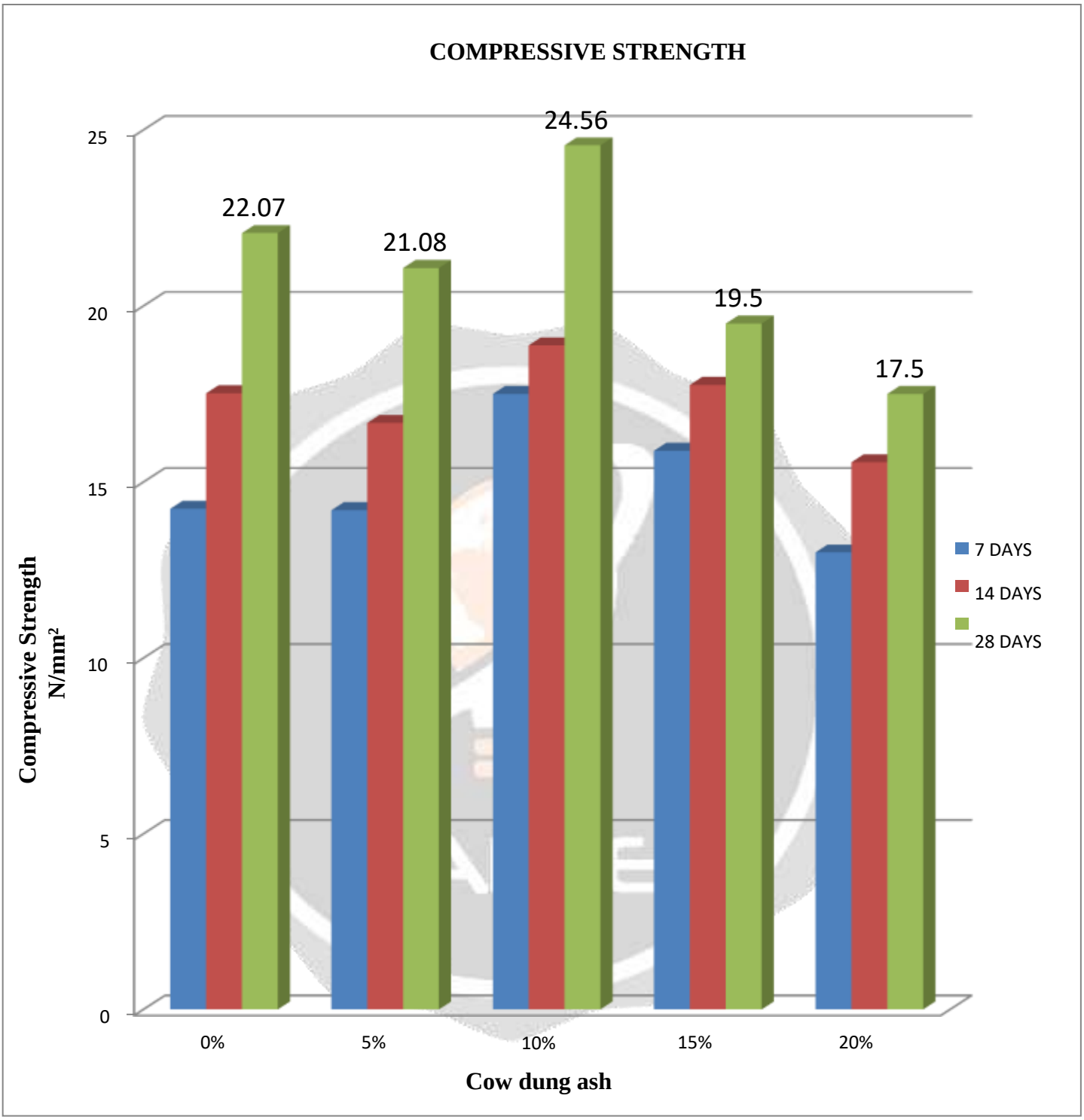




Compressive strength Test Result

Table: 2 Compressive Strength Test Result

S No	Mix (%)	Average Compressive Strength (N/mm^2)		
		7 days	14 days	28 days
1	0	14.24	17.52	22.07
2	5	14.20	16.68	21.08
3	10	17.50	18.88	24.56
4	15	15.89	17.72	19.5
5	20	13	15.56	17.50



CONCLUSION

Experimental investigations carried out to study the cow dung ash on the strength of concrete. Cement was partially replaced with four percentages (5%, 10%, 15%, and 20%) of cow dung ash by weight.

The compressive strengths of the concrete specimens were determined at 7, 14 and 28 days respectively.

Test results indicated that the consistency limits increased up to an optimum content and decreased further with the increase in the % of CDA in cement.

The compressive strength is increased when the cement was replaced by 10% of CDA and decreased with increase in the cow dung ash content. Hence, it is concluded that the 10% cement can be replaced with CDA in Concrete.

Based on test results we conclude the partial replacement of cement with 10% of cow dung ash increase the compressive strength of the concrete than that of conventional concrete. So, it should use in construction of any structure.

The compressive strength of the concrete is reduced with the increase in CDA and in strength increase with the increase in curing days

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