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EXPERIMENTAL STUDY ON MORTAR INCORPORATING COTTON SEEDS AS PARTIAL REPLACEMENT OF FINE AGGREGATE

Ms.Swetha,
Assistant professor,
Dept of Civil Engineering,
FETW, Sharnbasva university
Kalaburagi, Karnataka, India.

**Basetti Shruthi, Tejashwini Chagshetti,
Usha,Prema**

U.G Students
Dept of Civil Engineering,
FETW, Sharnbasva university Kalaburagi,
Karnataka, India.

Abstract: Concrete is one of the most widely used construction materials in the world due to its strength, durability, and versatility. It is primarily composed of cement, water, coarse aggregates, and fine aggregates such as natural sand. Among these components, fine aggregate plays a crucial role in filling voids, improving workability, and contributing to the overall strength of concrete. However, the rapid growth in construction activities has led to an excessive demand for natural sand, resulting in environmental degradation, depletion of natural resources, and increased costs. This situation has created a need to explore alternative materials that can partially replace fine aggregates in concrete without compromising its performance.

I. INTRODUCTION

In recent years, researchers have focused on utilizing agricultural by-products and waste materials as sustainable substitutes in construction. One such promising material is cotton seed. Cotton is a major agricultural crop, and its processing generates a significant amount of by products, including cotton seeds. These seeds are generally used for oil extraction, but their residual waste often remains underutilized. The fibrous and lightweight nature of cotton seed makes it a potential candidate for use in concrete as a partial replacement for fine aggregate.

The incorporation of cotton seed in concrete not only provides an effective solution for waste management but also contributes to the development of eco-friendly and sustainable construction materials. By replacing a portion of fine aggregate with cotton seed, it is possible to reduce the dependency on natural sand while enhancing certain properties such as thermal insulation and weight reduction. However, the use of cotton seed also requires careful evaluation, as it may affect the mechanical properties, durability, and water absorption characteristics of concrete.

Cotton seeds are the seeds of the cotton plant, a major agricultural crop cultivated worldwide for its valuable fibre. After the cotton fibres are separated from the harvested bolls during the ginning process, the remaining seeds are known as cotton seeds. These seeds are an important by-product of cotton production and have significant economic value.



FIG-1 COTTON SEEDS

Cotton seeds are oval-shaped, dark brown to black in colour, and are covered with short fibres called linters. They contain high amounts of oil and protein, making them useful in several industries. Cottonseed oil extracted from the seeds is widely used for cooking and in the manufacture of soaps, cosmetics, and other industrial products. The residue left after oil extraction, known as cottonseed cake or meal, serves as a nutritious feed ingredient for livestock.

In agriculture, cotton seeds are also used as planting material for the production of new cotton crops. Improved and hybrid cotton seeds have been developed to provide higher yields, better fibre quality, and resistance to pests and diseases. Therefore, cotton seeds play a vital role not only in the textile industry but also in the food, feed, and agricultural sectors, contributing significantly to the economy of many cotton-producing countries.

II.LITERATURE REVIEW

1. **M.K.Sharma and R.K.Gupta (2019)et.al.**“10% cotton seed ash improves concrete strength”- The study by M. K. Sharma and R. K. Gupta (2019) investigated the use of cotton stalk/seed ash (CSA) as a partial replacement of fine aggregate in concrete. The researchers prepared CSA by burning cotton waste and sieving it into fine particles. Concrete of M20 grade was produced by replacing sand with CSA at 0%, 5%, 10%, and 15%. The results showed that workability decreased as the percentage of CSA increased due to higher water absorption.

Conclusion: In this study, cotton stalk/seed ash (CSA) was prepared by burning cotton waste under controlled conditions and sieving it through a 75-micron sieve to obtain fine particles. Concrete materials such as Ordinary Portland Cement, river sand, and coarse aggregates were used, and M20 grade concrete was produced by replacing fine aggregate with CSA at 0%, 5%, 10%, and 15%. The concrete was mixed, cast into 150 mm cube moulds, demoulded after 24 hours, and cured in water for 7 and 28 days. Tests such as slump test and compressive strength test were conducted to evaluate performance.

2.**P. Singh And V. Kumar (2022)et.al** The Research Concluded That “CSA Can Be Effectively Utilized As A Sustainable Fine Aggregate Substitute In Non-Structural Concrete Applications”-) focuses on the use of cotton seed/stalk ash as a partial replacement of fine aggregate in concrete to promote sustainable construction practices. With the increasing demand for natural sand and the environmental issues caused by its excessive extraction, the researchers aimed to explore agricultural waste materials as alternatives. Cotton waste, being abundantly available, was converted into ash and utilized in concrete to study its effect on strength, microstructure, and overall performance.

Conclusion: cotton seed/stalk ash (CSA) can be effectively used as a partial replacement of fine aggregate in concrete at lower percentages. The results show that workability decreases with increasing CSA content due to its high water absorption, while compressive strength improves up to about 10% replacement and decreases beyond that level. Microstructural analysis indicated a denser and more compact structure at lower

replacement levels, while higher percentages led to increased porosity and weaker bonding. Therefore, an optimum replacement level of around 10% is recommended for achieving better strength and durability, making CSA suitable for sustainable and non-structural construction applications.

III.OBJECTIVES OF STUDY

1. To study the feasibility of using cotton seed as partial replacement of fine aggregate.
2. To prepare concrete cubes with different percentage of cotton seeds as partial replacement of fine aggregate and compare their strength with normal concrete mix.
3. To evaluate workability of concrete mix.
4. To study compressive strength of concrete.

IV. Methodology

4.1 Selection of Materials

Ordinary Portland cement, fine aggregate, coarse aggregate, potable water, and Cotton seeds were used for the preparation of concrete cubes. The concrete mix was designed for M20 grade concrete.

4.2 Mix Design

Concrete mix proportion adopted was 1 : 1.5 : 3 with a water–cement ratio of 0.50 cotton seeds was added as a percentage of Fine aggregate weight. Three different percentages were used i.e 2%, 4% & 6%. One normal concrete cube without cotton seeds was also prepared for comparison.

4.3 Preparation of Concrete Cubes

- The materials were weighed accurately as per the mix design.
- Cement, fine aggregate, and coarse aggregate were first mixed in dry condition until a uniform colour was obtained.
- Water was then added gradually, and the concrete was mixed until a workable and homogeneous mix was obtained.
- The prepared concrete was placed into cube moulds of size 150 mm x 150 mm x 150 mm in three layers.
- Each layer was compacted properly using a tamping rod to remove air voids.
- The top surface was finished smoothly.

A total of four Set of cubes were casted:

- One normal concrete cube (0 % cotton seeds)
- Three sets of cotton seeds concrete cubes with each set of 2%, 4%, and 6% were prepared.

4.4 Curing of Concrete Cubes

- After casting, the cubes were kept undisturbed for 24 hours.
- The cubes were then demoulded carefully.
- All the cubes were immersed in clean water for curing.
- Curing was carried out for 28 days to ensure proper hydration and strength development.

4.5 Compression Testing Machine – Mechanism

The Compression Testing Machine works on the principle of applying gradually increasing compressive load on the concrete specimen until failure occurs. The load is applied uniformly through steel plates. As the load increases, the concrete cube resists the compressive force. When the applied load exceeds the compressive strength of the concrete, the cube fails. The maximum load at failure is recorded, and compressive strength is calculated.

4.6 Procedure for Compressive Strength Test

After 28 days of curing, the cubes were dried and their dimensions measured. Each cube was placed in the compression testing machine, loaded gradually until failure, and the compressive strength was calculated.

Compressive strength = Load at failure / Area of cube

The same procedure was followed for all cubes, including the normal cube and fibre-added cubes.

Total Nine cubes were prepared with change in Percentage of Cotton Seeds reinforced concrete.

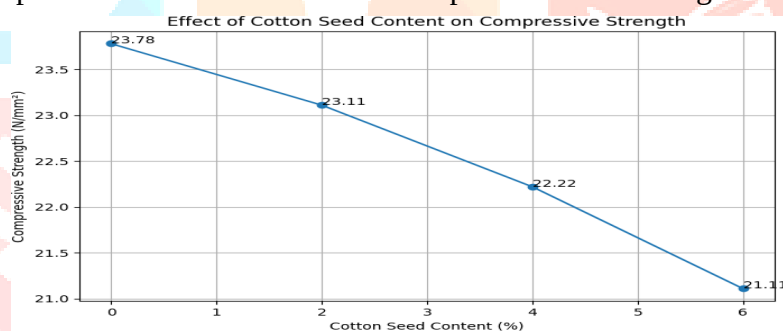
Cube no	SEEDS %	Cement (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)	Water (ml)	Cellulose Fibre (g)
1	2%	1.36	2.225	4.25	680	45
2	4%	1.36	2.179	4.25	680	91
3	6%	1.36	2.134	4.25	380	136

V. RESULTS AND DISCUSSION

RESULT

SPECIMEN NO	Number	WEIGHT (KG)	MAX LOAD (KN)	COMPRESSIVE STRENGTH (N/mm ²)	AVGE.COMPRESSIVE STRENGTH (N/mm ²)
Normal cube	1	8.20	535	23.78	23.79
	2	8.34	537.5	23.88	
	3	8.22	533.5	23.71	
Cube 1 (2%)	1	8.05	520	23.11	23.11
	2	8.450	518	23.02	
	3	8.520	522	23.20	
Cube 2 (4%)	1	7.95	500	22.22	22.22
	2	8.04	496	22.04	
	3	7.98	504	22.40	
Cube 3 (6%)	1	7.85	475	21.11	21.10
	2	7.80	470	20.88	
	3	7.83	473	21.02	

Graph description : The graph shows the effect of cotton seed replacement on the accelerated compressive strength of concrete cubes. The normal concrete cube (0%) exhibited the highest compressive strength of 23.78 MPa. As the percentage of cotton seed replacement increased from 2% to 6%, the compressive strength gradually decreased. The 2% replacement level produced strength values close to the control mix, indicating better performance than higher replacement percentages. Therefore, 2% cotton seed replacement can be considered the optimum level among the mixes tested.



x-percentage of Cotton Seeds
y-compressive strength(N/mm²)



FIG-2 TESTING OF SPECIMEN

VI. CONCLUSION

1. The compressive strength of concrete decreased gradually as the percentage of cotton seed replacement increased.
2. Conventional concrete (0% cotton seed replacement) showed the highest compressive strength of **23.78 MPa**.
3. Concrete with **2% cotton seed replacement** achieved a compressive strength of **23.11 MPa**, which was very close to that of normal concrete.
4. Higher replacement levels of **4% and 6%** reduced the compressive strength to **22.22 MPa** and **21.11 MPa**, respectively, due to the porous and water-absorbing nature of cotton seeds.
5. Cotton seeds can be effectively used as a **sustainable partial replacement for fine aggregate up to 2%**, helping reduce natural sand consumption and promoting the utilization of agricultural waste in eco-friendly construction.

REFERENCES

- 1) Swati P. Jain, M. G. Bhandari, R. K. Malviya and Arti K. Jain International Research Journal of Engineering & Technology (IRJET) volume: 05 Issue: 01. Jan-18
- 2) M. D. Zafar Eqyaabal and A. Ambica:-Department of Civil Engineering, Bharath University, Chennai - 600073, Tamil Nadu, India (November 2015)
- 3) Udit Jain, Vikram Rajvanshi and Ayush Agarwal International Research Journal of Engineering & Technology (IRJET)
- 4) Dushyant, Ramesh bhai and Bhimani :-International Research Journal of Engineering & Technology (IRJET)
- 5) Saha, S., & Basak, S. (2023). "Influence of Cotton Waste on Concrete Properties: A Review." Journal of Building Materials and Structures, 18(2), 113- 125. ,DOI: 10.1016/j.jbms.2023.04.001
- 6) Das, P., & Kumar, R. (2022). "Sustainable Concrete Production Using Cotton Industrial Waste: An Experimental Study." Construction and Building Materials, 345, 128431. DOI: 10.1016/j.conbuildmat.2022.128431.