

Study on Partial Replacement of Cement by Poultry Waste in Concrete

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Abstract: Concrete is the major construction material which is widely used in the Civil Engineering discipline. Ordinary Portland Cement (OPC), the major constituent of concrete causes environmental problem by emitting 5% to 8% of global CO₂. To overcome this problem utilization of agricultural and industrial waste which would not only control the environmental pollution but also economical. Several researches and even Portland cement industry are investigating alternative to produce green buildings. Currently the attempt is to utilize the large amount of poultry waste, the waste from poultry farms as supplementary replacement material. The poultry waste obtained by poultry forms is studied for mechanical property and their suitability as binders.

The project initiative is to study the effect of poultry waste blended cement on the strength of concrete and to reduce the emission of CO₂. In this research, poultry waste is used in concrete as a partial cement replacement since it has high silica content and other comparable cement constituents. Mechanical properties such as compression strength and split tensile strength of M₂₀ grade concrete is tested for 5% replacement of cement by poultry waste in the concrete and it is compared with the strength of M₂₀ grade conventional concrete.

Key Words – Poultry waste, Compressive strength, Tensile strength, Concrete technology.

1. INTRODUCTION

Concrete

Concrete is a composite material composed of Ordinary Portland Cement, fine aggregates, coarse aggregates bonded together with a fluid element that hardens over time. Concrete is an important construction material used extensively in buildings, bridges, roads and dams. Its uses range from structural applications to pavements, kerbs, pipes and drains.

Cement

Cement is a binder, a substance used for construction that sets, hardens and adheres to other materials to bind them together. Cement consists essentially of compounds of lime mixed with silica and alumina. India is the second largest producer of cement in the world and the production reached almost 280 million metric tons in 2017.

Poultry Waste

Poultry or broiler waste is a mixture of chicken excreta, spilled feed, feathers and material used as bedding in poultry i.e., rice husk.

2. LITERATURE SURVEY

Harshit Varshney “Utilisation of Rice Husk Ash in Concrete as Cement Replacement”, IOSR Journal of Mechanical and Civil Engineering. The compressive strength of concrete increased with increase in percentage of RHA from 10% to 15% after 7 & 28 days of curing when compared with conventional concrete.

Bandhavya G B, Sandeep K, Bindhushree G B “An Experimental Study on Partial Replacement of Cement with Egg Shell Powder in Concrete”, International Research Journal of Engineering and Technology (IRJET), in June 2017. Compressive strength was higher than conventional concrete for 5% & 10% ESP Replacement at 3, 7 & 28 days of curing. ESP replacement greater than 10% had lower strength than conventional concrete.

Amit Kumar Sharma “Chicken Feather as a substitute of Fine aggregates in Mortar”, International Journal of advances in engineering & scientific research, in Dec-2016. According to the tests that were conducted on sample shows that the strength remains stable up to 5% of feather and strength of sample decreases with increase in percentage.

D.Gowsika, S.Sarankokila, K.Sargunan “Experimental Investigation of Egg Shell Powder as Partial Replacement with Cement in Concrete”, International Journal of Engineering Trends and Technology (IJETT), in Aug 2014. Egg Shell Powder obtained from industrial wastes is added in various ratios for cement replacement & it was found that replacement of 5% ESP+20% micro silica can be added without any reduction.

3. OBJECTIVE OF THE STUDY

To compare the Compressive strength and Tensile strength of reinforced concrete blended with poultry waste with conventional concrete. To obtain the most optimised concrete mix by replacing cement with poultry waste.

To reduce the consumption of Ordinary Portland Cement by partially replacing it with poultry waste without the compromise of the strength of the concrete and indirectly reducing the emission of CO₂ during cement manufacturing.

4. MATERIALS USED

a. CEMENT

Ordinary Portland Cement (OPC) of 53grade is used in our experimentation. It has been tested as per Indian standard specification IS: 1489 PART-1 1991.

b. FINE AGGREGATE

Manufactured Sand (M-Sand) is used for experimental program. It has been tested as per Indian standard specification IS: 383-1970.

c. COARSE AGGREGATE

20mm size aggregates are used for experimental program. It has been tested as per Indian standard specification IS: 383-1970.

d. POULTRY WASTE



Figure 4.1: Poultry waste

Table 4.1: Chemical Properties of Poultry waste

Property	Value
Silica as SiO_2	47.94%
Calcium as CaO	2.38%
Aluminum as Al_2O_3	0.52%

e. MIX PROPORTION

Mix proportioning is the process of selecting suitable ingredients for concrete and determining their relative quantities with the objective of producing a concrete of the required strength, durability, and workability as economically as possible. M20 grade concrete was designed as per the Indian standard specification IS: 10262-2009.

Table 4.2: Mix proportioning

Materials	For 3 Cubes
Cement	4.38 kg
Fine aggregate	7.36 kg
Coarse aggregate	14.73 kg
Water	2.75 litres
W/C ratio	0.5

f. SPECIMEN DETAILS

The specimens like cubes, cylinders and beams are used to conduct the strength tests according to IS: 100086 – 1982.

- Compressive strength test- In this research, moulds of size 150×150×150mm were tested for determining the compressive strength of conventional concrete, concrete with 5% replacement of cement by poultry waste at 7, 21 and 28 days.
- Split tensile strength test- Cylindrical moulds of 150mm diameter at 300mm height were tested for knowing the tensile strength of conventional concrete, concrete with 5% replacement of cement by poultry waste at different mixes at 7, 21 and 28 days.

5. RESULTS AND DISCUSSIONS

a. WORKABILITY OF CONCRETE

Slump test

The slump value increases up to 0.3% of poultry waste addition and then it gradually decreases. The graphical representation is shown in figure 5.1.

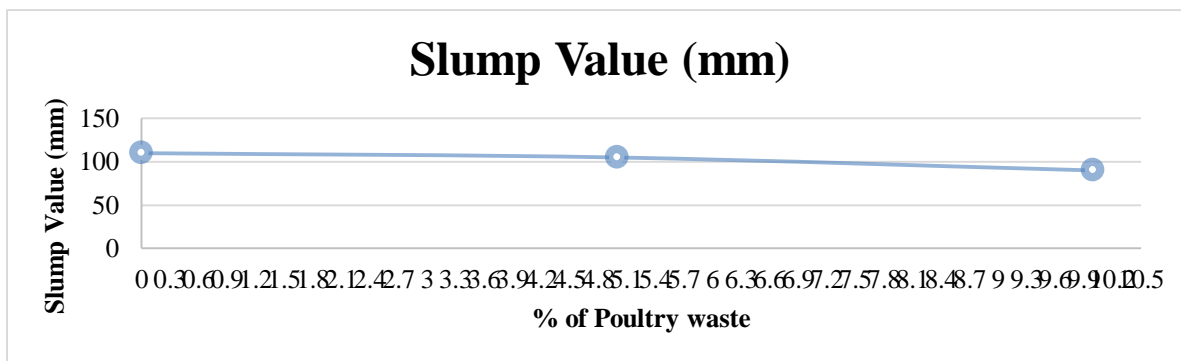


Figure 5.1: Slump value of concrete mix for varied % of Poultry waste

b. COMPRESSIVE STRENGTH TEST

The compressive strength results of 7, 21 and 28th day are tested and results are represented graphically as shown in figure 5.2.

Table 5.1: 7, 21 and 28th day Compressive Strength Results

Days	Normal Concrete (N/mm ²)	Concrete with Partial replacement of Poultry waste (N/mm ²)
Percentage of Replacement	0%	5%
7	12.79	19.01
21	17.56	23.75
28	21.20	26.13

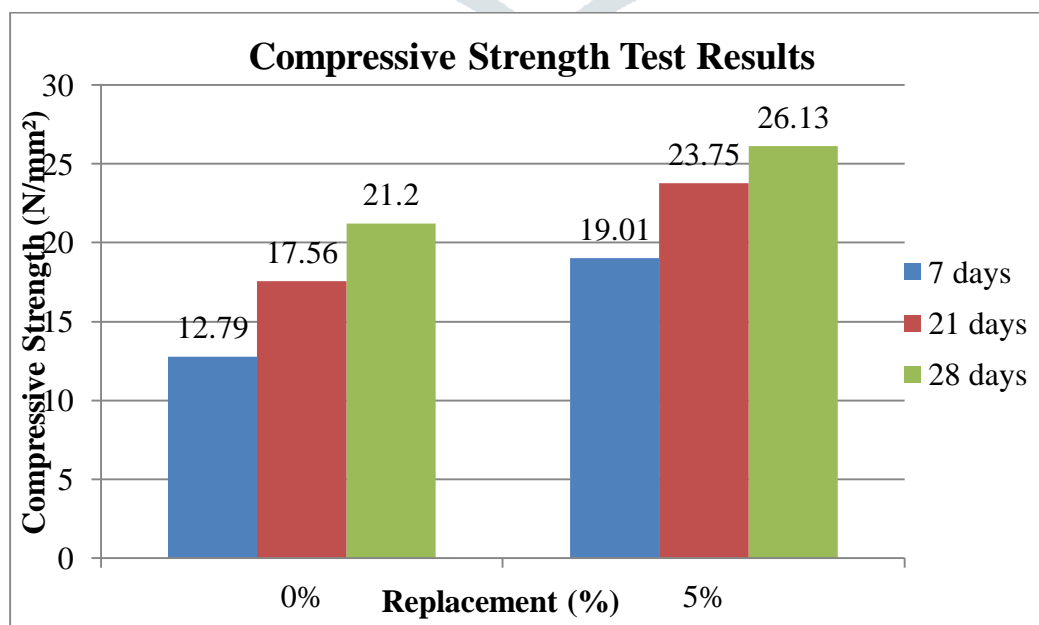


Figure 5.2: Graph of Compressive Strength V/S Replacement

- The compressive strength of concrete has been increasing with the percentage of mix is of 5% when compared to conventional concrete.

c. SPLIT TENSILE STRENGTH TEST

The tensile strength results of 7, 21 and 28th day are tested and results are represented graphically as shown in fig 5.3.

Table 5.3: 7, 21 and 28thdays split tensile strength results

Days	Normal Concrete (N/mm ²)	Concrete with Partial replacement of Poultry waste (N/mm ²)
Percentage of Replacement	0%	5%
7	1.56	8.04
21	2.261	8.69
28	2.80	9.11

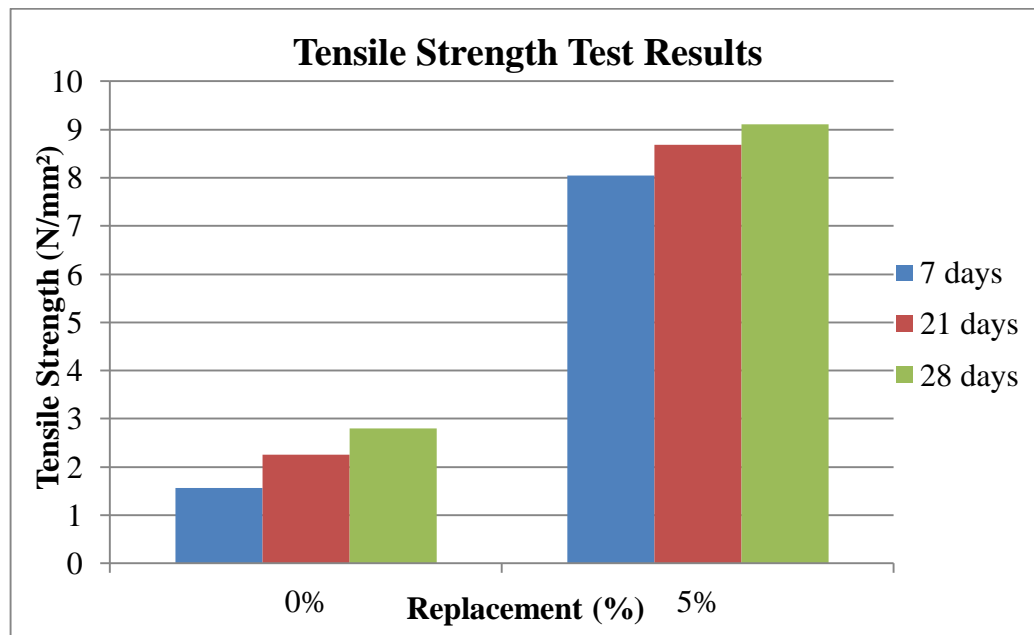


Fig 5.3: Graph of Split Tensile Strength v/s Replacement

- We know that, concrete is weak in tension. By adding Poultry waste the tensile strength of concrete can be increased.
- The tensile strength for the mix percentage of 5% increases when compared to conventional concrete.

6. CONCLUSION

- The result obtained from basic material testing are within the limit and satisfactory.
- The Compressive strength of concrete in which 5% of cement being replaced by poultry waste for at 7days, 21days and 28days of curing is increased by 23.8% when compared to conventional M₂₀ grade concrete.
- The Tensile strength of concrete in which 5% of cement being replaced by poultry waste for at 7days, 21days and 28days of curing is increased by 225.35% when compared to conventional M₂₀ grade concrete.
- By observing the above results, we can conclude that 5% of replacement of cement by poultry waste gives the desired compressive strength. Further increase in percentage of poultry waste, compressive and tensile strength is decreased.

7. REFERENCES

1. A.M. King' Ori "Management of poultry Processing By-Products-Utilization of feathers", International Journal of livestock research ,in Sept-2012
2. Amit Kumar Sharma "Chicken Feather as a substitute of fine aggregates in mortar", International Journal of advances in engineering & scientific research , in Dec-2016.
3. Bandhavya G B, Sandeep K, Bindhushree G B "An experimental study on partial replacement of cement with egg shell powder in concrete", International Research Journal of Engineering and Technology (IRJET), in June 2017.
4. D.Gowsika ,S.Sarankokila ,K.Sargunan "Experimental Investigation of Egg shell powder as partial replacement with cement in concrete", International Journal of Engineering Trends and Technology (IJETT) ,in Aug 2014.
5. Harshit Varshney "Utilisation of Rice husk ash in concrete as cement replacement", IOSR Journal of Mechanical and Civil Engineering.