



Effect on Properties of Concrete by Using Wheat Straw Ash as Partial Replacement of Cement

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ABSTRACT

The paper presents the effect of using wheat straw ash as a partial replacement material of cement in concrete mixes. The wheat straw ash is the remains left after open burning of wheat straw. In this study, wheat straw ash prepared from uncontrolled burning of wheat straw is evaluated for its suitability as partial replacement of cement in concrete. The strength parameters i.e. compressive strength and workability of concrete blended with wheat straw ash cement are evaluated & studied by replacing cement by 10%, 20%, 30% & 40% by weight to OPC. Slump test was carried out on fresh concrete and compressive strength test was carried out on hardened concrete. Several cubes were tested at 7 & 28 days. The result shows that wheat straw ash is good replacement material with SiO_2 , Al_2O_3 , Fe_2O_3 of about 75%. The slump value decreased with increase in wheat straw ash. The compressive strength also decreased with increase of WSA.

Keywords: Concrete, cement, Wheat straw ash, compressive strength, workability.

1. INTRODUCTION

Generally concrete is a composite construction material composed of cement and other filler material like coarse aggregates, fine aggregates, chemical admixtures & water for mixing. Depending upon nature of work the cement, fine aggregates, coarse aggregates & water are mixed in specific proportion to produce fresh & plain concrete. The aim of mix design is to achieve max. durability, workability and compressive strength as far as possible without compromising with quality. Engineers are trying to increase the limits of concrete with help of some innovative chemical admixture along with modified manufacturing technique.

The use of concrete is increased & the rate of construction is increased. Concrete is used in construction of different structures with long life. In a survey conducted few years ago it was found that million tons of waste material is produced & burned every year like wheat straw ash. Appropriate utilization of such waste materials brings ecological & economical benefits.

Wheat straw ash is a waste material produced by agriculture industry. It is produced when the wheat straw is left after harvesting of wheat. This causes heaps of wheat straw produced each year. So to use this waste material as the replacement of cement is the focus of study. This study examined the use of wheat straw as partial replacement of OPC in concrete. It was observed that when fine aggregates were partially replaced with

10%,20%,30%,40% waste material, there was some effect on workability & compressive strength of concrete. It involved determination of workability & compressive strength of concrete.

II.OBJECTIVES

- The main objective of this study is proper utilization of waste material (wheat straw ash) as fine aggregates which is mixed with OPC to investigate the effect of this wheat straw ash on properties of concrete of M25 grade.
- To evaluate and compare the result of workability and compressive strength of M25 grade concrete by using wheat straw ash with standard concrete.
- To ensure optimum use of domestic and industrial waste & reduce carbon footprints.
- To generalize the properties of concrete with use of wheat straw ash.

III.MATERIALS USED AND METHODOLOGY

(i). Wheat Straw

The wheat straw used for research has been obtained from local farmers in Rohtak. After drying, it was subjected to open burning and the remaining ash was passed through No. 200 BS test sieve

Oxide	% (by wt.)
SiO ₂	8.7
Al ₂ O ₃	1.3
Fe ₂ O ₃	1.2
MgO	1.4
CaO	1.6
LOI	4.0

(ii). Cement

Cement, ordinary Portland cement of grade 43 was used (Jaypee cement), with following physical properties :-

Characteristics	Value
Sp. Gravity	3.15
Consistency %	33%
I.S. Time	105 (min)
F.S. Time	260 (min)

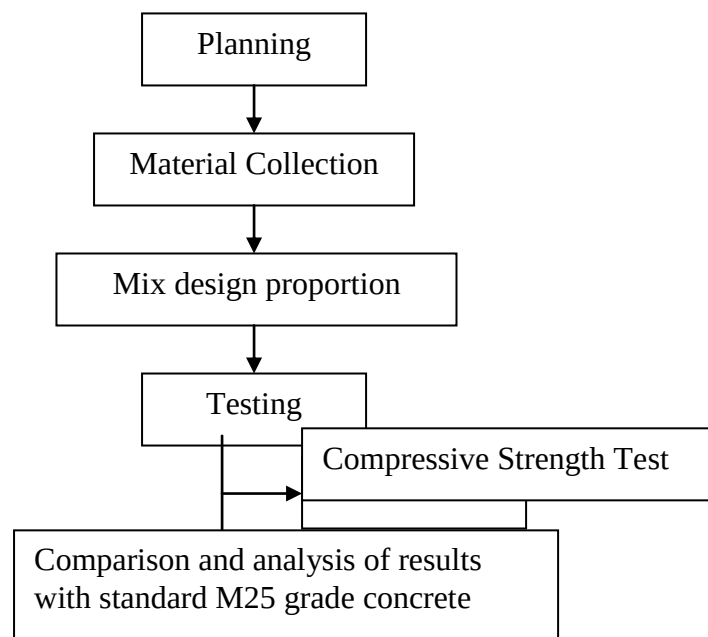
(iii).Aggregates

20mm size of aggregates was used as coarse aggregates with specific gravity of 2.61 and 4.75mm size of aggregates was used fine aggregates with specific gravity of 2.63 as per IS 383:1970.

(iv). Water

Clean & portable water was used for mixing and curing purposes.

Methodology



IV.SPECIMEN PREPARATION AND EXPERIMENTAL INVESTIGATION

Wheat straw ash was used to replace OPC at 10%,20%,30%,40% by wt. of cement. The mix ratio used was 1:1:2 with water binder ratio of 0.45. Table shows mix proportion for each category of wheat straw ash concrete.

Sr. No.	WSA (%)	Cement (kg/m ³)	Fine aggregates (Kg/m ³)	Coarse Aggregate (Kg/m ³)	Water (Kg/m ³)
1.	0%	420.6	601.51	1190	190
2.	10%	402.42	601.51	1190	190
3.	20%	381.24	601.51	1190	190
4.	30%	360.09	601.51	1190	190
5.	40%	340.89	601.51	1190	190

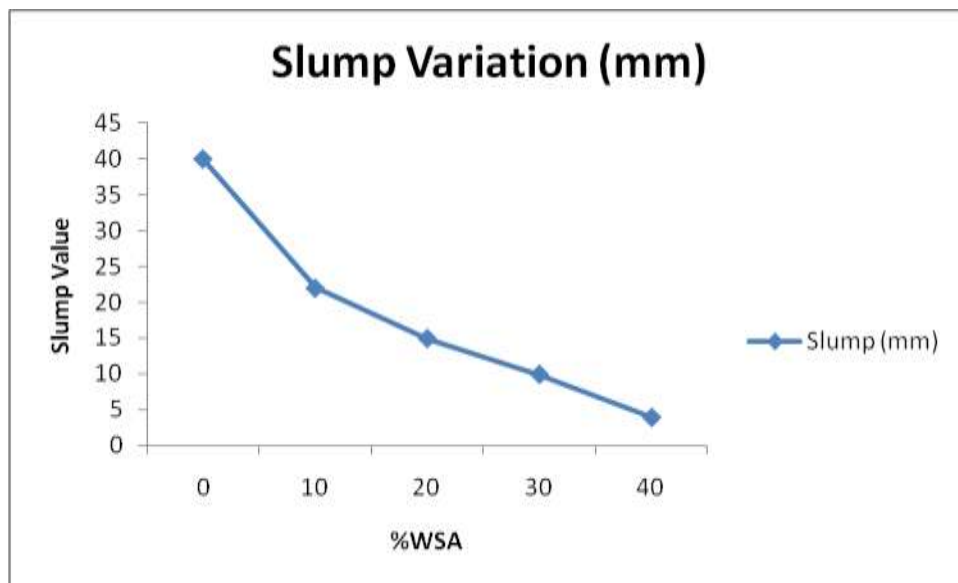
(i). Slump Test and Values

To find consistency of concrete, slump test is the best method. It can be done in lab as well as in field. It is performed on fresh concrete. The result of slump indicates that workability of wheat straw ash concrete decreases as wheat straw ash content increases. The table shows slump value variation with percentage of WSA used.

% of WSA	Slump (mm)
0%	40
10%	22
20%	15
30%	10
40%	4

From these result it was notified that concrete becomes less workable as WSA percentage is increased that means more water is required to make mix more workable.

This was due to increased amount of Silica in the mixture. The graph shows the variation of slump value.



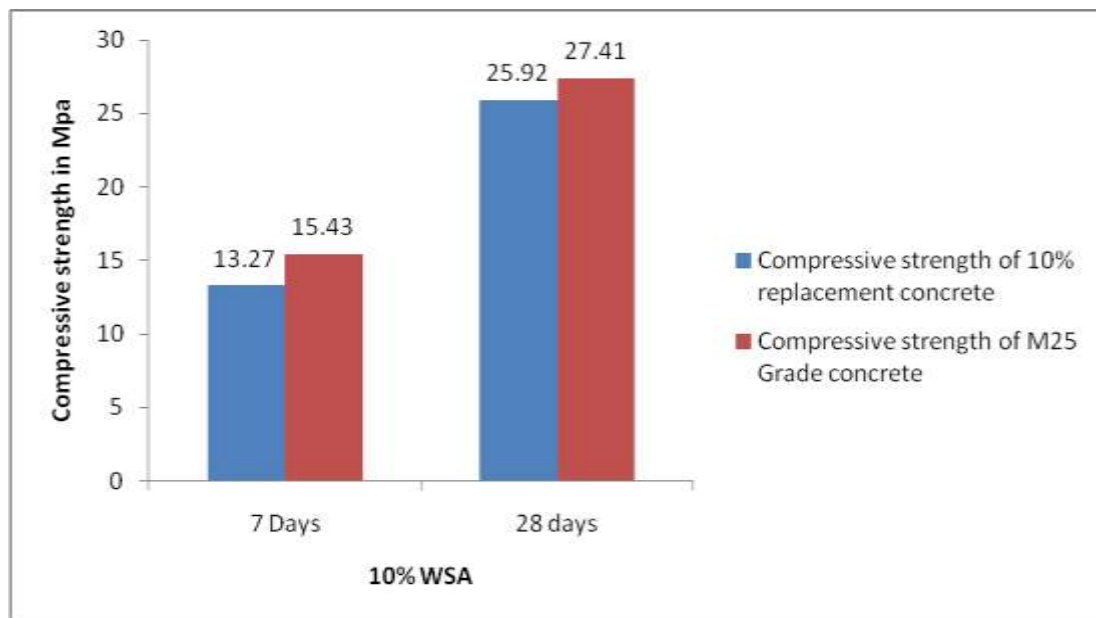
(ii). Compressive Strength Test and values

For this study, 15 cubes of size 150×150×150mm were tested of design mix of M25grade. The specimens were tested after curing period of 7 and 28 test. The first three normal concrete cubes were used for comparison with partial replacement of cement with wheat straw ash. The wheat straw ash was used in various proportions of 10%, 20%, 30%, 40% with replacement of cement and casted three cubes for each proportion. Concrete design mix was prepared as per Indian standards with water to binder ratio of 0.45.

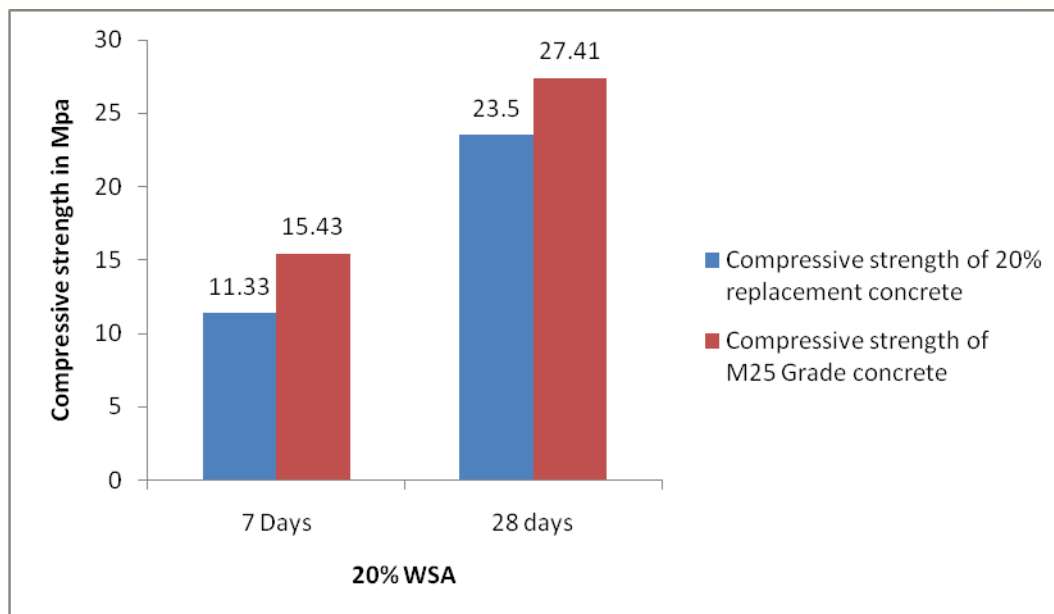
The result of compressive strength test are shown in these tables :-

Strength →	M25 grade concrete
Days ↓	Compressive strength in MPa
7	15.43
28	27.41

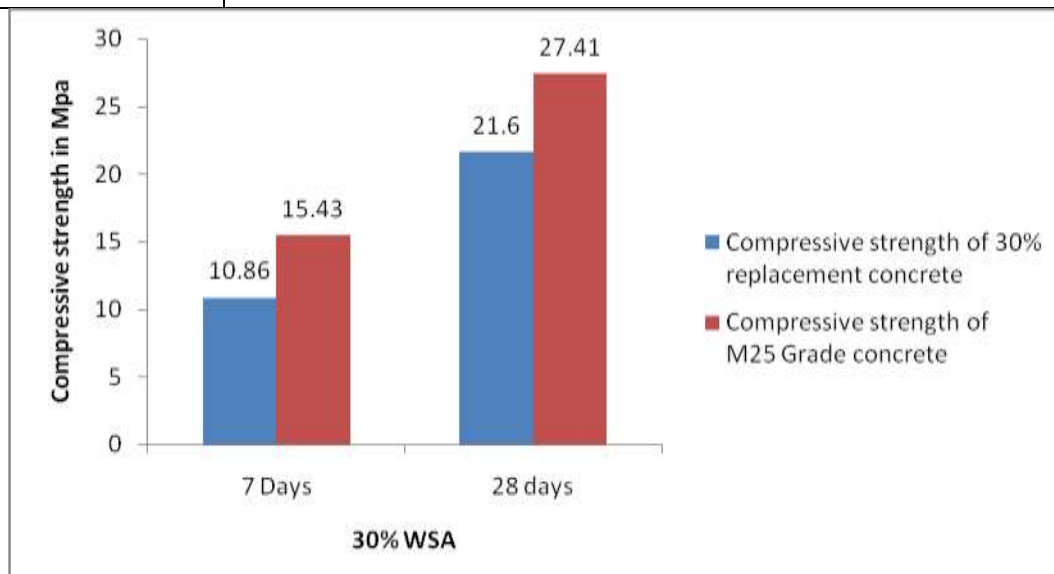
Strength →	10% wheat straw ash replacement
Days ↓	Compressive strength in MPa
7	13.27
28	25.92



Strength →	20% wheat straw ash replacement
Days ↓	Compressive strength in MPa
7	11.33
28	23.50

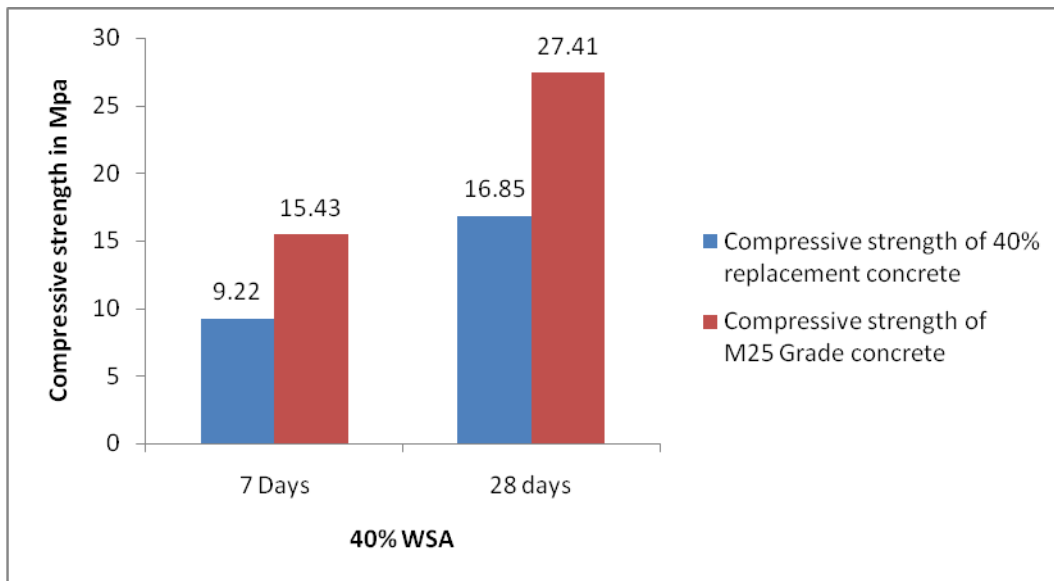


Strength →	30% wheat straw ash replacement
Days ↓	Compressive strength in MPa
7	10.86
28	21.60



Strength →	20% wheat straw ash replacement
Days ↓	Compressive strength in MPa

7	9.22
28	16.85



The Tables and Graphs show the variation in compressive strength of 10%, 20%, 30%, 40% replacement concrete with M25 grade standard concrete.

V.CONCLUSION

- At 10% replacement of WSA gives 13.09% and 5.43% decrease in compressive strength at 7 & 28 days respectively.
- At 20% replacement of WSA gives 26.57% & 14.20% decrease in compressive strength at 7 & 28 days respectively.
- At 30% replacement of WSA gives 29.60% & 21.10% decrease in compressive strength at 7 & 28 days respectively.
- At 40% replacement of WSA gives 40.20% & 38.50% decrease in compressive strength at 7 & 28 days respectively.
- Concrete becomes less workable as WSA percent increases, that means more water is required to make mix more workable i.e. WSA has high water demand.
- Use of WSA can prove to be economical as it is a waste and free of cost
- WSA will preserve the resources particularly cement and thus makes construction industry sustainable.
- It will solve the problem of disposal of wheat straw and will prove to be environmental friendly.



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