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Partial Replacement of Cement with Corn Cob Ash in Preparation of Concrete

[1]Asha Oak, [2]Abhishek Namdev Dalve

[1]Professor at MIT ADT College of Management, Loni Kalbhor, Pune
[2]Student at MIT ADT College of Management, Loni Kalbhor, Pune
Email id: abhishekdalve@gmail.com

ABSTRACT –

The Cement is the most utilized construction material, and second most consumed in the world after water. Its demand has increased proportionately with the rise in population in a bid to match the required development. The heavily energy-intensive processes that are involved in its production contribute to about 7-10% of the total global emissions, with potentially adverse environmental implications, and are also economically expensive. This study investigated the ability of Corn Cob Ash (CCA) to be used as partial replacement of cement. CCA was obtained and used to replace cement partially in specified ratios of 0%, 10%, 15%, 20%. Results were compared with a conventional concrete, which was made with 100% cement. The potential of corn cob ash CCA as an alternate cementitious material was calculated. The physical, chemical and mineralogical characteristics of CCA were studied. CCA can be used as partial replacement for cement in concrete production as well as for walls of building units and other works of mild construction. Impact Test, Crushing Test and Shape Test were conducted on aggregates and found satisfactory results.

***Key Words*: Cementitious material, Compressive strength, Corncob Ash, Partial Cement replacement, Pozzolanas.**

1. INTRODUCTION

1.1 General

Concrete is a construction material composed of cement, fine aggregates (sand) and coarse aggregates mixed with water which hardens after specific time. For production of concrete the most commonly used material is Portland cement. Concrete technology gives information about properties of concrete and its practical applications. Concrete is required for the construction of foundations, columns, beams, slabs and other load bearing elements of the structure. Apart from cement different types of binding material used are lime for lime concrete and bitumen for asphalt concrete which is used for road construction. Required strength is obtained by mixing the materials in required proportions. Strength of mix is given as M5, M10, M15, M20, M25, M30 etc., in which M signifies mix and 5, 10, 15 is their strength is in kN/m2.When water is mixed with materials, hydration reaction starts. This reaction helps ingredients to form a bond that binds the materials together into a durable stone-like material. Concrete can be casted in any shape and size. Because it is a plastic material which is in normal state, various types of shapes and sizes of formworks are used to provide different shapes such as rectangular, circular etc. It is said that 7% of the worlds carbon dioxide emission is because of Portland cement industry. Because of the significant contribution to the environmental pollution, to the high consumption of natural resources like limestone and the high cost of Portland cement etc., we cannot go on producing more and more cement. There is need to reduce the use of cement. One of the practical solutions to reduce use of cement is to replace cement with supplementary cementitious materials like corn cob ash. So, by the research and test we decided to use Corn Cob Ash and replace it partially with cement. Corn cob is the hard thick cylindrical central core of maize (on which are borne the grains or kernels of near of corn). It is an agricultural waste product obtained from maize or corn which is the most important cereal crop in sub-Saharan Africa. Corn is the third most important food crops after rice and wheat in India. According to the advance estimate, it is cultivated in 8.7 m ha (2010-11) mainly during kharif season which covers 82% area. In India maize contributes nearly 10% the national food basket and more than ₹101 billion to the agricultural GDP at current prices apart from the generating employment to over 100 million man-days at the farm and downstream agricultural and industrial areas. The use of corncob ash with normal strength is a new innovation of concrete design, and if large-scale applications will reform the construction industry through cost savings. The chemical composition of pozzolanas varies considerably, depending upon the source and the preparation technique. Pozzolanas contains silica, alumina, iron oxide and a variety of oxides and alkalis, each in varying degrees. Use of corn cob ash as a pozzolanas, without accounting this chemical CCA suitable for use as pozzolanas. In this study, it is working to produce CCA MIT- ADT

mixed cement in a factory controlled environment because it is an ordinary Portland cement. The CCA used is produced by grinding the dried corn mandrel to a diameter of about 4.00 mm to enhance sufficient combustion and reduce the impact pozzolanas properties of CCA.

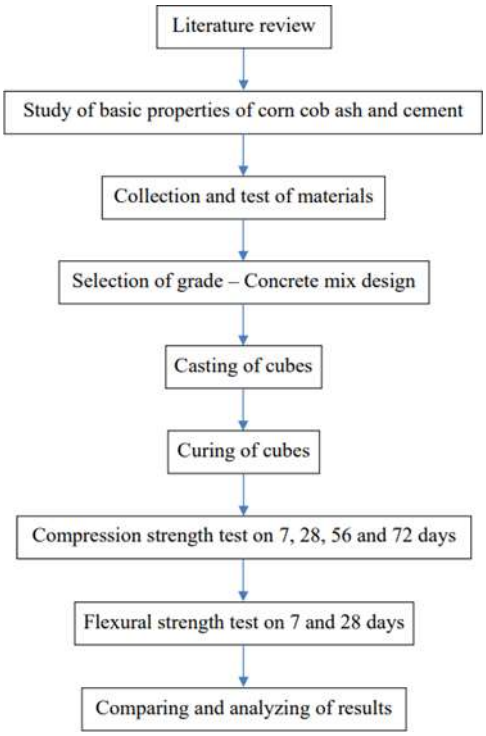
1.2 Objectives

Comparative Analysis of Corncob Ash Concrete with Conventional Concrete.

1.3 Scope of study

This paper gives the information about the use of corn cob ash as the pozzolanas in the concrete mixture. Corn cob Ash used in making of concrete increases the compressive properties of the concrete. Initial compressive strength after using Corn Cob Ash was less as compared to conventional concrete after 28 days but strength gradually increases after a period of time. In project we study how Corn Cob Ash can be used in the concrete to make a quality composite material which can be used for economic construction in near future.

2. Material and Method



2.2 Materials

2.2.1 Cement

The Ordinary Portland Cement (OPC) 53 grade cement is used in the project work. Table 1 shows the Compressive strength of the cement.

Table -1: Chemical Properties of Cement

Sr. No.	**Particulars**	**Results**
1.	Calcium Oxide (CaO)	61.90
2.	Silica (SiO2)	20.02
3.	Alumina (Al2O3)	4.70
4.	Sulphur Trioxide (SO3)	3.90
5.	Iron Oxide (Fe2O3)	3.00
6.	Magnesium Oxide (MgO)	2.60
7.	Loss of Ignition	1.90
8.	Others (K2O, Na2O)	1.98

2.2.3 Corn Cob Ash

Corncob Ash is a waste product obtained during production of corns. Corn is the third most important food crops after rice and wheat. Corncob was burnt and ash obtained was sieved.

Table -2: Chemical Properties of Corn Cob Ash

Sr. No.	**Particulars**	**Values**
1.	Calcium Oxide (CaO)	12.00%
2.	Silica (SiO2)	64.56%
3.	Alumina (Al2O3)	7.41%
4.	Sodium Oxide (Na2O)	0.39%
5.	Iron Oxide (Fe2O3)	4.60%
6.	Magnesium Oxide (MgO)	1.86%
7.	Potassium Oxide (K2O)	3.89%
8.	Sulphur Trioxide (SO3)	2.90%

2.2.4 Fine Aggregate

The aggregates used are of the grain size of sand used is of zone II. Sand passing through 4.75mm sieve tested as per IS: 383-2016. Natural sand is generally used as fine aggregate, silt and clay also come under this category. The soft deposit consisting of sand, silt and clay is termed as loam. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.

2.2.5 Coarse Aggregate

Coarse aggregate shall consist of naturally occurring materials such as gravel, or resulting from the crushing of parent rock, to include natural rock, slag's, expanded clays and shale's (light weight aggregates) and other approved inert materials with similar characteristics, having hard, strong, durable particles, confirming to the specific requirements. Locally available, aggregate passing through 20mm sieve as per IS: 383-2016.

2.3 Mix Design

Sr. No	**Replac ement of CCA with cement**	**Cem ent Content Kg/m3**	**Corn Cob Ash Conte nt Kg/m3**	**Aggre gate Kg/m3**	**San d Kg/m3**	**Wa ter Kg/m3**
1	0%	438	00	1048	771	197
2	10%	394	44	1048	771	197
3	15%	372	66	1048	771	197
4	20%	350	88	1048	771	197

Table-3: Mix Proportion

2.4 Results and Discussion

2.4.1 Test on Aggregate

Aggregate Impact Value

Aggregate Impact Value of all sample is in between 10% to 20% and we got an average 16.34%. Therefore, Samples are strong.

Aggregate Crushing Value

Aggregate Crushing Value of Mean Value of two sample is 15.14% which is less than 30%. Hence it can be used.

Elongation And Flakiness Value

% Elongation = Total Weight of Retaining aggregate / Total weight = 0.9/6.42

% Elongation = 14.01%

% Flakiness = Total Weight of Passing aggregate / Total weight = 0.786/6.42

% Flakiness = 12.24%

2.4 2 Test on Cement

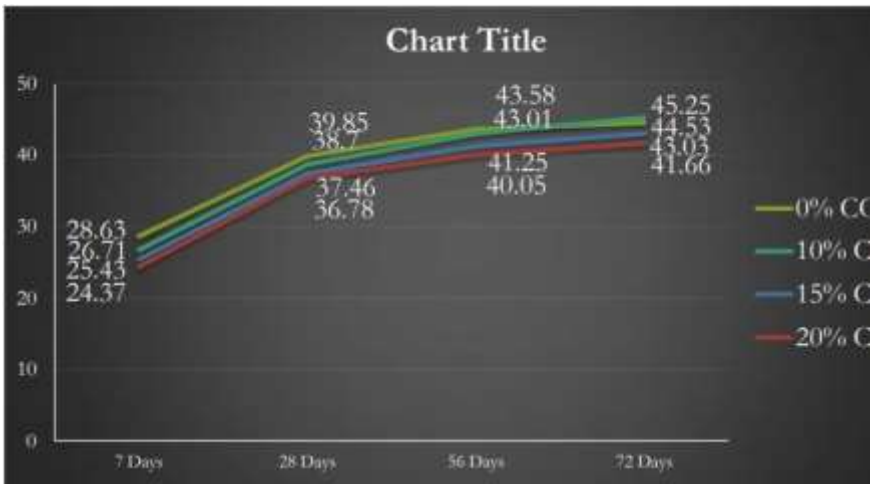
Content of CCA	**0%**	**10%**	**15%**	**20%**
Initial (Min)	120	172	178	187
Final (Min)	260	308	354	371

Table-4: Setting Time of Cement

2.4.3 Compression Strength of Concrete

Table-5: Compression Test on 7, 28, 56 and 72 Days

Compressive strength	**0%**	**10%**	**15%**	**20%**
7 Days	28.63	26.71	25.43	24.37
28 Days	39.85	38.70	37.46	36.78
56 Days	43.58	43.01	41.25	40.05
72 Days	44.53	45.25	43.03	41.66



Graph-1: Comparison of Compressive Test on 7, 28, 56 and 72 Days

3. CONCLUSIONS

1. CCA is a suitable pozzolanic material. Strength of CCA blended concrete is dependent on its pozzolanic activities.
2. Compressive strength of CCA blended cement concrete is lower than that of conventional concrete at early curing ages but improves significantly at later ages and in fact has higher percentage gain in strength gain in strength than conventional concrete.
3. CCA can be used to partially replace cement in the production of concrete to a maximum of 10% because replacement beyond this reduced the concrete strength.

4. Replacement of this nature can also be used for compound wall and partition wall where load can be applying in lesser amount compare to other members.
5. The setting time of concrete is increased with increase in corn cob ash from 260min to 308min when cement was replaced with 10% CCA.

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