

# Use of Corn Kernel Split Ash in Concrete

Sidharth Gagan<sup>1</sup> Barun Kumar<sup>2</sup> Ajay Pratap Singh<sup>3</sup>

<sup>1</sup>B.E. Student <sup>2,3</sup>Assistant Professor

<sup>1,2,3</sup>Department of Civil Engineering

<sup>1,2,3</sup>Lakshmi Narian College of Technology & science

**Abstract**— Effect of corn kernel split ash by replacing cement investigation has been conducted to check the strength and durability of concrete composite. Different corn kernel split ash content as 10%, 20%, and 30% were used. The durability of concrete composite includes water impermeability, dry shrinkage property, the carbonation resistance etc. The water impermeability improved and restricted the dry shrinkage of concrete composite, by addition of corn kernel split ash. This paper presents the experimental results of the investigation of various properties related to the durability and Ordinary Portland Cement, OPC. The properties that were investigated in an experimental program include; equilibration of specimen in different relative humidity, determination of physical properties, compressive strength, workability.

**Key words:** Cement, Workability, Corn Kernel Split, Compressive Strength

## I. INTRODUCTION

The Indian cement industry is the second largest producer of cement in the world after China. The installed capacity of Indian cement Industry is about 250 Million Tons and the corn kernel ash is produce about approximate 50 Million Tons in India, Over the last few years the use of agricultural and industrial wastes with pozzolanic reactivity such as corn kernel split, replacement of cement are becoming very popular in producing high strength and high performance cement mortar and concrete. In last decade, due to availability of consistent quality of corn kernel split. The country and awareness of positive effects, it has been used in concrete.

Many studies have shown that the addition of pozzolanic materials in concrete tighten the pore structure and hence, reduced the total porosity. This tight pore structure of concrete and mortar increases its resistance against the penetration of aggressive fluid and ions, which results in a high performance concrete. Porosity and pore structure perhaps more than any other characteristics affect the behavior of concrete.

About 70% cost in developing countries like India. Therefore, it became necessary to replace costly and scarce conventional with in material by innovative, cost effective and environment friendly alternate building material. Thus, to reduce cost of cement, it can be replaced by corn kernel split ash,

Corn kernel split ash generation, as a byproduct from agriculture product, is posing a great threat to the atmosphere. Since, pollution control, huge amounts of fine particles of the matter (corn kernel split ash) is emitted in to the atmosphere causing serious problem to air pollution, and effecting area of fertile land. Because, corn kernel split ash causes environmental pollution and the cost of storage of corn kernel split ash is very high, hence, It has been used in concrete technology. It is beneficial in both regards to control environment pollution and positive effect on countries economy.

Due to replacement of cement by corn kernel split ash up to certain percentage it saves energy also.

The durability of concrete is one of its most important properties aside from its compressive strength. Permeability is also considered important property effecting concrete durability. Cement fineness, corn kernel split ash fineness, and corn kernel split ash volume fraction all have significant influences on strength development and other early-age properties of blended cement mortars.

Partial replacement (10% & 20% and 30%) of cement with corn kernel split ash refines pore structure, enhances the compressive strength, and increases resistance to chloride ion penetration, resulting in a durable and high performance cement mortar.

In India, all across the country corn kernel split generation is in huge quantity. If this material segregated collected and used properly can solve the major problems of its disposal and by using it reducing the quantity in the use of cement. Which can work as quality pozzolanic materials? Corn kernel split ash concrete and its advantages.

## II. EXPERIMENTAL PROGRAMME

The experimental exercise helps to study the various properties of concrete with different replacement levels of corn kernel split ash It has been plan to find out compressive strength of concrete block corn kernel split ash by replacing of cement at various percentage levels

### A. Cement:

Cement is the main parameter in terms of strength. Ordinary Portland cement, 43 grades, produced by Ultratech Company has been used. Cement clinker, at present in India OPC in considered as the best if not the sole, pozzolanic material in the concrete. The other material primarily corn kernel ash is viewed as replacement or substitutes for cement.

It is a fact, that use of corn kernel split ash save energy and conserve natural resources, but their technical benefits are the strongest. The affect the progress of hydration, reduces the water demand and improves workability, the particles pozzolanic corn kernel ash are spherical and thus improves the workability.

Their inclusion has the physical effect of modifying the flocculation of cement, with a resulting reduction in the water demand. The pore size in concrete in smaller. The fine particles that fit between cement particles, thereby reducing permeability.

Properties of cement have been given in table 1

Composition (%)	Cement
SiO <sub>2</sub>	20.17
Al <sub>2</sub> O <sub>3</sub>	5.58
Fe <sub>2</sub> O <sub>3</sub>	2.86
CaO	63.51
MgO	3.15

Na <sub>2</sub> O	0.12
K <sub>2</sub> O	0.57
SO <sub>3</sub>	2.56
<b>Physical Properties</b>	
Specific gravity	3.05
Specific surface (cm <sup>2</sup> /g)	3295

Table 1: Properties of Cement

<b>Physical Properties</b>	
Specific gravity	2.45
Specific surface (cm <sup>2</sup> /g)	2370

Table 2: Properties of corn kernel split ash

Sieve Sizes	Total Percentage Retained		
	Fine Aggregate	Coarse Aggregate	Combined coarse and fine (65:35)
1-1/2-in. (38.1-mm)	0	4	3
¾ in (19.00 mm)	0	49	32
3/8 in. (9.5 mm)	0	91	59
No. 4 (4.75 mm)	4	100	66
No. 8 (2.36 mm)	21	100	72
No. 16 (1.18 mm)	46	100	81
No. 30 (600 µm)	74	100	91
No. 50 (300 µm)	89	100	96
No. 100 (150 µm)	95	100	98
Total %	329	744	598

Table 3: Grading of Fine Aggregate & Coarse Aggregates

Fineness modulus = Total percentage/100

Fine aggregate = 329/100 = 3.29

Coarse aggregate = 744/100 = 7.44

Combined = 598/100 = 5.98

The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 were used. The Flakiness and Elongation Index were well-maintained below 15%.

### C. Properties of Concrete

The compressive strengths of OPC are same after 28 days and letter. However, the rate of gain of strength up-to 7 days is slow, due to heat of hydration being low. This drop in compressive strength upto 7 days should not be considered as a sign of poor quality as this is often accompanied by other properties. Curing became critical factor in concrete containing blended cement. It is very important stage in the life of conventional concrete. Blended cement hydrates slower than OPC hence, a curing method should be adopted. The wet curing required which is most neglected activity at site, but imported. The curing method and period for the curing should be specified (Ref-2).

Use of Blended cement of concrete improves resistance to thermal cracking, because of low heat of hydration, resulting ultimate strength, reduction in permeability due to pore refinement, and a better durability to chemical attacks such as chloride, sulphate water, soil and alkali- aggregate expansion. It is necessary to minimize the rise of early age thermal cracking by controlling the temp rise caused by hydration, in huge foundations bridges, water retaining structures etc. To reduce this concrete containing blended cement can be used. Blended cement concrete have a higher resistance to the penetration of chlorides. The blended cement concrete is more resistant to Chloride

### B. Workability of Corn Kernel Split Ash Concrete Blocks

Mix	Slump (mm)
<b>Standard Concrete</b>	83
<b>CKSA10</b>	95
<b>CKSA20</b>	103
<b>CKSA30</b>	110

Table 3: Slump

#### 1) Sand

Locally available Sand from Narmada River passing through 4.75 mm sieve and retained on 0.015 mm size sieve has been used.

penetration and thus proved protection in coastal areas against corrosion many more than OPC concrete.

It is observed air content of the concrete mix is unaffected by the replacement of cement by corn kernel split ash. As corn kernel split ash have lower specific gravity as compared to cement, there is a slight reduction in the density of concrete at a higher level of cement replacement. Observed to decrease with the increase of percentage of corn kernel split ash content with respect to strength of OPC. The result after 28 days is almost as per the OPC instead of replacement of 20% OPC. After 28 days strength has been found more than OPC. Cement normally gains its maximum strength minimum 28 days. Mortar made with Fly ash have slightly lower strength than cement mortar up to 28 days but gradually higher strength within 90 days.

#### 1) Specimens Preparation:

Portland cement has been replaced by 10%, 20%, 30 % by mass, and corn kernel split ash has been used. The paste has been made after adding water and specimens has been casted in 15mm×15mm×15mm cube size moulds.

#### 2) Compressive Strength:

The compressive strength of average three samples was periodically tested after 7, 14, 28, under standard compressive strength testing machine.

MIX	Compressive Strength (N/MM <sup>2</sup> )		
	7 Days	14 Days	28 Days
<b>Standard Concrete</b>	36.9	39.87	42.24
<b>CSPA10</b>	37.637	39.849	40.659
<b>CSPA20</b>	39.78	41.25	44.89
<b>CSPA30</b>	37.227	38.129	38.519

Table 4: Compressive strength (MPa) of Cement: corn kernel split ash for Various Replacement Level

After tests results we found that maximum strength has been achieved within 28 days.

### III. CONCLUSIONS

From the study, it is observed that,

- 1) Use of corn kernel split ash improves the workability of concrete. This phenomenon can be used either to reduce the unit water content of mix or to reduce the admixture dosage.
- 2) Density and air content of concrete mixes are generally unaffected with the use of pozzolanic materials.
- 3) Due to adjustment of admixture dosage to obtain similar workability in all concrete mixes, no significant change in setting characteristics are observed for a particular cementitious content.
- 4) It is also concluded that, addition of optimum with corn kernel split Ash in concrete paver blocks, increases its compressive strength up to 13.26% in their 10% replacement mix as compared to standard mix.
- 5) Corn kernel split Ash with increase the workability of the concrete, this mix increase slump value of concrete by 24.54%. compared to standard mix

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