International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 3.45 (SJIF-2015), e-ISSN: 2455-2584
Volume 3, Issue 5, May-2017

Experimental study of replacement of pozzolanic material with corn cob ash (CCA)

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Abstract— ***Today researches all over the world are focusing on ways of utilizing either industrial or agricultural wastes as a source of raw materials for the construction industry. These wastes utilization would not only be economical, but may also help to create a sustainable and pollution free environment. Corn cob ash is one such fibrous waste-product of the sugar refining industry, along with ethanol vapor. Corn cob ash mainly contains aluminium oxide and silica oxide. In this paper, untreated corn cob ash has been partially replaced in the ratio of 0%, 2%, 4%, 6% 8% and 10% by volume of cement in concrete. Fresh concrete tests like compaction factor test and slump cone test were undertaken along with hardened concrete tests like compressive strength, split tensile strength. The result shows that bagasse ash can be a suitable replacement to fine aggregate.***

Keywords— chemical properties, physical properties, compressive strength, flexure strength

I. INTRODUCTION

Today, concrete has become the most commonly used building material in the construction. The other important characteristics of concrete, besides its strength, are its ability to be easily molded into any form, it is an engineered material that can meet almost any desired specification, and it also adaptable, incombustible, high ductility, fluent, affordable and easily obtained. The great advantage of concrete is its excellent mechanical and physical characteristics like compressive strength, flexural, tensile, also high resistance again chemical corrosion if properly designed and manufactured. Currently, concrete is extensively used with more than 10 billion tons produced annually in modern industrial society [MEYER C]. It has been estimated that by 2050, the rate of the world's population will grow substantially from 1.5 to 9 billion, and, thus, will cause an increase in the demand for energy, housing, food and clothing as well as for concrete, which is forecast to increase to approximately 18 billion tons annually by 2050[MEHTA PK]. So more and more we need to production of cement to reach demand.

Everything has two sides if one side is advantages and another one is disadvantages. Cement material is good as binder material and good friction during physically and chemical attack it has also some disadvantages. In the last 100 years, the concrete industry has had an enormous effect on the environmental appearances. In addition, CO2 emissions are caused during the manufacturing process with a large volume of raw materials required to produce the billions of tons of concrete worldwide each year. The cement industry alone is estimated to be responsible for about 7% of all the CO2 generated worldwide [MALHOTRA VM]. It has been found that every ton of Portland cement produced releases approximately one ton of CO2 into the atmosphere. During the production of cement we have large amount of carbon dioxide also produced in environment, along with the use of energy and aggregate consumption in great amounts, the demolition waste of concrete, and filler requirements, contribute to the common environmental impact that concrete has making it a non-friendly that is unsuitable for sustainable development. Currently world production rate of cement is approximately 1.2 billion tone/year. This is expected to grow to about 3.5 billion tone/year by 2015. This increasing demand for cement is expected to be met by partial cement replacement.

Corn cob ash will be use for replacement of pozzolanic material. (Reheem, 2008)In this paper focused on improvement of initial strength of corncob ash with sodium silicate. To improvement initial strength using OPC 53 grade cement and mix design procedure base on IS 10262:2009.

II. Materials

Cement.

Ordinary Portland cement (Grade 53) was used. Its physical properties and chemical properties are as given below

Table 1Physical properties

Physical properties	result
Fineness IS 90 micron sieve residue	8%
consistency	31.5%
Initial setting time (min)	48
Final setting time (min))	225
Soundness (mm)	2
Specific gravity	3.15
Compressive strength after 28 days (Mpa)	55.9

Table 2 Chemical properties

Chemical compound	Abbreviation	%
Silica	SiO_2	20.2
Aluminum Oxide	Al_2O_3	4.7
Iron Oxide	Fe_2O_3	3
Calcium Oxide	CaO	61.9
Magnesium Oxide	MgO	2.6
Sodium Oxide	Na_2O	0.19
Potassium Oxide	K_2O	0.82
Sulphur trioxide	SO_3	3.9

Aggregate

Two types of coarse aggregate is using one is 20 mm and another one is 10mm which is bring from tapi,surat and fine aggregate bring from boreli. All aggregate tested for specific gravity, bulk density and fineness modulus which is shown in below table.

Table 3 Physical properties of aggregate

Physical test	Coarse aggregate (20mm)	Coarse aggregate (10mm)	Fine aggregate
Specific gravity	2.8	2.8	2.7
Water absorption	3%	5.5%	9%
Fineness modulus	6.94	6.59	2.84

Corn cob ash (CCA)

Corncob is the hard cylindrical core that bears the kernels of an ear of corn, usually an agricultural by-product found after removal of the corn. Described corn cob as the agricultural waste product obtained from maize or corn; which is the most important cereal crop. CCA has chemical properties tested in GEO, vadodara shown below.

Table 4 Chemical properties of CCA

Chemical composition	CORN COB ASH(CCA)
Sio2	62.30
Al2o3	6.25
Fe2o3	4.40
Cao	10.57
Mgo	1.86
So3	1.02
Na2o	0.36
K2o	3.89

Determined that the corn cob ash has an SiO2 content 62% and an oxides combination of Al2O3 and SiO2 in range of 70–75%. This shows that the ash from corn cob can be used as a supplementary cementations material in concrete.

III. Experimental work

The experimental work consists of performing the sieve analysis of corn cob ash as per the Indian standard procedure and using the results for the mix design to achieve the concrete of required strength and quality. In This Paper an attempt is made to study the various properties of concrete when cement is replaced by different proportions of corn cob ash (CCA) powder which can act as pozzolanic material Fresh properties of concrete determine by slump test and also the strength characteristics of concrete like compressive strength, tensile strength, flexure strength, are found. The Percentage CCA replacement of 0%,2%,4%,6%,8%,10% in blended cement with sodium silicate 7% replacement by water. The testing ages of 7, 28, and 56 days. Testing carried as per IS 516: 2004 recommendation.

Concrete as we know is relatively strong is compression and weak in tension. In reinforced concrete members, little dependence is placed on the tensile strength of concrete since steel reinforcing bars are provided to resist all tensile force. However, tensile stresses likely to develop in concrete due to drying shrinkage, rusting of steel, temperature gradient and many other reasons. Therefore, the knowledge of tensile strength of concrete is an importance. A beam test is found dependable to measure flexure strength properties of concrete and same is applied. For testing flexural strength of beam size of specimens 15 x 15 x 70 cm. test specimens of OPC beam; it beam in to water 28 days and then tested in SSD condition. In this dissertation work beams specimens were tested at 7 and 28 days.

IV. Result and *discussion*

Compressive strength

Compression testing of cubes was done on compression testing machine having capacity of 3000 KN. Compressive strength of Corn cob ash waste contain concrete cubes was determined after 7, 28, 56 days

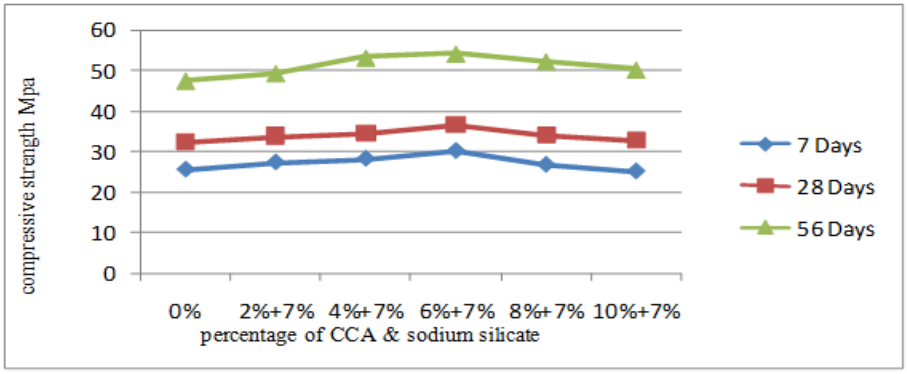

Figure 1 7, 28 and 56 days compressive strength

Flexure strength

Flexural strength is done as per IS: 516 – 1959. The axis of the specimen is aligned with the axis of the loading device. The specimen is loaded till fails and the maximum load applied to the specimen during test is noted.Flexural strength of beam is determined at age of 7 and 28 days.

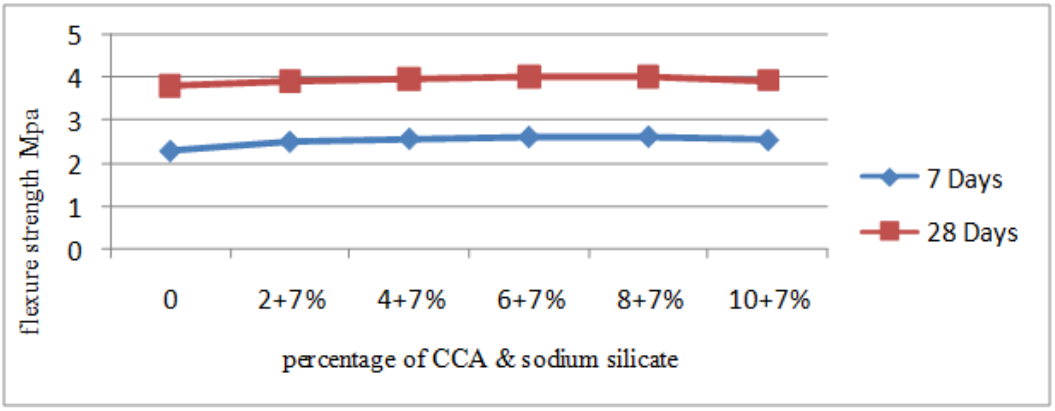

Figure 2 Flexure strength

V. Conclusion

After 7 day 28 day 56 day percentage is increase compressive strength is increase. Corn Cob ash optimum level is 6% with combination sodium silicate 7%Material increasing its slump value decreasing. Water absorption is increasing percentage of corn cob ash is increasing so the using of sodium silicate use as plasticizer to increase initial strength of concrete. When Percentage of material increase the flexure strength also increase but after 8 % of Corn cob ash & Sodium silicate 7% flexure strength maximum strength is grain.

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