Partial Replacement of Cement in Concrete by Sugarcane Bagasse Ash

Authors:1.Sudeshna Patil, 2.Chandanika Gosavi, 3.Raunak Khan, 4.Janhavi Nimkar
Department of Civil engineering, Guru Gobind Singh Polytechnic, Nashik.
Email: 1.sudeshna7473@gmail.com, 2.chandanikagosavi@gmail.com 3.raunakkhan1612@gmail.com
4.janhavinimkar@gmail.com

Abstract:

India is the greatest producer of sugar cane of the world. Two types of ethanol fuel are produced: hydrated, which is used as straight fuel to power alcohol vehicles, and anhydrous which is blended to gasoline as octane enhancer. The major sugar-alcohol industry by-products are bagasse, cane-washing water, leaves and ends, filter tart, yeast and vinhoto. The bagasse is used in the energy production (steam/electricity), fuel, hydrolysis, paper pulp, cellulose and wood veneer. Considering that the Indian sugar cane producing in 2004 was 410 millions tones. approximately 120 millions tonnes of the bagasse was generated. In India, the bagasse is usually burned (95%) to produce steam, which can be used either as mechanical the mill drivers, or to energy cogeneration. For 2010, it is expected that 1.500 MW of power for electrical power will be generated by bagasse burning. In this process, a new by-product is generated: residual sugar cane bagasse ash (SCBA).

The SCBA is composed mainly of silica (SiO_2). This characteristic indicates its potential as mineral Portland cement admixture; nevertheless there are few studies about its application. This paper presents the results of an experimental program developed in order to produce an ultra-fine SCBA and to value its performance as mineral admixture in conventional and high-performance concretes. The ultra-fine SCBA was produced through optimization of the mechanical grinding, where granulometry, specific surface and pozzolanic activity of SCBA were assessed. The conventional concrete were made with 3% and 6% of ultra-fine SCBA as cement replacement (in mass). The fresh, mechanical and durability properties of the concretes were performed and the results indicated that the ultra-fine SCBA has a high potentiality to be used as cement admixture Its availability in India indicates that it can be used, in our country, in large quantities in the closest are to minimize cement use and achieve the economy.

I. INTRODUCTION

Cement, both in mortar and concrete, is the most important element of the infrastructure and can be a durable construction material. However, the environmental aspect of cement has become a growing concern, as cement manufacturing is responsible for about 2.5% of total worldwide waste emissions from industrial sources. One effective way to reduce the environmental impact is to use mineral admixtures, as a partial cement replacement both in concrete and mortar, which will have the potential to reduce costs. Conserve energy, and minimize waste emission. Mineral admixtures are found in various forms in nature, including blast furnace slag, fly ash, and silica fume.

The use of mineral admixtures improves the compressive strength. pore structure. and permeability of the mortars and concretes because the total porosity decreases with increasing the hydration time Bagasse is a major by-product of the sugar industry, which is utilized in the same industry as an energy source for sugar production. Sugarcane contains 25-30% bagasse, whereas industry recovered sugar is about 10%. Bagasse is also used as a raw material for paper making because of its fibrous texture, and about 0.3 tons of paper can be made from one ton of bagasse.

Thus, the agricultural ash properties depend on burning time, temperature cooling time. and grinding conditions. The objective of this investigation is to evaluate bagasse ash as supplementary cementations material with reference to mechanical and permeability properties of hardened concretes and to identify the optimal level of replacement in concrete formation to minimize the chloride permeability in the concrete in addition to reducing environmental problems associated with cement manufacturing and ash production.

II. METHODOLOGY

1. AGGREGATES

Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. Earlier, aggregates were considered as chemically inert materials but now it has been recognized that some of the aggregates are chemically active and also that certain aggregates exhibit chemical bond at the interface of aggregate and paste. The mere fact that the aggregates occupy 70-80 per cent of the volume of concrete. Their impact on various characteristics and properties of concrete is undoubtedly considerable

2. SAND

Sand is a mass of finely crushed rock. It is either crushed naturally as seen on the sea shore, in river beds, or in deserts, or it is artificially produced in crusher plants near rock. Sand is classified according to the shape of its particles, which differs depending on where the sand came from originally. It is also graded according to the size of its grains. All along in India, we have been using natural sand. The volume of concrete manufactured in India has not been much, when compared to some advanced countries. The infrastructure development such as express highway projects. Power projects and industrial developments have started now.

3. MIX DESIGN

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The purpose of designing as can be seen from the above definitions is two-fold. The first object is to achieve the stipulated minimum strength and durability. The second object is to make the concrete in the most economical manner. Therefore attention is mainly directed to the cost of materials. Since the cost of cement is many times more than the cost of other ingredients, attention is mainly directed to the use of as little cement as possible consistent with strength and durability.

4. TEST FOR COMPRESSIVE STRENGTH OF CONCRETE SPECIMEN

PROCEDURE:

Specimens stored in water shall be tested immediately on removal from the water and while they are still in the wet condition. Surface water and grit shall be wiped off the specimens and any projecting fins removed. Specimens when received dry shall be kept in water for 24 hours before they are taken for testing. The dimensions of the specimens to the nearest 0.2 mm and their weight shall be noted before testing.

The bearing surfaces of the testing machine shall be wiped clean and any loose sand are other material removed from the surfaces of the specimen which are to be in contact r the compression platens. In the case of cubes, the specimen shall be placed in the machine in such a manner that the load shall be applied to opposite sides of the cubes as cast, that is, not to the top and bottom. The axis of the specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. No packing shall be used between the faces of the test specimen and the steel platen of the testing machine. As the spherically seated block is brought to bear on the specimen, the movable portion shall be rotated gently by hand so that uniform seating may be obtained. The load shall be applied without shock and increased continuously at a rate of approximately 140 kg/sq cm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

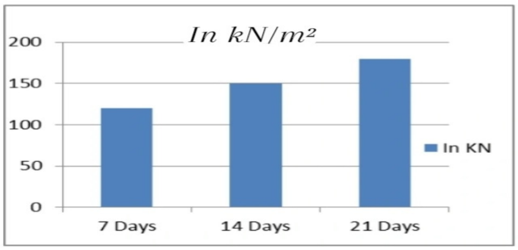
CALCULATION:

The measured compressive strength of the specimen shall be calculated by dividing the maximum load applied to the specimen during the test by the cross-sectional area, calculated from the mean dimensions of the section and shall be expressed to the nearest kg per sq. cm. Average of three values shall be taken as the representative of the batch provided the individual variation is not more than 15 percent of the average. Otherwise repeat tests shall be made.

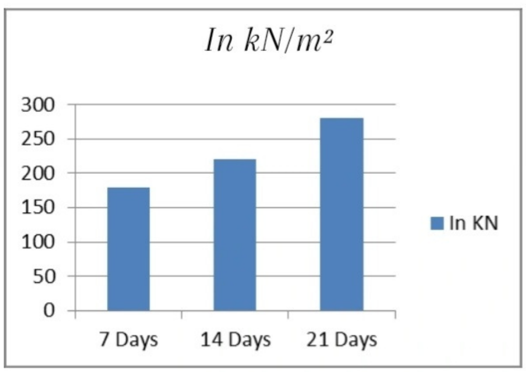
III. RESULTS

CONCRETE MIX DESIGN OF GRADE M20 WITHOUT PARTIAL REPLACEMENT OF CEMENT BY BAGASSE

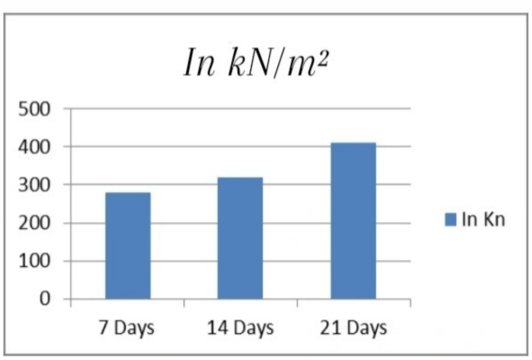
Graphical Analysis grade of GRADE M20



CONCRETE MIX DESIGN OF GRADE M20 CONCRETE BY 3% WITH PARTIAL REPLACEMENT OF CEMENT BAGASSE ASH



CONCRETE MIX DESIGN OF GRADE M20 CONCRETE BY 6% WITH PARTIAL REPLACEMENT OF CEMENT BAGASSE ASH



IV. CONCLUSIONS

The partial substitution of Portland cement by up to 3% and 6% of ash in the mixture did not bring about any significant modification in the specific mass of the concrete; the concrete with proportions of SBC in substitution with cement between 0, 3% and 6%, at 7, 14 and 21 days, indicate the possibility that the compressive strength has been increased at 21days.

Hence, it is concluded by obtained results, the cement replace by sugarcane bagasse ash is optimum can cause the reduction in cement use. Hence economical and cost is reduced.

FUTURE SCOPE

The Bagasse Ash imparts high early strength to concrete and also reduce the permeability of concrete. In future, if the proportions can change we can get more compressive strength and also it will reduce the economical cost.

References

[1] Subrato Chowdhary, Sandeep kadam, Satyaki Sarkar and Parha P. Biswas, "Impact of aggregate sizes on fresh and hardened states of concrete". Indian Concrete Journal, December 2009.

[2] Prashant D. Ramugade, "Estimating Compressive Strength". Indian Concrete Journal, July 2010.

[3] R. Nagendra, Ashok Kumar Dhabale, H. Sharada Bai and S.V.Rajeeva, "Analysis of Shape parameters of coarse aggregate and their effects on packing density by DIP technique", Indian Concrete Journal, July 2006.

[4] IS: 383-1970, "Specification for coarse aggregates from natural sources for concrete". Bureau of Indian standards, Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi.

[5] IS: 456-2000. "Plain and Reinforced Concrete - Code of Practice", Bureau of Indian standards, Manak Bhavan. 9 Bahadur Shah Zafar Marg. New Delhi.

[6] ACI Education Bulletin El-07. "Aggregates foir concrete", American Concrete Institute. Farmington Hills, MI 48331, U.S.A, August 2007.
[7] M.S. Shetty, "Concrete Technology", S. Chand and company limited. Ramnagar New Delhi - 110 055.