EXPERIMENTAL STUDY ON USE OF BAGGASE ASH IN CONCRETE

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Abstract
Concrete is the most widely used material for the construction. One of the important ingredients of concrete is cement. During the production of cement, large amount of CO2 is emitted, which affects the global environment. With increasing demand and consumption of cement, scientists and researchers are in search of developing alternate binders that are eco-friendly. Initiatives are emerging worldwide to strike a balance between the developments in infrastructure and prevention of the environment from contamination, by using the industrial and agricultural wastes. In this study, the feasibility of using Sugarcane Bagasse Ash (SBA), a finely ground waste product from the sugarcane industry, as partial replacement for cement in conventional concrete is examined. The disposal of this material is causing environmental problems around the sugar factories. On the other hand, the boost in construction activities in the country created shortage in most of concrete making materials especially cement, resulting in an increase in price. The percentages selected for this study are 0%, 5%, 10% and 15% by the weight of cement in concrete. Based on the experimental tests, it can be concluded that SBA, an agro waste product, can be utilized effectively in partial replacement of cement, thus reducing CO2, emissions and disposal problems to some extent. The properties for fresh concrete are tested like slump cone test, spilt tensile strength and for hardened concrete compressive strength at the age of 7, 14 and 28 days. The test result indicate that the strength of concrete increase up to 10% SCBA replacement with cement.

Keywords: bagasse ash, cement, concrete, strength

I. INTRODUCTION

We are aware that a lot of damage is done to environment in the manufacture of cement. It involves lot of carbon emission associated with other chemicals. The researches has shown that every one ton of cement manufacture releases half ton of carbon dioxide, so there is an immediate need to control the usage of cement. On the hand materials wastes such as sugarcane baggase ash is difficult to dispose which in return is environmental hazard. The bagasse ash imparts high early strength to concrete and also reduce the permeability of concrete .the silica present in the bagasse ash reacts with components of cement during hydration and imparts additional properties such as chloride resistance ,corrosive resistance etc. Therefore the use of bagasse ash in concrete not only reduces the environmental pollution but also enhance the properties of concrete and also reduces the cost. It makes the concrete more durable. This project mainly deals with the replacement of cement with bagasse ash in fixed proportions .the concrete mix designed by varying the proportions of bagassw ash for 0%,5%,10%,15% the cubes and cylinders.

Sugarcane bagasse ash:

Sugarcane bagasse ash is a byproduct of sugar factories found after burning sugarcane bagasse which itself is found after the extraction of all economical sugar from sugarcane. The disposal of this material is already causing environmental problems around the sugar factories. It's not exactly sugar juice, but the sugar cane fiber left over after the juice is extracted, which is burned to make electricity.

The fiber is called bagasse, and is being used in cogeneration power plants. Once it dries, it is burned in boilers to make steam. The steam is used to create electricity.

It produces two forms of energy from a single fuel source. Almost all sugar mills in India are traditionally using cogeneration by using bagasse as a fuel. Sugar production process releases a valuable byproduct known as Bagasse. Basically it is a fibrous material that remains behind after the crushing of sugar cane.

bagasse is a byproduct from sugar industries which is burnt to generate power required for different activities in the factory. The burning of bagasse leaves bagasse ash as a waste, which has a pozzolanic property that would potentially be used as a cement replacement material. It has been known that the worldwide total production of sugarcane is over 1500 million tons. Sugarcane consists about 30% bagasse whereas the sugar recovered is about 10%, and the bagasse leaves about 8% bagasse ash (this figure depend on the quality and type of the boiler, modern boiler release lower amount of bagasse ash) as a waste, this disposal of bagasse ash will be of serious concern. Sugarcane bagasse ash has recently been tested in some parts of the world for its use as a cement replacement material. The bagasse ash was found to improve some properties of the paste, mortar and concrete including compressive strength and water tightness in certain replacement percentages and fineness. The higher silica content in the bagasse ash was suggested to be the main cause for these improvements. Although the silicate content may vary from ash to ash depending on the burning conditions and other properties of the raw materials including the soil on which the sugarcane is grown, it has been reported that the silicate undergoes a pozzolanic reaction with the hydration products of the cement and results in a reduction of the free lime in the concrete. This attack is related to the expansive character of the ettringite formation by reaction of internal (in the concrete) or external (from the environment) sulphate with the hydrated calcium aluminate of the hardened cement matrix. Not necessarily the ettringite formation produces a damaging effect. When it occurs homogeneously and immediately(within hours or days) in a mixture or in a deformable concrete early ettringite formation (EEF) the related expansion does not cause any significant localized disruptive action. This happens when ground gypsum reacts with anhydrous calcium aluminates within some hours (set regulation) or when a calcium aluminate sulphate hydrates within few days producing a relatively small, homogeneous, harmless and rather useful stress. On the other hand, when ettringite forms heterogeneously and later (after months or

MATERIAL AND IT'S PROPERTIES

Ordinary Portland cement:

Concrete is made by Portland cement, water and aggregate is hydraulic cement that hardens in water to form a water-resistant compound. The hydration products act as binder to hold the aggregate together to form concrete. The name Portland cement comes from the fact that the colour and quantity of the resulting concrete are similar to Portland stone, a kind of limestone found in England.

MANUFACTURE OF PORTLAND CEMENT**:**

Portland cement is made by blending the appropriate mixture of limestone and clay or shale together and by heating them at 1450 $^{\circ}$c in a rotary kiln . The preliminary steps are a variety of blending and crushing operations. The raw fees must have a uniform composition and be a fine enough so that reactions among the components can complete in the kiln. Subsequently, the burned clinker is ground with gypsum to form the gray powder known as Portland cement. The raw material used for manufacturing Portland cement are limestone, clay, and iron ore. Since the primary constituents of Portland cement are calcium silicate , we can define Portland cement as a material which combine CaO SiO_2 in such a proportion that the resulting calcium silicate will react with water at room temperature and under normal pressure.

TEST PERFORMED ON ORDINARY PORTLAND CEMENT:

Consistency and fineness.

Baggase ash :

Bagasse is the fibrous matter that remains after sugarcane are crushed to extract their juice. It is dry pulpy residue left after the extraction of juice from sugar cane. Bagasse is used as a biofuel and in the manufacture of pulp and building materials. Bagasse can also be very useful to generate electricity. Dry bagasse

is burnt to produce steam. The steam is used to rotate turbines to produce power.

The disposal of this material is already causing environmental problems around the sugar factories. On the other hand, the boost in construction activities in the country created shortage in most of concrete making materials especially cement, resulting in an increase in price. This study examined the potential use of sugarcane bagasse ash as a partial cement replacement material. bagasse ash sample was collected from purti sugar factory and its chemical properties were investigated. Ordinary Portland cement and Portland Pozzolana cement were replaced by ground bagasse ash at different percentage ratios .Normal consistency and setting time of the pastes containing Ordinary Portland cement and bagasse ash from 5%, 10% and 15% replacement were investigated. . Concrete properties and further environmental and economical advantages can also be exploited by using bagasse ash as a partial cement replacement material. The utilization of industrial and agriculture waste produced by industrial processes has been the focus of waste reductions research for economical, environmental and technical reasons.

FINE AGGREGATE:

The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica, usually in the form of quartz. The second most common type of sand is calcium carbonate, for example aragonite, which has been mostly created, over the past half billon years, by various forms of life, like coral and shellfish.

In this experiment programme, locally procured sand of kanahan river available from kanahan road Nagpur and conforming tp grading zone II was used. The sand first sieved through 4.75 mm sieve to remove particles greater than 4.75 mm size. Sieve anlaysisnd physical properties of fine aggregate are tested as per IS: 383-**1970.**

TESTS PERFORMED ON SAND:

Sieve analysis,bulking of sand,specific gravity.

COARSE AGGREGATE:

Crushed granite stones obtained from local queries were used as coarse aggregate. The maximum size of coarse aggregate used was 20mm. The properties of coarse aggregate were determined by conducting tests. The aggregate were washed to remove dust and dirt and were dried to surface dry condition. For a good concrete mix, aggregates need to be clean, hard, strong particles free of absorbed chemicals or coatings of clay and other fine materials that could cause the deterioration of concrete.

The coarse aggregate used were a mixture of two available crushed stones of 10mm and 20mm size. For minimum the bigger size coarse aggregate 75:25 Proportion was kept. The sieve analysis and physical properties of coarse aggregate satisfied the requirement of coarse aggregate satisfied the requirement od IS:383-1970[10] and results are as given below in table. The physical properties has been given below.

TESTS PERFORMED ON COARSE AGGREGATE:

Sieve analysis, specific gravity, water absorption, flakiness and elongation index.

WATER:

Potable water is generally considered satisfactory for mixing and curing of concrete. Accordingly potable water was used for preparation of all concrete mixes. The water used in the mix design was from the water – supply network system; so, it wasd free from suspended solids and organic materials, which might have affected the properties of the fresh and hardened concrete. pH of water is used for concrete mixes should be between a range of 6.5 to 8.5.

MIX DESIGN

Definition:

Mix design is the process of selecting suitable ingredient if concrete and determines their relative proportions with the object of certain minimum strength and durability as economically as possible.

Objective of Mix Design: The objective of concrete mix design as follows

.□ The first objective is to achieve the stipulated minimum strength.

□ The second objective is to make the concrete in the most economical Manner. Cost wise all concrete's depends

□ primarily on two factors, namely cost of material and cost of labour. Labor cost, by way

of formwork, batching, mixing, transporting and curing is namely same for good concrete.

Factors to Be Considered:

In Mix Design

1.Grade of concrete
2.Type of cement
3.Type & size of aggregate
4.Type of mixing & curing
5.Water /cement ratio
6.Degree of workability
7.Density_of_concrete

PROJECT METHODOLOGY

General:

In order to achieve the objective of the present study, an experiment program was planned to investigate the effect of the sugarcane baggase ash on properties of cement replaced by sugarecane baggase ash in different percentage i.e. 0%, 5%,10%,15%respectively.The various parameters are investigated and test are performed such as compressive strength.

The experiment program includes the following.

1- Testing of properties of materials used.
2- Development of concrete of desired strength by making trials.
3- Testing slump cone to assess workability.
4- Casting and curing of the specimen.
5- Compressive strength test on specimen.
6- Replacement of cement by sugarcane baggase ash.
7- Testing slump cone test to assess workability.
8- Casting and curing of specimen.

TESTING OF SPECIMENS

Slump test:

According to IS:1199-1959,workability is defined as the property of concrete which determines the amount of useful internal work necessary to produce complete compaction. For determining the workability of concrete slump test was adopted. Slump test is the most commonly used method for measuring consistency of concrete which can be employed either in laboratory or at site of work. It is not a suitable method for very wet or very dry concrete. However, it is used conveniently as a control test and gives an indication of the uniformity of concrete from batch. Slump test was conducted according toIS:1199-1959.

The mould for the test specimen shall be in the form of the frustum of a cone having the following internal dimensions:

Bottom diameter=20cm
Top diameter=10cm
Height=30cm

The following test have been carried out on the cube

COMPRESSIVE STRENGTH TEST

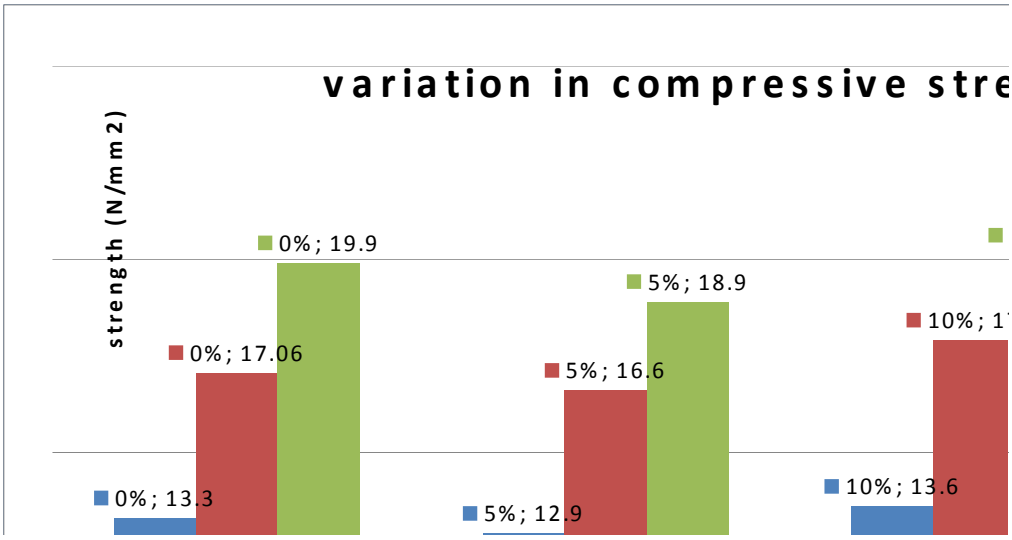
The test was conducted according to IS CODE 516-1959[11] . Specimens were taken out from curing tank at the age of 7, 14, and 28 days of moist curing and tested immediately after removal from water. Surface water was allowed to drip down. Specimens were tested on 200 TONES CAPACITY OF UNIVERSAL TESTING MACHINE UTM . THE POSITION OF THE CUBE WHILE TESTING WAS at reight angles to that of casting position .

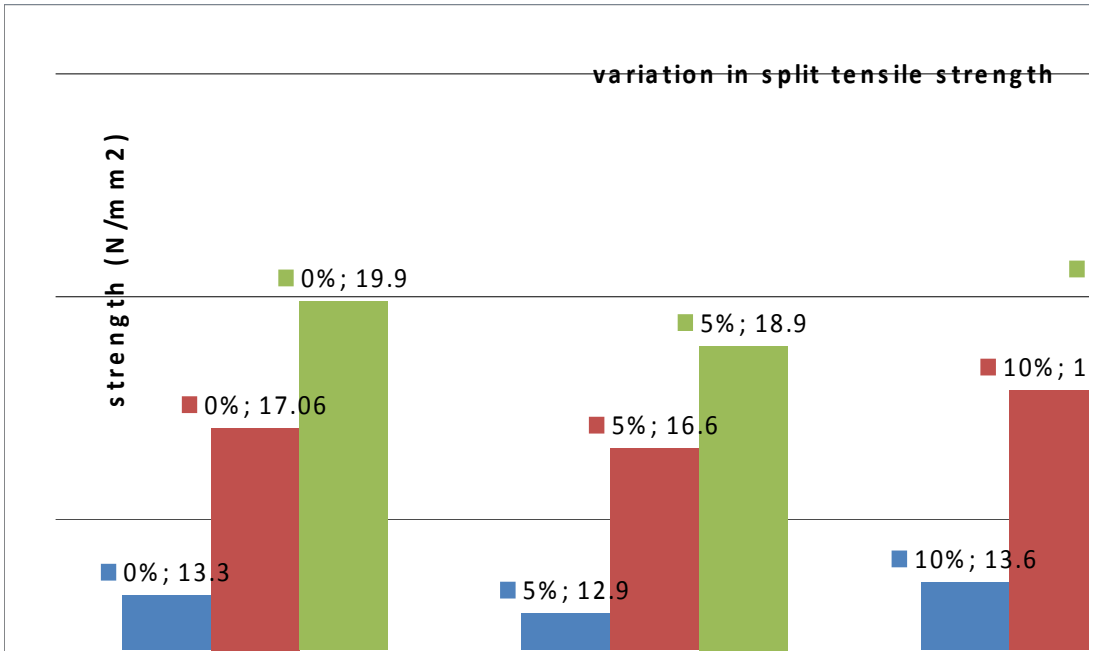
SPILT TENSILE STRENGTH TEST:

The tensile strength of concrete is one of the basic and important properties. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack.

RESULTS: Effect of sugarcane baggase ash on compressive strength of concrete

The result of compressive strength tests using sugarcane bagasse ash in varying percentages (i.e 0%, 5%, 10% & 15%) as partial replacement of cement at moist curing age of 7, 14 and 28 days are represented in the table and are plotted in figures which show the variations of compressive strength of concrete with different replacement level of bagasse ash and at various ages of moist curing.





CONCLUSION

Cement can be replaced by bagasse ash upto 10% without much loss in compressive strength.

As per IS standard, we required minimum strength is 20 N/mm^2 after 28 days testing, but we got strength more than required value after 28 days testing. So it is safe.

Compressive strength test for cube is maximum in mix (10% bagasse ash + 90% cement) as compared with standard mix concreting.

Split tensile strength test for cylinder is maximum in mix (10% bagasse ash + 90% cement) as compared with standard mix concreting.

On the basis of test performed and observation for split tensile strength and compressive strength, we concluded that the addition of 10% sugarcane bagasse ash gives the higher strength. From this project, we conclude that the quantity of cement can be reduced by replacing it with sugarcane bagasse ash. By this project, we can reduce the cost of construction.

Effective utilization of sugarcane bagasse ash in concrete can save the waste of industries and also produces a 'greener' concrete.

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