Experimental Study on using Bagasse Ash in Concrete and Curing With Different Types of Water

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Abstract - *In modern era construction sector is expanding rapidly on large scale and this involves large consumption of concrete. Concrete generally consist of cement, coarse aggregate, fine aggregate and Water. The entire component plays an important role but the major component of concrete is cement. In addition to all these negative impacts due to production of cement the expert are enforced to find the solution of these problems. Now a days the generation of in agro waste in increasing rapidly and it affects our environment. Utilization of agro waste by industrial process has been focused on waste reduction. One of the agro wastes is the sugarcane bagasse ash, which is fibrous waste product obtained from sugar mills as by product. Using bagasse ash in different proportions (0%,5%,15%,25%) and testing their strength by using 3 different types of water that is available in Salem for curing. Water sample 1 (well water), Water sample 2 (tap water),Water sample 3 (bore well water) and Testing the designed M20 concrete's compressive strength at 7 days,14 days, 28 days and comparing them with conventional concrete and publishing the result.*

Key Words: Agro waste, Bagasse ash, Curing,Water Samples, Compressive strength.

1. INTRODUCTION

Cement, each in mortar and concrete, is that the most significant component of the infrastructure and might be a sturdy construction material. However, the environmental facet of cement has become a growing concern, as cement producing is chargeable for regarding. 5% of total worldwide waste emissions of CO2 are from industrial sources. One effective thanks to cut back the environmental impact is to use mineral admixtures, as a partial cement replacement each in concrete and mortar, which can have the potential to scale back prices, conserve energy, and minimize waste emission. Mineral admixtures area unit found in numerous forms in nature, together with furnace dross, fly ash, and silicon oxide fume. The employment of mineral admixtures improves the compressive strength, pore structure, and porosity of the mortars and concretes as a result of the whole consistency decreases with increasing the association time. Pulp may be a major by-product of the sugar trade, that is used within the same trade as Associate in nursing energy supply for sugar production. Sugarcane contains 25-30% pulp, whereas trade recovered sugar is regarding 100%. Burning pulp leaves three-dimensional ash, that has no use apart from landfills. The silicon oxide content of pozzolans reacts with free lime discharged throughout the association of cement and forms extra metallic element salt hydrate (CSH) as new association product, that improves the mechanical properties of concrete formation. The ash made by the controlled burning of agro waste materials below 700°C incinerating temperature for one h transforms the silicon oxide content of the ash into Associate in Nursing amorphous part, and also the reactivity of amorphous silicon oxide is directly proportional to the particular expanse of ash. The ash thus made is powdered or ground to the desired fineness, then mixed with cement to provide a homogenized cement. Thus, the agricultural ash properties rely on burning time, temperature, cooling time, and grinding conditions. The target of this investigation is to judge pulp ash as supplementary building material with relation to mechanical and porosity properties of hardened concretes and to spot the best level of replacement in concrete formation to attenuate the chloride porosity within the concrete additionally to reducing environmental issues related to cement producing and ash production. Sugarcane (Saccharum officinarum) is that the largest crop by production amount in the globe. an outsized quantity of wet pulp is yielded and also the management of this residue is of nice importance from Associate in Nursing environmental purpose of read. The combustion of this pulp is one in every of the foremost common practices, leading to the assembly of an extra residue, the sugarcane pulp ash (SCBA). Chemical and mineralogical composition of SCBA makes it a possible supplementary material in hydraulic cement blends and conjointly in geopolymeric binders. Fineness, crystallinity, and also the presence of change state particles area unit crucial for the event of pozzolanic reactivity and for having smart mechanical performance. sturdiness of SCBA-based mortar and concrete is suitable, and in several cases two hundredth replacement of cement is allotted while not vital performance loss. A discount of CO2 emissions has been projected with the employment of those residues. Within the method of constructing sugar, sugarcane is crushed to extract the juice. The fibrous residue is termed pulp and is employed as a fuel supply for feeding a boiler. Sugarcane pulp ash (SCBA) is so a residue obtained from the burning of pulp within the sugar trade. In general, the ash with high silicon oxide content contains a high portion of quartz. It is characterized as a solid waste and is sometimes disposed of as lowland. The SCBA contains an outsized quantity of silicon oxide (62%) and a few Al2O3, CaO, Fe2O3, and atomic number 19 compound (K2O). LOI of regarding 100% implies the high content of unburnt organic matter. The main crystalline phases found in sugarcane pulp ash area unit quartz (SiO2) and mineral (SiO2).

2. RELATED WORKS

According to E. B. Oyetola [1] the compressive strength of some industrial sandcrete blocks in Minna, African country was investigated. Rice Husk Ash (RHA) was ready mistreatment Charcoal from burning fuel. Preliminary analysis of the Constituent materials of the standard hydraulic cement (OPC) /Rice Husk Ash (RHA) hollow sandcrete blocks were conducted to substantiate their suitableness for block creating. Physical take a look at of the freshly ready combine was additionally allotted. One 50mm x 450mm hollow sandcrete blocks were forged cured and crushed for 1, 3, 7, 14, 21, and twenty eight days at zero, 10, 20, 30, 40 and 50 replacement levels. Take a look at results indicate that the majority industrial sandcrete blocks in Minna city area unit below commonplace. The compressive strength of the OPC/RHA sandcrete blocks will increase with age at activity and reduces because the proportion of RHA content will increase. The study received an optimum replacement level of two hundredth. K.C.P. Faria et.al., found that once concrete was mixed with partial 100 percent of SCBA then the compressive strength raised one in 21 times and lastingness raised one in 4 times. With addition of SCBA to concrete, members shows a more robust sturdiness as they're less porous to chloride ions [2]. V. Morales et.al., provides the knowledge regarding the chemical composition of bagasse ash. This study make a case for that ash contain silicon oxide, aluminium and iron chemical compound as major part. Among these 3 elements silicon oxide content is a lot of above different and helps in pozzolanic reactions. oxidisation temperature of pulp ash plays a significant role in getting higher pozzolanic reaction [3]. In line with Lathamaheswari, et,al., the workability of concrete has not been noticeably stricken by increment in replacement of cement with SCBA and cement would get replaced with SCBA upto a most limit of 100 percent once cement was partly replaced by SCBA in concrete, it had additionally shown a decent modulus of snap [4]. Noor-Ul Amin had terminated in their analysis that upto two hundredth of high strength hydraulic cement may be part replaced with SCBA with none altered impact on the properties of concrete. Addition of SCBA can ends up in high early strength, reduction in porousness and resistance to chloride permeation and diffusion [5]. U.R.Kawade et al determined that cement may be with success replaced with SCBA upto an extent of day. The partial replacement of SCBA will increase the workability of concrete thanks to that super softener was not needed [6]. In line with G. Nithin Kumar Reddy et,al., Concrete once exposed to aggressive environments have loads of effects and this can be an awfully severe downside of the structures made nearer to ocean, industries cathartic gases containing excess salt content. Most of the concretes show effects like cracking, spalling, growth of concrete and clearly loss within the strength. Blending cements show terribly sharp results proscribing this salt attack, sugarcane pulp ash being one amongst the mixing materials that has shown an awfully sensible end in increase of strength and workability. This project deals with the impact of sulphates on concrete replaced part with sugarcane pulp ash[7]. In line with Kunchala et,al., Geopolymer concrete with the replacement of pulp ash or rice husk ash up to 100 percent that is the optimum proportion may be used. One amongst any may be used looking on the supply chance, if each area unit of same chance or having equivalent accessibility probabilities than continued for the replacement of pulp ash is best than the rice husk ash. With replacement of half-hour to five hundredth of rice husk ash the strength bit by bit decreases for compression wherever as for the split tensile and also the flexural strength properties there is an unexpected decrease in strength that ought to be restricted getting used [8]. In line with M. V. Madurwar et,al., application of bio-fuel by-product sugarcane pulp ash (SBA) as a principal material for the producing of bricks was studied. The bricks were developed mistreatment the quarry mud (QD) as a replacement to natural stream sand and lime (L) as a binder. It absolutely was determined that SBA–QD–L bricks area unit lighter in weight, energy economical and meet compressive strength necessities of IS 1077:1992. The bricks additionally serve the aim of solid waste management and innovative property construction material [9]. In M. A. S. Schettino et,al., work, Floor tile items containing up to two percent sugarcane pulp ash waste as a partial replacement of quartz were ready by uniaxial pressing and shape at 1190 C. The subsequent technological properties were determined mistreatment commonplace procedures: flexural strength, apparent density, linear shrinkage, and water absorption. The experimental results indicated that the sugarcane pulp ash waste is wealthy in quartz particles, and has potential to be used as an alternate material for the assembly of ceramic floor tile [10]. In D. Tonnayopas, Characterization in behavior of the clay material employed in construction clay brick business thanks to additions of sugar cane pulp ash (SCBA) was investigated. Mixtures of clayey soil and SCBA in proportions of 10-50% of weight were hydraulic uniaxially ironed and shape at optimized temperature of 50 degree celsius. Experimental results of partial replacement of the SCBA specimens displayed that it may be directly affected on the properties of the shape clay brick product [11].

3. MATERIALS USED

3.1 CEMENT

Ordinary Portland cement of fifty three grade having relative density of 3.15 from one batch was used for the complete work and care has been taken that it has to been keep in airtight containers to forestall it from being tormented by the atmospherical and monsoon wet and wetness. The cement was tested for physical and chemical properties as per IS: 4031 – 1988 and located to be confirming to varied specifications as per IS: 12269-1987.

3.2 FINE AGGREGATE

M-Sand is employed as fine mixture in this study. It was created from crushing of rock or granite for construction functions in cement or concrete. M sand differs from natural stream sand in its physical and mineralogical properties. The mixture was tested for its physical needs like sieve analysis. Sieve analysis facilitate to work out the particle size distribution of fine mixture. The specific gravity of M-sand is a 2.67. This is often done by sieving the aggregates as per IS 2386 (Part I) – 1963. The set of sieves used for testing are of sizes 4.75 mm, 3.35 mm, 2.36 mm, 1.18 mm, 600 µm, 300 µm, 150 µm, 75 µm.

3.3 COARSE AGGREGATE

Coarse mixture unremarkably called crushed aggregates of nominal most size of 20mm and specific gravity of 2.497 were used. Throughout the investigations, crushed coarse aggregates of 20mm procured from the native crushing plants was used. The mixture was tested for its physical needs like sieve analysis in accordance with IS:2386(Part I)-1963.

3.4 WATER

Typically water that is offered simply on the location like tap water, bore ground water, well water, municipal waste water etc., area unit directly used for mix the concrete. Therefore during this project work an effort is formed to research the results of various sorts of water on compressive strength of concrete and identification of civil work wherever these water are often used while not compromising structural strength parameters. Qualities of water for creating concrete (mixing water for concrete) nearly any natural water that is drinkable and has no pronounced (strongly marked) style or odor are often used as mix water for creating concrete. But some waters that are not suitable for drinking could also be appropriate to be used in concrete. A water supply comparable in analysis to any of the waters within the table is perhaps satisfactory to be used in concrete. Excessive impurities in water not solely could have an effect on setting time and concrete strength, however conjointly could cause efflorescence, staining, corrosion of reinforcement, volume instability, and reduced sturdiness. Therefore, certain mandatory limits could also be set for chlorides, sulfates, alkalies and solids within the mix water or acceptable tests are often performed to work out the impact of the impurity has on varied properties. Some impurities could have very little impact on strength and setting time, nonetheless they wll adversely have an effect on sturdiness and different properties. The target of this work is to match the compressive strength of concrete for M20 grade by investigating the various qualities of water such a faucet water, bore ground water, well water, waste water etc. that area unit offered on completely different construction sites and area unit directly being employed for creating concrete, conjointly identification of civil works wherever these water are often used while not compromising structural strength parameters. Water regionally offered potable water (drinking water) confirming IS: 3025 – 1986 (Bureau of Indian Standards 1986) having hydrogen ion concentration 7.0 is used. The concrete combine for M20 grade with water cement ratio 0.5 were investigated, then investigated completely with different quality of water like waste water, well water, bore ground water, bisleri water (mineral water) were used to cast 150mm concrete cube. Though water is a crucial constituent of concrete, it does not receive due attention in preparation and internal control in concrete. Strength and different properties of concrete area unit developed as a results of reaction of cement and water and therefore water plays a crucial role. Quality of blending and action water generally results in distress and disintegration of concrete reducing the helpful lifetime of the concrete structure. Water used for concrete mixture ought to not contain substances which may have harmful impact of strength or sturdiness of the concrete in commission , sure substances if present, in mix and action should be taken and make it free from injurious amounts such as oil, acids, alkalis, salts, organics matter, waste material and different substances unit which are harmful to concrete steel reinforcement. Portland water is mostly thought about satisfactory for mix and action of concrete, in case of doubt, water ought to be tested for its quality. The main points of assorted tests (physical and chemical) for water utilized in concrete area unit given in- IS: 3025-1964. Permissible limits of impurities in mix water area unit laid out in IS 456-1978 and is given in table. For evaluating the impact of using a water of questionable quality to create comparative tests for time of set and soundness, and strength with water for uncertain quality. Compressive strength take a look at for performance of water in concrete shall be dispensed on 150mm concrete cubes prepared with water proposed to be used. Average twenty eight days compressive strength of comparable cubes ready with water is taken. Initial setting time of test block created with projected water and cement shall not be less than half-hour and not differ by +-30 minutes from the initial setting time of control test block prepared with an equivalent and distilled water.

3.5 SUGARCANE BAGASSE ASH

Sugarcane pulp consists of roughly 50% of polysaccharide, 25% of hemicelluloses of ligin. every ton of sugarcane generates close to twenty sixth of pulp (at a wetness content of 50%) and 0.62% of residual ash. The residue once combustion presents a chemical composition dominates by silicon oxide ($SiO2$). In spite of being a material of hard degradation which presents few nutrients, the ash is employed on the farms as a chemical within the sugarcane harvests. In present study, SCBA is employed as partial replacement of cement within the relation of 0%, 5%, 15%, 25% to see the optimum strength of concrete. The density essentially defines because the mass per unit volume. The sugarcane pulp ash is extremely lightweight weight material and its density is 1.95g/cm^3. The obtained density value fall among the category of carbon and oxide that is 1.8 and 2.2 g/cm^3 respectively. Furthermore, the structure, size and form of the particles varies.

4. CONVENTIONAL CONCRETE MIX DESIGN PROCEDURE:

4.1 TARGET STRENGTH FOR MIX DESIGN

In order that not more than the required proportion of test results are seemingly to fall below the characteristic strength, the concrete mix has got to be designed for a somewhat higher than the target average compressive strength (σck). The margin over the characteristic strength depends upon the standard management (expressed by the quality deviation) and also the accepted proportion of results of strength tests below the characteristic strength (σck) is 26.6 N/mm^2.

4.2 SELECTION OF WATER-CEMENT RATIO

Since completely different cements and aggregates of various most size, grading, surface texture, form and alternative characteristics might produce concretes of various compressive strength for constant free water cement ratio, the relation between strength and free water-cement ratio should probably established for the materials actually to be used. The calculated water cement magnitude relation is 0.50.

4.3 SELECTION OF WATER CONTENT

For the required workability, the amount of mixing water per unit volume of concrete and the ratio of the fine aggregate to total aggregate by absolute volume are calculated. The calculable water content is 197.16 kg/m^3.

4.4 CALCULATION OF CEMENT CONTENT

The cement content per unit volume of concrete could be calculated from the free water-cement ratio and also the amount of water per unit volume of concrete. The calculated cement content is more than the minimum cement content for gentle exposure condition thus the calculated cement content is appropriate for the mix proportion.

4.5PROPORTION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT

Volume of aggregate corresponding to 20mm size aggregate and fine aggregate (zone 1) for water –cement ratio of corrected proportion of volume of coarse aggregate for the water cement ratio is calculated. The calculable coarse and fine aggregate values are 0.54 and 0.46 respectively.

4.6 MIX PROPORTION

The mix proportion as calculated in trial mix. With this proportion, concrete is prepared and tested for fresh concrete properties demand i.e. workability, bleeding and finishing qualities.

5. EXPERIMENTAL WORK

In the present experimental investigation sugarcane bagasse ash has been used as partial replacement of cement in concrete mixes. On replacing cement with different weight percentage of SCBA the compressive strength is studied at different ages of concrete cured in different types of water such as well water, tap water and bore water. After completion of mix Design for conventional concrete and test to be conducted for material used in preparation of concrete cubes, 150 mm x 150 mm x 150 mm size concrete cubes are casted. Total of 36 cubes had been casted for M20 grade in which 9 cubes are casted with cement, sand and aggregate i.e 0% of bagasse ash. 9 cubes are casted with cement, sand, aggregate and sugarcane bagasse ash, whereas this 5% of cement is replaced with sugar cane bagasse ash i.e 5%. 9 cubes are casted with 15% cement replaced with sugar cane bagasse ash, sand, aggregate and remaining cement ie 15%. 9 cubes are casted with 25% cement replaced with sugar cane bagasse ash, sand , aggregate and remaining cement i.e 25%. This replacement of cement with sugar cane bagasse ash is continued for 5%, 15%, 25%, each 9 cubes are casted, mixing sand and aggregate. After mixing the proportions in the mixing machine, it is taken out into the bucket. The concrete is placed in to the moulds, which are already oiled simply by means of hands only without using any compacting devises. After 24 hours the specimens are removed from the moulds and immediately then cured in bore water, tap water , well water and kept there until taken out just prior to testing. The tests for compressive strength were conducted using a 1000kN compression testing machine.

6. RESULTS

The influence of SCBA content on the workability of mixtures at constant water to binder ratio of 0.50. The results show that, SCBA mixtures had high slump values of 72mm and acceptable workability. This may be due to the increasing in the surface area of sugarcane ash after adding SCBA. The quantity of cement and ash used are listed in Table 1. The strength test results obtained for concrete cube specimens with partial replacement of SCBA shown in Table 2. From the table, it is clear that the addition of SCBA in plain concrete increases its strength under compression up to 25% of replacement bagasse ash. Comparison of the results from the 7, 14 and 28 days samples shows that the compressive strength increases with SCBA up to 25% replacement which is still higher than those of the plain cement concrete. From the results taken, it is seen that, the compressive strength at 28th day is higher for 5% of cement replacement with SCBA.

Table - 1: Quantity of cement and SCBA

% of SCBA	Quantity of cement in Kg	Quantity of SCBA for 1 cube in Kg
0	1.33	0
5	1.26	0.066
15	1.12	0.19
25	0.99	0.33

Table - 2: Average strength result of SCBA in concrete

% of SCBA	7th day	14th day	28th day
0	15.16	21.0	22.99
5	17.61	22.89	25.79
15	11.42	17.22	18.94
25	10.10	13.99	15.37

The average compressive strength of conventional concrete, 0%, 5%, 15% and 25% of adding SCBA to concrete after curing in three different types of water is shown in below charts. From the charts given below, it is clearly seen that, the compressive strength of the cubes cured in bore water contribute higher strength than the cubes cured in well water and municipality water.

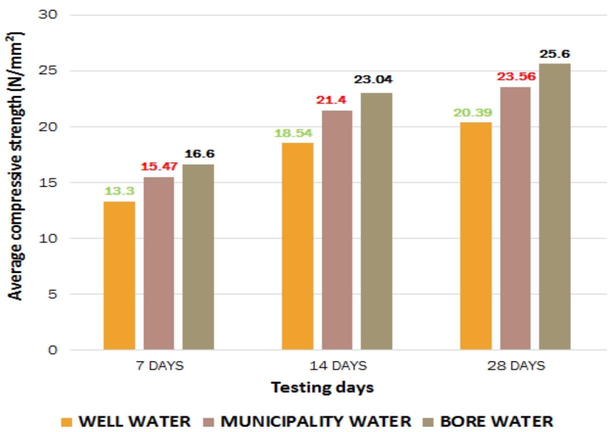

Chart -1: Compressive strength for conventional concrete

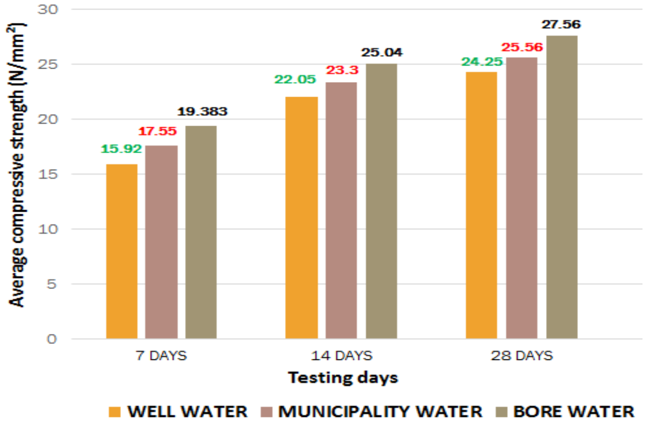

Chart -2: Compressive strength for 5% of cement replacement

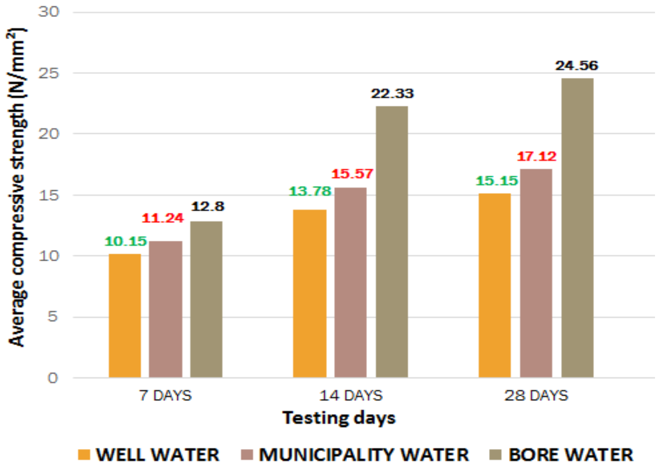

Chart -3: Compressive strength for 15% of cement replacement

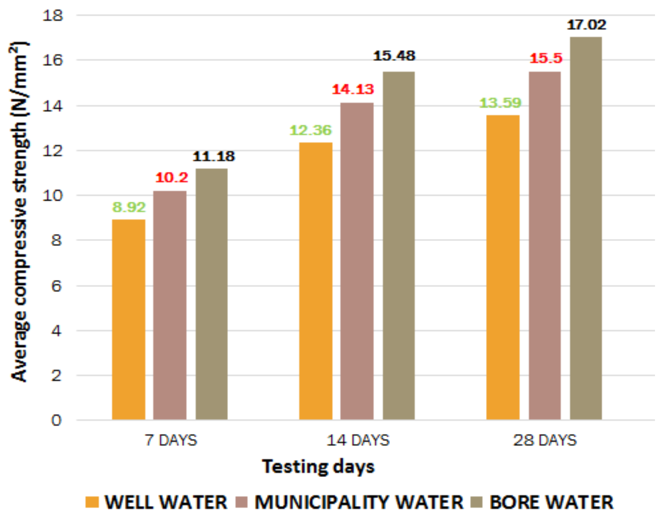

Chart -4: Compressive strength for 25% of cement replacement

7. CONCLUSION

This research was successfully carried out, to the establishment of SCBA as an alternative cement replacement material in concrete. SCBA in concrete gives the higher compressive strength as compared to the normal strength concrete, hence optimal results were found at the 15% replacement of cement with SCBA. The usage of SCBA in concrete is not only a waste-minimizing technique, also it saves the amount of cement. Partial replacement of cement with SCBA increases the workability of fresh concrete; therefore, use of super-plasticizer is not essential.

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