Experimental Investigation on Partial Replacement of Fine Aggregates by Sugarcane Bagasse ash and M-Sand in Concrete

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Abstract— Nowadays the 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. Sugar-cane bagasse is one such fibrous waste-product of the sugar refining industry, along with ethanol vapour. And Shortage of good quality natural sand due to depletion of resources and limitation due to environmental considerations has made concrete manufacturers to look for suitable alternative fine aggregate. One such alternative is "manufactured sand". Workability strength and durability of concrete with manufactured sand as replacement to natural sand in proportions of 10% constant, and the replacement of bagasse ash by 10%, 20%, 30% and 40% is studied. The experiment were conducted on M20 grade of concrete with the ratio of 1:1.5:3 of Cement, fine aggregates, coarse aggregates. Fresh concrete test like slump test and hardened concrete test like compressive strength and tensile strength test are conducted. The test results shows that the replacement of bagasse ash up to 30% with constant 10% replacement of M Sand can be considered.

Keywords: Bagasse Ash, M-Sand in Concrete

I. INTRODUCTION

Sugarcane is one of the major crops grown in over 110 countries and its total production is over 1500 million tons. In India only, sugarcane production is over 300 million tons/year that cause about 10 million tons of sugarcane bagasse ash as an un-utilized and waste material After the extraction of all economical sugar from sugarcane, about 40-45% fibrous residue is obtained, which is reused in the same industry as fuel in boilers for heat generation leaving behind 8 -10 % ash as waste, known as sugarcane bagasse ash (SCBA) The SCBA contains high amounts of unburnt matter, silicon, aluminum and calcium oxides.

The present study was carried to study the use of SCBA as a partial replacement of fine aggregate in cement concrete since the availability of natural sand is on the cry off in the last decades as a result of ecological and environmental limitations.

The experimental study examines the workability properties of fresh concrete such as slump and compaction factor and also 7 and 28 days compressive strength, 28 days tensile strength and sorptivity coefficients with 10%, 20%, 30% and 40% replacement of fine aggregate with bagasse ash by volume. Increasing demand and consumption of cement investigators, researchers and scientist made in examination of alternate binders that are biodegradable and contribute towards waste management. The construction industry is the foremost consumer of natural resources which led to exhaustion of good quality natural sand (fine aggregate).

A. Prashant O Modani et al (2012):

The review presented the fraction of fine aggregates i.e. 10% to 20% can be effectively replaced with a bagasse ash (untreated) without a considerable loss of workability and strength properties. The compressive strength results represent that, the strength of the mixes with 10% and 20% bagasse ash increases at later days (28 days) as compared to7 days that may be due to pozzolanic properties of bagasse ash. The Sorptivity test result shows that the sorptivity coefficient increases with increase in percentage of bagasse ash which indicate more permeable concrete that is due to porous nature of SCBA and the impurities in it. In its purest form the bagasse ash can prove to be a potential ingredient of concrete since it can be an effective replacement to cement and fine aggregate.

B. S.Dharanidharan et al (2015):

From the experiments and investigation in this research work it was observed that Due to non-availability of natural sand at sensible cost as fine aggregate and cement in concrete for various motives, search for alternate material like SCBA which succeeds itself as suitable standby for sand and cement at low-cost. SCBA have its place to zone IV as per IS code. Water constraint increased as the percentage of SCBA increased. Compressive strength of 26.4 N/mm2, split tensile strength 1.8 N/mm2 and flexural strength of 3.6 N/mm2 at 28 days is achieved for M25. Therefore, concluded that bagasse ash can increase the complete strength of the concrete when used up to a 10% cement and 30% fine aggregate replacement level with w/c ratio of 0.46.

C. Jayminkumar A. Patel (2015):

The experimental result shows that the increase in the strength of concrete with use of sugar cane bagasse ash. Therefore, with the use of sugar cane bagasse ash in partially replacement of cement in concrete, we can increase the strength of concrete with reducing the consumption of cement. Also it is best use of sugar cane bagasse ash instead of land filling and make environment clean.

D. Carlos Humberto Martins (2016):

The employment of sugarcane bagasse ash for the production of mortars seems to be an interesting waste utilization, resulting in a reduction in the need for disposal areas for the ash, reducing the utilization of sand and the environmental impact caused by your extraction. The partial sand replacement with SCBA caused a decrease in the mortar workability, however it was corrected by the utilization of super plasticizer. The SCBA use showed advantages such as

the increase of water retentivity and the bulk density; the latter improvement caused an increase of the strengths as well. It was observed as a disadvantage, the slightly raise of the mortars permeability due to a higher porosity caused by the waste presence. The utilization of super plasticizer caused a reduction in the strength results; however its presence improved the workability and reduced the permeability and the Young's modulus.

E. Sudha et al (2016):

From the experimental study of M60 grade concrete on river sand and M sand with and without addition of bagasse ash the followings were observed. The compressive strength of concrete at 28 days with M Sand shows higher the strength than the M sand. The bagasse addition up to 20% in concrete with M sand and R sand gives the more strength; further addition of bagasse ash shows the decrease in trend in the strength of the concrete. The developments of split tensile strength were 6.41 N/mm2 and 6.99 N/mm2 at 28 days from the values of 5.64 N/mm2 and 5.69 N/mm2 at seven days strength in R sand and M sand concrete mixes. A Similar trend was observed in flexural strength, and it confirms that the optimal quantity of SCBA content was attaining at 20% replacement of cement in concrete. SCBA utilization as the partial replacement of cement for M60 grade concrete provides a satisfactory solution to environmental concerns and problems associated with the construction industry. Use of M sand in the M60 grade concrete shows the good results with and without the addition of bagasse ash.

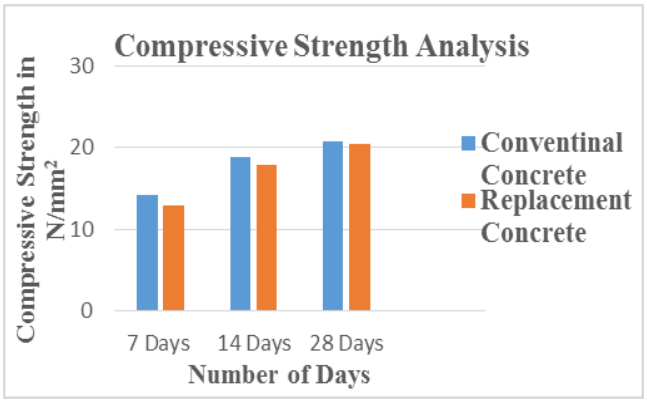
F. Halesh Kumar B T et al (2017):

From the present investigation, the following conclusions were drawn. Manufactured sand is a best alternative for natural river sand in terms of strength and durability. Replacement of 15% Natural River sand by manufactured sand yielded good compressive strength for M20grade concrete. Replacement of 15% Natural River sand by manufactured sand yielded good split tensile strength for M20 grade concrete. Replacing natural sand by manufactured sand induces higher strength in concrete than the conventional concrete. Better control over gradation and free from impurities. Shape of the aggregates may be maintained and desired zone can be achieved. Hardness and strength better than natural river sand.

G. Amar R D et al (2017):

The compressive strength is increased at 0%, 5% & 10% of strength value as 51.78, 43.78 & 38 kN/mm2 respectively. Compared to conventional concrete of strength as 37.47 kN/mm2 of 28 days normal curing. As percentage of SCBA increased strength got increased up to 10% as compared to conventional concrete and maximum value was observed for 0% SCBA with 100% M-sand. The split tensile strength is increased at 0%, 5%, 10% & 15% of strength as 3.14, 2.48, 2.86 & 3.1kN/mm2 respectively. Compared to conventional concrete of strength as 2.35 kN/mm2 of 28 days normal curing. As percentage of SCBA increased strength got increased up to 15% as compared to conventional concrete and maximum value was observed for 15% SCBA with 100% M-sand. The flexural strength is decreased with increase in SCBA as Compared to conventional concrete of strength of 28 days normal curing. Slump value is decreased with increase in SCBA as compared to conventional concrete. Specific gravity, Fineness modulus, water absorption of M-SAND shows good results with comparison to river sand. SCBA can be used up to 10% replacement for cement with 100% M-Sand for structural purpose.

II. RESULTS AND DISCUSSIONS



Difference between Conventional Concrete with Partially Replacement of Fine Aggregates by 30% bagasse ash and 10% M Sand.

A. Observation:

From the above charts it shows the difference between conventional concrete with partial replacement of fine aggregates by bagasse ash at 7, 14 and 28 days respectively. There is increase in compression up to 20% and then decreases at 30% and 40%. Compressive strength constantly increases as the curing period goes on increasing. Adding of increasing quantities of SCBA generally decreased the strength at a given age due to the greater porosity of the material as specified by higher water necessity.

Difference between Conventional Concrete with Partially Replacement of Fine Aggregates by 30% bagasse ash and 10% M Sand.

B. Observation:

From the above graphs, we observed that split tensile strength of cylinder decreases as the percentage replacement of SCBA reaches 40% due to dilution effect. But with 10 % of replacement of fine aggregates and 30% of the fine aggregate by SCBA gives greater strength compared to normal mix

III. CONCLUSION

On basis of experimental investigations carried out following conclusions are drawn:

1) Fine aggregates can be effectively replaced with bagasse ash and M Sand up to 30% without a considerable loss of strength.
2) Workability of the concrete decreases with the Replacement of bagasse ash and M Sand consistently with increase of replacement of materials.
3) Minimum compressive strength can be achieved up to 30% Replacement of bagasse ash and 10% of M Sand.
4) There is a considerable increase of split tensile strength up to 30% Replacement of bagasse ash and 10% of M Sand.

5) Experimental investigations shows consumption of fine aggregates can be reduced effectively by using alternative material like bagasse ash and M Sand.

IV. FUTURE SCOPE

1) Further work can be carried out by varying M Sand Replacement with fine aggregates.
2) Admixtures like super plasticizers can be used to improve workability and strength with varying materials Replacement.

REFERENCES

[1] Prashant O Modani, M R Vyawahare (2012): "Utilization of Bagasse Ash as a Partial Replacement of Fine Aggregate in Concrete".
[2] S.Dharanidharan, L.Rajkumar, B.Karthick (March,2015): "An experimental study on mechanical properties of concrete by using sugarcane bagasse ash"
[3] Jayminkumar A. Patel, Dr. D. B. Raijiwala (April 2015): "Experimental Study on Use of Sugar Cane Bagasse Ash in Concrete by Partially Replacement with Cement" International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 4, April 2015.
[4] Carlos Humberto Martins, Tainara Rigotti de Castro, Camila Colhado Gallo (2016) : "Characterization of Mixed Mortars with Partial Replacement of Sand with Sugarcane Bagasse Ash (SCBA)"
[5] C. Sudha, Ajesh K. Kottuppillil, P. T. Ravichandran and K. Divya Krishnan (September 2016): "Study on Mechanical Properties of Concrete with Manufactured Sand and Bagasse Ash" Indian Journal of Science and Technology, Vol 9(34), September 2016.
[6] Halesh Kumar B T (2017): "Replacement of Fine Aggregate by M-Sand" IJSTE - International Journal of Science Technology & Engineering Volume 3, Issue 12, June 2017.
[7] Amar R D, Shivakumar Gumte, Siddarooda, Tousif Ladaf, Nijroop (2017) : "Study on Concrete by replacing cement by SCBA using 100% M-Sand as fine aggregate" International Research Journal of Engineering and Technology (IRJET) Volume 4 Issue 6, June -2017.
[8] IS 383 (1970): Specification for Coarse and Fine Aggregates From Natural Sources For Concrete [CED 2: Cement and Concrete]
[9] IS 4031-6 (1988): Methods of physical tests for hydraulic cement, Part 6: Determination of compressive strength of hydraulic cement (other than masonry cement) [CED 2: Cement and Concrete]

