International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8, Issue-1, May 2019

Potential Use of Biochar as Construction Material

G.Swamy yadav, E.Vamshi Krishna, S.Yeshwanth Kumar, G.Hari Prasad, R.Pavan kalyan

Abstract: ***Manageability and Eco-Accommodating Construction Practices is the Key to the Next Generation for having a more noteworthy and better work as for Engineering Perspectives. Numerous sorts of research have been done before and are being done in the present on building materials broadly utilized for Constructions. With the end goal to shield the future and ration the characteristic assets, numerous investigations have been directed by utilizing waste material in development research. A large amount of waste from septic treatment plants was observed. It contains finer particles going from 10 microns to 150 microns estimate. With the end goal to take care of the transfer issues of waste and protection of common assets, for example, Cement is considered as a powerful substitute. As it is the binding material in the mix, which assume an imperative job in hydration response and produces a bond between two contiguous particles, and economize the cost of material in the concrete the Biochar from septic treatment plant is taken as a substitute for cement.***

The purpose of this study is to find an alternate source for cement. In M30 mix, Portland Pozzolana Cement was used and is partially replaced using Biochar with different percentage such as 5, 10, 15 and 20. The Mechanical Properties were taken for 7 and 28 days, and observed that 5% replacement of cement with Biochar shows optimum value for all mechanical properties, Here Cement was already 30% replaced with Flyash as it is PPC, So Adding the advantage of 5% with Biochar economizing the work.

Index Terms: Biochar, Sludge Ash, septic treatment plant, PPC, Compressive strength, Flexural Strength, Split tensile strength.

I. INTRODUCTION

From last few years population growth increasing rapidly, overpopulation is caused by reduced morality rate, progress of food production, migration and urban concentration. Due to the overpopulation countries around the world are phasing many problems like shortage of natural resources, environmental issue, rising unemployment rising living cost, from these problems authors worked on shortage of natural resources, environmental issue and urbanization to reduce these impact on earth. Natural resources are nonrenewable resources which cannot be reproduced or regenerated. Construction industry is one of the industry which is using maximum amount of natural resources for their construction activities. Natural resources like lime stone, iron, steel, wood, sand, granite as aggregate etc. sustainability of natural resources can be maintained or keep in existence by replacing of natural resources with renewable resources or manmade resources like fly ash, M sand, Risk husk, ash recycled aggregates, and with some waste materials.(Sankh, Biradar, Naghathan, & Ishwargol, 2014).[1]

In this study authors worked on replacement of cement with SSA (sewage sludge ash). Sewage sludge is a byproduct of domestic sewage sludge treatment plant. Due to the urbanization and population growth, amount of SSA (sewage sludge ash) is also increased and also it will increase in future. Before the installation of domestic sewage sludge treatment plant in urban areas, public use to dispose sewage sludge in open areas, lakes, and directly in damping areas. sewage sludge contains pathogens, micro pollutants, heavy metals (arsenic, cadmium, copper, barium, lead, chromium) .these are potentially thousands other components of sludge that remain untested/un treated disposal of sewage sludge in environment, which have been proven to be hazardous to both human and ecological health.

Alternative solution for sewage sludge disposal is incineration which makes sewage sludge to SSA (sewage sludge ash). In this process main components are sewage sludge in presence of high temperature (500 to 700 degree Celsius) such as SiO_2, CaO, Al_2O_3. These are the components of OPC (Ordinary Portland cement). So, it can be used in place of cement content in concrete without any objection. With current population and urbanization, it is clear that demand of cement will increase in future.(Ing, Chin, Guan, & Suil, 2016).[2]

By this research not only maintain sustainability and to minimize the use of natural resources in construction activities. But also to reduce carbon dioxide emission from cement plant (900kg of CO_2 is emitted to atmosphere for production of 1000kg of cement). This research is conducted to nonstructural use like flooring, plastering, filler material etc, future research may conducted on structural elements like beams, slabs, columns etc.

Revised Manuscript Received on 22 May 2019.

***** Correspondence Author

G.Swamy yadav*, Assistant Professor, Member in Centre for Construction Methods and Materials, Department of Civil Engineering, S R Engineering College, Warangal, India.

E.Vamshi Krishna, UG Student, Department of Civil Engineering, S R Engineering College, Warangal, India.

S.Yeshwanth Kumar, UG Student, Department of Civil Engineering, S R Engineering College, Warangal, India.

G.Hari Prasad, UG Student, Department of Civil Engineering, S R Engineering College, Warangal, India.

R.Pavan kalyan, UG Student, Department of Civil Engineering, S R Engineering College, Warangal, India.

II. MATERIALS

Table 1: Properties of Cement.

S.No	Properties Of Cement used	
1	Cement	PPC
2	Grade	43
3	Specific Gravity	3.17
4	Fineness Of Cement	7%
5	Consistency	31.3%

Table 2: Properties of Fine Aggregates.

S.No	Properties Of Fine Aggregates Used	
1	Sand Availability	Zone -II
2	Fineness Modulus	2.51
3	Specific Gravity	2.80

Table 3: Properties of Coarse Aggregate.

S.No	Properties Of Coarse Aggregates Used	
1	Type	Granite
2	Maximum Size	20mm
3	Specific Gravity	2.67
4	Water Absorption	0.25%

Table 4: Properties of Biochar.

10gm sample +25ml water	T °C	PH	EC	TDS (PPT)
BRICK-1	22.5	6.40	0.83	0.63
BRICK-2	21.4	11.08	1.65	0.98
ASH[BIOCHAR]	21.9	10.27	4.66	2.66
SLUDGE	21.5	7.19	1.01	1.14
5%ASH[BIOCHAR]	21.7	11.60	6.29	3.62
10%ASH[BIOCHAR]	22.1	11.70	6.60	3.86
BRICK-1+ASH	21.8	10.07	3.18	1.94
BRICK-2+ASH	21.7	9.68	4.36	2.70

Water:

Drinking water available near to the field was used in the present work both for casting and curing.

Super plastisizer:

Complast SP 430 FOSROC is used for the experimental study.

III. METHODOLOGY

Material(Biochar or Sludge ash) collected from sewage treatment plant located in city of Warangal. The tests were conducted and are shown in *Table* 4. All Material properties of Cement, Fine Aggregate, Coarse Aggregate are tested and are shown in *Table* 1,2,3. The Mix design followed according to IS 10262-2009 for M30 Concrete. The experimental investigation is carried out by replacing cement with Biochar by varying percentages of 5% ,10%,15%,20% the results were observed. The required material is weighed and mixed manually and the specimens were casted. The cube of 150 mm x 150 mm x 150 mm. Cylinder of 150mm diameter 300mm height. Beam of size 100 mm x 100 mm x 500 mm.

The specimens has been de moulded after 24 hours and cured at room temperature in water bath. The tests were conducted for all the specimens for 7-Days and 28-Days. The results drawn and are shown in the tables 5,6,7. Results are Compared with conventional concrete of M30 Mix and conclusions drawn.

IV. RESULTS

Table 5: Compressive Strength of Concrete.

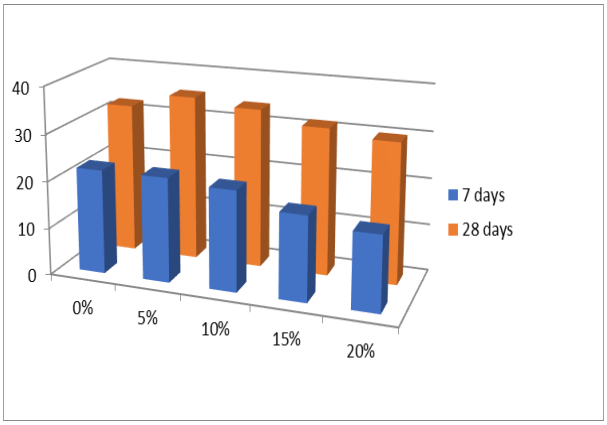
Replaced % of Biochar	7 Day strength	28 Day strength
0 %	22.22	32.22
5 %	22.22	35.33
10 %	21.33	34.00
15 %	18.00	31.43
20 %	16.00	29.97

Table 6: Tensile Strength of Concrete.

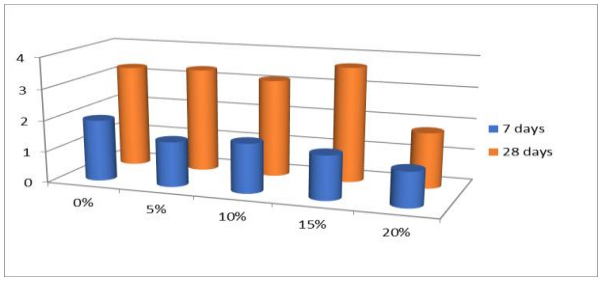
Replaced % of Biochar	7 Days strength	28 Days strength
0 %	1.96	3.28
5 %	1.44	3.33
10 %	1.58	3.12
15 %	1.41	3.67
20 %	1.12	1.77

Table 7: Flexural Strength of Concrete.

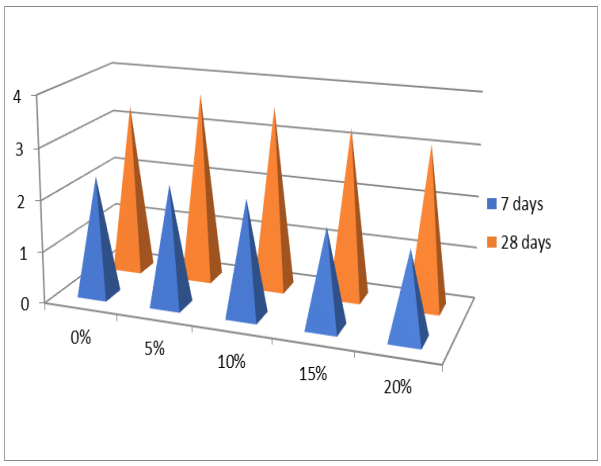
Replaced % of Biochar	7 Days strength	28 Days strength
0 %	2.33	3.33
5 %	2.33	3.70
10 %	2.24	3.57
15 %	1.89	3.30
20 %	1.68	3.14



Graph represents Compressive Strength of Concrete.



Graph represents Tensile Strength of Concrete.



Graph represents Flexural Strength of Concrete.

CONCLUSIONS

- By the replacement of cement with Biochar all the Mechanical Properties of Hardened Concrete were observed maximum at 5%.
- Using Biochar the cost of Concrete was reduced.
- Reduced Cement content makes the concrete eco-friendly.
- Above 15% Replacement, The Biochar in the Concrete Mix absorbing more water.

REFERENCES

1. Ing, D. S., Chin, S. C., Guan, T. K., & Suil, A. (2016). The use of sewage sludge ash (SSA) as partial replacement of cement in concrete. *ARPN Journal of Engineering and Applied Sciences*, *11*(6), 3771–3775.
2. Jiang, D. L., Ni, G. W., & Ma, G. Y. (2010). Reuse of Municipal Wastewater Sludge for Construction Material. *Advanced Materials Research*, *156–157*, 939–942. https://doi.org/10.4028/www.scientific.net/amr.156-157.939.
3. Sankh, A. C., Biradar, P. M., Naghathan, S. J., & Ishwargol, M. B. (2014). Recent Trends in Replacement of Natural Sand With Different Alternatives. *IOSR Journal of Mechanical and Civil Engineering*, *2014*, 59–66. Retrieved from www.iosrjournals.org.
4. MD Ikramullah Khan, M . Sravanthi, E. Laxmi Prasanna (2018). An Experimental Studyof The Mechanical Properties of S Glass Fiber Reinforced High Strength Concrete Partially Replacing Cement with Nano Silica. International Journal of Civil Engineering and Technology (IJCIET), 9(4), 1398-1409.
5. Ravi Kumar T, A.Siva Krishna (2017). Design and Testing of Fly-Ash Based Geo Polymer Concrete. International Journal of Civil Engineering & Technology (IJCIET), 8(5), 480–491.
6. Praveen. G. V (2012). Laboratory Study of Interaction Behaviour of Reinforcing Strips Embedded in Cement Modified Marginal Backfill. Proceedings of 'National Conference on Recent Advances in Geosciences, Engineering & Technology' Organized by JNTU, Kakinada , India.
7. Shankar. S (2013). Effect of Calcite Induction on the Compressive Strength of Concrete. Proceedings of 'National conference on Role of Civil and Mechanical Engineer in Development of Society' Organized by NIT, Warangal , India.
8. G.V.Praveen (2016). Shear Strength Behavior of Geotextile Reinforced Marginal Soil Without and With Cement Modification. Journal of the Institution of Engineers (India) – Submitted and Under review
9. Baeza, F., Payá, J., Galao, O., Saval, J. M. and Garcés, P. (2014). Blending of Industrial Waste from Different Sources as Partial Substitution of Portland cement in Pastes and Mortars. Journal of Construction and Building Materials, 66, 645–653.
10. Siti Noorain Roslan, S. S. G. 2013. Study on the Characteristics and Utilization of Sewage Sludge at Indah Water Konsortium (IWK). International Journal of Environment, Earth Science and Engineering. 7(8), 536- 540. Tay.
11. Zhang, T., Gao, P., Gao, P., Wei, J. and Yu, Q. 2013. Effectiveness of Novel and Traditional Methods to Incorporate Industrial Wastes in Cementitious Materials - An overview. Resources, Conservation and Recycling, 74, 134-143.
12. Mustafa, M. Y., Rajnish, K. C., and Roman, E., Biogas from organic waste - A Case Study, Procedia Engineering, vol. 146, pp. 310 – 317, 2016. Peterson.
13. Liew, G. I. Abdul, Azni. Wong and H. K Calvin: Waste Management & Research, Vol.22(2004), p. 226 - 233 doi:10.1007/s10163-003-0105-7.
14. Kardos, L., Juhasz, A., Palko, G. Y., Olah, J., Barkacs, K., and Zaray, G. Y., Comparing of mesophilic and thermophilic anaerobic fermented sewage sludge based on chemical and biochemical tests, Applied Ecology and Environmental Research, vol. 9, no. 3, pp. 293-302, 2011.

AUTHORS PROFILE

G. Swamy Yadav M.E Structural Engineering working as an Assistant Professor and Member in Centre for Construction Methods and Materials in S R Engineering College, Warangal.

E. Vamshi Krishna UG Student, Department of Civil Engineering, S R Engineering College

S. Yeshwanth Kumar UG Student, Department of Civil Engineering, S R Engineering College

G. Hari Prasad UG Student, Department of Civil Engineering, S R Engineering College.

R. Pavan Kalyan UG Student, Department of Civil Engineering, S R Engineering College