Irish Interdisciplinary Journal of Science & Research (IIJSR)
Vol.5, Iss.3, Pages 26-32, July-September 2021

Performance of Concrete Using Paper Sludge Ash and M-Sand

Sathish M.[1], Rubesh Babu C.[2] & A. Sathiya Moorthy[3]

[1,2,3]*Department of Civil Engineering, Bharathidasan Engineering College, Natrampalli, Tamilnadu, India.*

Article Received: 13 April 2021 *Article Accepted: 15 July 2021* *Article Published: 03 August 2021*

ABSTRACT

Due to increase in construction activities there is increase in demand for concrete, which leads to over use of natural resource. Hints, conservation of natural resource is necessary thing. Among the waste generated it is presumed that 10% to 15% of waste hazardous and increasing at the rate of 2% to5% per year resulting in environmental pollution and effect to living beings. These wastes can be utilized as alternative construction material, so that would be one of the consistent ways of disposal. This paper attempts to study the strength parameters such as compressive and tensile strength of paper sludge ash (15% and 20%) as partial replacement of cement, M-sand (50% and 60%) of partial replacement of fine aggregate for a design mix of M25.

1. Introduction

In this rapid moving era focus on infrastructure development has been increased concrete is a prominent premier mixture in civil engineering whose manufacturing process consist of ingredients like cement, aggregates, water and admixtures [1]. Since there is an increase in demand for concrete it is expected to see the scarcity of raw material available in nature such as river sand and coarse aggregate. Due to growth in industrialization large amount of waste are been generated. Hence the reuse of this waste material can be enhanced. In order to avoid these circumstances, the waste which is disposed from industries and agricultural sectors could be used as an alternative building material, so that the conservation of natural resources and disposal of harmful waste can be reduced. In the present work, Paper Sludge Ash (PSA) is used as substitute for cement and M-sand [2-4]. It is used as substituent for fine aggregate both the material used here are waste generated in industries if such material are found suitable in concrete making both reduction in cost of construction material as well as safe disposal of waste material can be achieved.

1.1. Paper Sludgeash

a) Paper sludge ash is a waste material formed during paper manufacturing process by wooden pulp in a paper mill along with certain ingredients. It imposes a major economic and environmental crisis in paper and board industry.

b) The recycling and disposal are the main routes for paper sludge which are put on land-spreading as agricultural fertilizer incineration combined heat power (CHP) plants in paper mill, producing paper sludge ash, or disposal to landfill.

c) The landfill spreading process is limited and lies within the industry code of practice. Paper sludge is comprises of cellulose fibres, fillers such as calcium carbonate and china clay and residual chemicals mixed up with water.

d) The moisture content is usually up to 40%. It has an energy content that makes it as a useful substitute as alternative fuel for the manufacture of Portland cement.

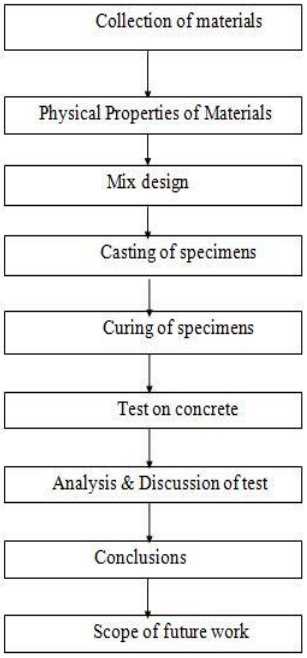


Fig.1. Methodology of Study

2. Design of Concrete mix

- Mix design methods applying to normal weight concrete are generally difficult to use with light weight concrete. The lack of accurate value of absorption, specific gravity and the free moisture content in the aggregate makes it difficult to apply the water cement ratio accurately for mix proportioning [5-7].
- Concrete mix design is usually established by trial mixes. The proportionate of fine to coarse aggregates and the cement and water requirement are estimated based on the previous experience with particular aggregates.
- Various degree of water absorption by different M- SAND aggregates is one of the serious difficulties in the design of mix proportions. Reliable information of saturated, surface dry bulk specific gravity becomes difficult.
- Sometimes the aggregate is saturated before mixing. So, it does not absorb the water used for mixing. The quality of concrete does not get altered on account of absorption by aggregate. It has been that the strength of the resulting concrete is about 5 % to 10 % lower than when dry aggregate is used for the same content and workability [8]. This is due to the fact that in the latter case some of the mixing water id adsorbed prior to setting. This water having contributed to the workability at the time of placing gets absorbed later, thus reduces the bad effect of excess of water.

3. Testing on Hardened Concrete

3.1. Density of WPSA and M-Sand Using concrete

One of the disadvantage of conventional is its high self-weight. Density of normal concrete is 2200 to 2600kg/m^3. The heavy self- weight makes it to some extent uneconomical in structural material. Attempt has

been made to reduce the self- weight and to increase the efficiency of concrete as a structural material. The density of light weight concrete varies from300-1850kg/m^3.

There are many advantages of low density:

- Reduction of dead load.
- Speeds up the progress of the building.
- Lowers haulage and handling costs.

The weight of a building on the foundation is an important factor in design, particularly in case of week soil and tall structures. In framed structures, the beam and columns have carry load from floors and walls. If the floors and walls are made up light – weight concrete, it will result in considerable economy in structural materials. Another most important characteristic of light- weight concrete is the relatively low thermal conductivity a property which improves with decreasing density. In extreme climatic conditions and also in case of buildings where air – conditions be installed , the use of light-weight concrete with low thermal conductivity will be of considerable advantage from the point view of thermal comforts and waste such as clinker , fly ash, slag etc.. Which otherwise create problem for disposal.

3.2. Procedure

- Firstly the casted cube is taken out and dried at the sunlight for 24 hours.
- The cube is wiped off using the dry cloth to remove the surface moisture.
- Firstly the conventional cube is measured using a meter scale to calculate its volume.
- Firstly the conventional cube is measured using a meter scale to calculate its volume.
- Then weight the cubes of different grades of 15%-50%, 20%-60% of WPSA – M-Sand weight it by using the weigh balance.
- Then calculate density of conventional am than compare it with that of the coconut shell concrete.

Table 1. Failure Loads of Various Concrete Specimens

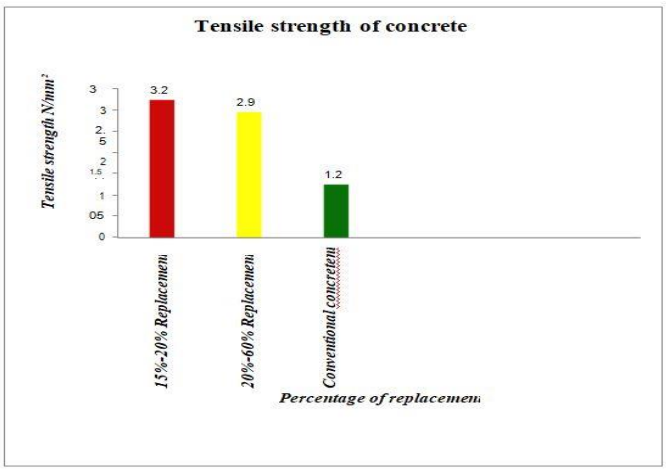
S. no.	Type of concrete	Failure load (KN)
1	Conventional concrete	230
2	15%-50%Replacement	210
3	20%-60% Replacement	160

3.3. Calculation of split tensile value

Split tensile value = [2 x failure load]/ (л x diameter of cylinder x length of Cylinder)

= [2 x 230 x 1000]/ [3.14 x150 x 300]

= 3.23N/mm^2

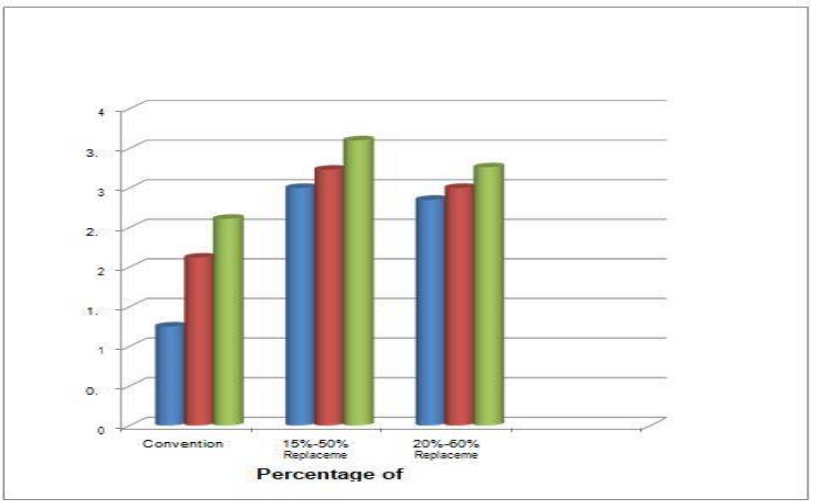


Graph 1. Density of Conventional Concrete and Non-Conventional Concrete

Table 2. Split Tensile Test Result of Non-Conventional Concrete

(WPSA – M-Sand (28 Days)

TYPE OF CONCRETE	LOADS	FAILER LOADS
Conventional	420	2.85
15%-50% Replacement	530	3.26
20%-60% Replacement	490	3



Graph 2. Split Tensile Test Result of conventional and Non-Conventional Concrete (15%-50%) & (20%-60%) WPSA-M-Sand (7, 14, 28 Days)

3.4. Points to be considered for Cost Analysis

- Cost analysis for hand mixing only.

- Assuming a lead particular of 10 km including braking, transporting, storage, collection. Quantities of materials all confirm to the schedule of rates published by P.W.D department during the 2012-2013. Market rates apply to all materials.
- Market wages apply to all different classes of labor specified by standard data book.

Table 3. Lead Statement for 10kg

Material	Unit(kg)	Rate(Rs)	Lead in (km)	Rate for lead per km(Rs)	Handling and braking charges(Rs)	Cost atsite (Rs)
M-Sand	10kg	10	10	2	4	34

. 34 for 10km and 10kg

=34/10 =3.4Rs/kg

Assuming 5% extra for wastage and other miscellaneous charge=3.4+0.17

=3.57≈3.6Rs per kg/10km

4. Results and Discussions

If we use 15% of WPSA and 50% of M-Sand we can attain the required strength. If we go beyond this mix proportion the required strength cannot be achieved.

Table 4. Final Results for Non-Conventional Concrete

TYPE OF CONCRETE	COMPRESSIVE STRENGTH (28^{TH} DAY STRENGTH) (N/mm^2)	SPLIT TENSILE STRENGTH ($N/mm^{2)}$	COST OF CONCRETE/M^3 (RS.)
Conventional	30.2	3.780	4313
15% & 50% Replacement	26.1	2.95	3999.4
20% & 60% Replacement	23.2	2.28	3459.4

5. Future Scope

- To reduce the environmental pollution by the using paper. In the world 70% of waste paper is produced.
- To reduce the volume of the Cement with using WPSA. When using in concrete mix

- To reduce cost of cement when using a Paper Sludge Ash.
- The replacement of paper sludge Ash with cement in15%-30%
- It is waste material produced by a quarry.
- It is low cost material used in concrete.
- The river sand is taken to use construction work so the ground water level is reduces that we use with M-sand are (50% & 60%) mix with river sand.
- This process are mainly to avoid reduce the ground water level.
- Many places are pollute by papers so the papers are collect and burnt to take paper sludge ash are (15% & 20%) to mix with cement .This process are mainly conduct reduce environmental pollution

6. Conclusion

As per results obtained based on the characteristics of materials say, Workability of concrete, Compressive Strength Test, Spilt Tensile Strength Test and Flexural Strength Test on M25 grade of concrete, made of different mixes with 15%and 20% replacement level of WPSA and 50%and 60% replacement level of M-Sand, considered for the study the following conclusions are been listed. Base on the compressive strength of a specimen with different replacement level these conclusions were found:

- ✓ For the grade of concrete considered for the study, FS2. M-Sand, Conventional Sand as proved to be having optimum ratio with gives maximum compressive strength of ratio.
- ✓ Similarly for the same grade of concrete WPSA, the ratio of 95:5 of cement, PSA has proved to have an optimum ratio which gives maximum compressive strength.
- ✓ Specimen of conventional concrete bearing the designation CC resulted in highest compressive strength at 7days, 14 days and 28 days of curing period, of all the mixes considered foe the study.
- ✓ Due to the continuous mining of the river beds for sand as lead to a huge demand of it. The scope of project lies within the optimum usage of a suitable replacement which is River Sand with M-Sand in Concrete Mix.
- ✓ Reduced the demand of cement.
- ✓ To use of paper sludge ash as a partial replacement of cement.

Declarations

Source of Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing Interests Statement

The authors declare no competing financial, professional and personal interests.

Ethical Approval

Not Applicable.

Consent for publication

Authors declare that they consented for the publication of this research work.

Availability of data and material

Authors are willing to share data and material according to the relevant needs.

References

1. Gunasekaran K and Kumar P.S "Light weight concrete mix design using coconut shell and EPS aggregate", Proceedings of the building materials, structural designs and construction practices, pp. 375-382.

2. O.T Olateju, (1992) "The efficacy of light weight aggregate from palm kernel shells", Journal of Housing Science 15(4), pp. 263-276.

3. R. Murugesan (2007) "Structural Engineers Handbook", IS 456-2000 Recom. for various Indian standards.

4. Arulmanickam, "Specification of materials, cost analysis and data preparation for various building works".

5. Jackson, N. (1996). "Civil Engineering Material", 5th Ed., Macmillan, London.

6. Neville, A.M. (1996)." Properties of cement" 4th Ed., Longman, London.

7. Mannan M.A., Ganapathy C., (2001) "Long–term strengths if concrete with oil palm shell as coarse aggregate", Cem. Con. Res., 31: 1319-1321.

8. Teo DCL, Mannan MA, Kurian VJ, Zakaria I (2006) "Flexural Behavior of Reinforced Light weight OPS Concrete Beams", 9th Int. Conference on Concrete Engineering and Technology, Malaysia, pp.244- 252.