



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 8, August 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.524



9940 572 462



6381 907 438



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Effective Management and Sustainable usage of Prosopisjuliflora Tree in Concrete to Eradicate Permanently

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ABSTRACT: Prosopisjuliflora is a type of tree which absorbs ground water and atmospheric moisture heavily. In order to save the environment and to save the natural resources. Hence the Juliflora has been mostly used in industries, power plants, incineration, etc. hence the residue generation is more. The industrial byproducts (waste) are being accumulated to a large extend leading to environmental and economic concerns related to their disposal. Cement emits vast amount of greenhouse gases, forcing researchers to look for an alternative such as sustainable building practice. This paper presents an overview of the work and done on the incorporation of Prosopisjuliflora ash as partial replacement of cement in concrete. In today's world the main emphasis is on green and sustainable development. Cement industry is one of the major contributors to pollution by releasing carbon dioxide. So by partially replacing cement with pozzolanic material such as prosopisjuliflora ash, the cement industry can serve both the purposes of meeting the demands of construction industry and at the same time providing a green and clean environment. Prosopisjuliflora ash is difficult to decompose. So using prosopisjuliflora ash is a major step towards sustainable development. Also the concrete is weak in tension, so with the addition of steel fibres its flexural and tensile strength is also enhanced. Prosopisjuliflora ash is obtained from biomass waste power plants as a waste material. Prosopisjuliflora ash is obtained from biomass waste power plants as a waste material. It is not able to produce the cementitious property required to generate strength on its own. However, when combined with water, it can react with the free lime present in cement to form hydrated products such as C2S and C3S. This combination helps in attaining strength and also improving the durability of the product. As the prosopisjuliflora ash is very fine in structure, it fills more voids and provides superior pore structure and thereby improves its strength at later stages due to reduced permeability.

KEYWORDS: Prosopisjuliflora ash, sustainable, green and clean environment, cementitious property and permeability.

I. INTRODUCTION

Prosopisjuliflora is a type of tree which absorbs ground water and atmospheric moisture heavily. Dense impenetrable thickets of invasive trees and shrubs compete with other water users and thus disrupt ecosystem functioning and services. Recently the Tamilnadu government started removing the tree with the help of PWD. Hence the Juliflora has been mostly used in industries, power plants, incineration, etc. hence the residue generation is more. The industrial byproducts (waste) are being accumulated to a large extend leading to environmental and economic concerns related to their disposal. Cement emits vast amount of greenhouse gases, forcing researchers to look for an alternative such as sustainable building practice. This paper presents an overview of the work and done on the incorporation of Prosopisjuliflora ash as partial replacement of cement in concrete. The characteristics of the ash depend upon biomass characteristics (herbaceous material, wood or bark), combustion technology (fixed bed or fluidized bed) and the location where ash is collected. As wood ash primarily consists of fine particulate matter which can easily get air borne

by winds, it is a potential hazard as it may cause respiratory health problems to the dwellers near the dump site or can cause groundwater contamination by leaching toxic elements in the water.

Due As the disposal cost of the ashes is rising and volume of ash is increasing, a sustainable ash management which integrates the ash within the natural cycles needs to be employed. Extensive research is being conducted on industrial by products and other agricultural material ash like wood ash which can be used as cement replacement in concrete. To current boom in construction industry, cement demand has escalated which is the main constituent in concrete. Also, the cement industry is one of the primary sources which release large amounts of major consumer of natural resources like aggregate and has high power and energy demand for its operation. So utilization of such byproduct and agricultural wastes ashes solves a twofold problem of their disposal as well providing a viable alternative for cement substitutes in concrete. Hence, incorporating the usage of Juliflora ash as replacement for cement in blended cement is beneficial for the environmental point of view as well as producing low cost construction entity thus leading to a sustainable relationship. Rice husk ash and fly ash, are major players which already proven to be effective mineral admixtures to cement at various percentages. Juliflora ash is also a similar waste materials produced from Juliflora burning industries which is mainly used as a fertilizer for soil. Significant quantities of Juliflora ash is currently land filled near the industries that uses Juliflora as a fuel partially or fully which poses a threat to the environment in many ways to life stock around. Chemical analysis of Juliflora ash shows that it has pozzolanic property, and using it as a partial replacement to cement may be one of the best application in the current environment scenario.

II. EXPERIMENTAL

2.1 Cement

Sri Devi Traders provided ordinary Portland cement of grade 53 in compliance with IS 12269-1987. The Indian Standard Code was used to determine the physical characteristics of cement, and the findings are reported in Table 1.

Table.1 Physical characteristics of cement

S.No.	Test	Experimental Values
1	Fineness of cement	3.0%
2	Specific Gravity	3.04
3	Acceptable consistency	28%
4	Setting time of cement in Minutes Initial Final	80 280
5	Compressive strength in MPa	
	7Days	37.20
	28 Days	53.30

2.2 Fine Aggregate

The river sand used in this study was collected in Karur, Tamil Nadu. The test results were compiled in Table 2 and the physical characteristics of river sand were determined in accordance with Indian Standard. Sand from rivers served as the fine aggregate and conformed to IS: 383-1970 Zone-II of Table 4.

Table2: Physical characteristics of fine aggregate

Sl. No.	Property	Value
1	Specific gravity	2.62
2	Fineness Modulus	2.60
3	Free Moisture	1%
4	Grading	Zone-II
5	Volumetric density in Kg/m ³	
	Loose state	1640.35 kg/m ³
	Dense state	1861.42 kg/m ³

2.3 Natural Coarse Aggregate

The coarse aggregate used in this research was purchased from Ramakrishna Crushing Unit, Erode, Tamil Nadu. Coarse aggregate had a maximum size of 20 mm. Table 3 displays the outcomes of Physical properties of Natural coarse aggregate.

Table3: Physical characteristics of Natural coarse aggregate

S.No	Property	Value
1	Specific Gravity	2.64
2	Impact value	10.5
3	Aggregate crushing value	20.19%
4	Abrasion value in %	16
5	Volumetric density in Kg/m ³	
	Loose state	1452.25 kg/m ³
	Dense state	1575.35 kg/m ³
6	Water absorption in %	0.10
7	Elongation index in %	22
8	Flakiness index in %	20

Water:

Water used for mixing and curing was potable water, which was free from any amounts of oils, acids, alkalis, sugar, salts and organic materials or other substances that may be deleterious to concrete or steel. The pH value should not be less than 6. The solids present were within the permissible limits as per clause 5.4 of IS: 456 – 2000.

2.4 Juliflora Ash (PJA):

Three different proportions of concrete mix (PJA replacement of 2.5%, 5%, 7.5%, 10%, 12.5%, 15%, 17.5% & 20% by weight of cement) including the control mixture were prepared with water to binder ratio of 0.5. The specific gravity of PJA was found to be less than that of cement. Specific gravity of Juliflora ash is 2.75 conforming to BS 5628-1: 2005. The suitable range of specific gravity of juliflora ash is 1.6 to 2.8.

Table 4: IS: 383-1970 Zone-II

Sl. No.	Property	Value
1	Specific gravity	2.75
2	Water absorption	5%

2.5 Mix design for concrete

The Indian standard recommended method IS10262-2009 was used to create a design of the concrete mix for M20 grade, with target strength of 26.6MPa. Table 5 displays the number of ingredients utilized to prepare the concrete.

S.No	Name of mix	% of Prosopis Juliflora Ash	Cement in kg/m ³	Prosopis Juliflora Ash in kg/m ³	Fine aggregate in kg/m ³	Coarse aggregate in kg/m ³	Water in lit
1	CC	0	383	0	582	1125	183.8
2	PJA2.5	2.5	373.4	9.6	582	1125	183.8
3	PJA5	5	363.85	19.15	582	1125	183.8
4	PJA7.5	7.5	354.20	28.8	582	1125	183.8
5	PJA10	10	344.7	38.3	582	1125	183.8
6	PJA12.5	12.5	335.14	47.86	582	1125	183.8
7	PJA15	15	323.55	57.45	582	1125	183.8
8	PJA17.5	17.5	315.97	67.03	582	1125	183.8
9	PJA20	20	306.4	76.6	582	1125	183.8

Table 5: Materials for concrete and their quantities per cubic metre

In the preceding Table 5, Concrete that is prepared conventionally abbreviated CC. PJA2.5 stands for 2.5% of ProsopisJuliflora Ash replacement replacement for cement in concrete. PJA20 stands for 20% of ProsopisJuliflora Ash replacement for cement in concrete. In the experimentation work, same nomenclature was suggested as PJA2.5 throughPJA20.

2.6 Tests for Compressive Strength

To investigate the compression behavior of ProsopisJuliflora Ash concrete. Cubes specimens measuring 150x150x150mm were cast, and the cement was replaced with ProsopisJuliflora Ash. A total of 54 cube examples were cast; 6 of them were made with natural coarse aggregate, and the remaining samples were created by substituting 2.5%, 5%, 7.5%, 10%, 12.5%, 15%, 17.5% & 20% of cement with ProsopisJuliflora Ash. In all of the mixtures, the testing work has used fine aggregate, specifically clean river sand.Figure.1. Show the testing of cube specimen in CTM.



Fig. 1: Testing of cubespecimen in CTM

2.7 Tests for Split Tensile Strength

To investigate the Split Tensile behavior of ProsopisJuliflora Ash concrete. specimens measuring 30cmx15cm were cast, and the cement was replaced with ProsopisJuliflora Ash. It is crucial to test at least three specimens for the appropriate ages in order to determine the split tensile strength for 14 and 28 days. To ensure proper placement of the specimen in the compression testing machine, a diametrical line connecting the two ends of the specimen was drawn before testing. Figure 2 shows the setup for split tensile strength.

**Fig. 2: Testing of a sample in CTM**

2.8 Flexural Strength Test

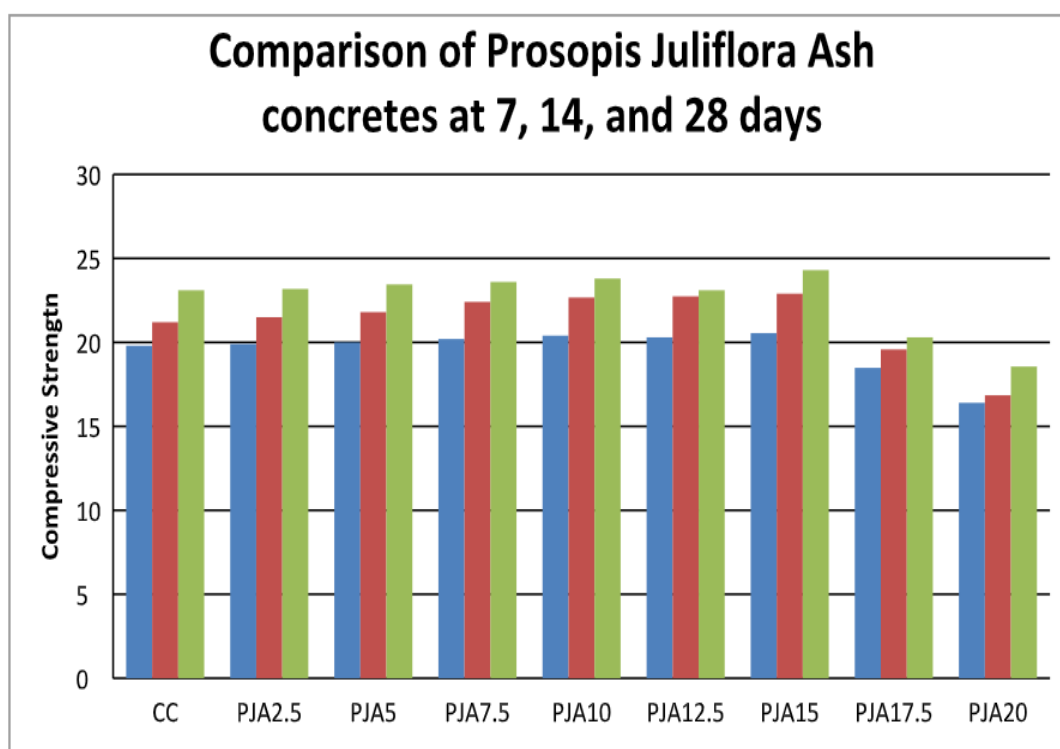
Flexure Strength testing was carried out using a symmetrical third point loading pattern. Size of the specimen is 150x150x700mm. The load points were marked at one-third of the span, and the theoretical maximum tensile stresses that reached the test beam's bottom fiber, known as the Modulus of rupture, were calculated. Under third-point loading, one-third of the length of the beam's extreme fiber was subjected to the highest stresses, resulting in the critical crack developing at any point along one-third of the beam's length.

**Fig.3: Loading of beam specimen****Fig.4: Propagation of crack under the roller**

The center-point loading test will yield a higher value of modulus of rupture but more variable values. As a result, the center-point loading test is rarely used to determine flexural strength. Figure.3 and 4 shows the test setup for a third-point loading specimen. And Propagation of crack under the roller.

III. RESULT AND DISCUSSION

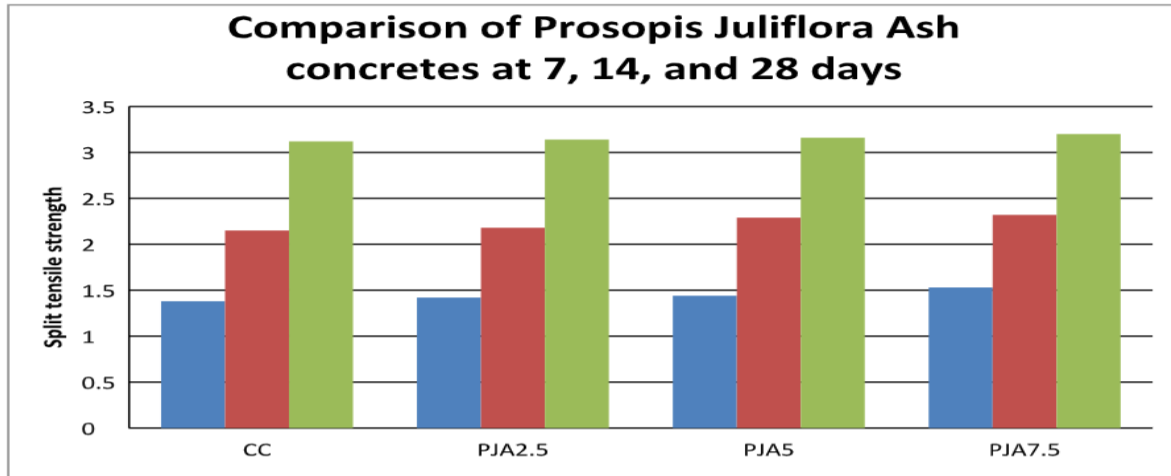
3.1 Compressive strength test



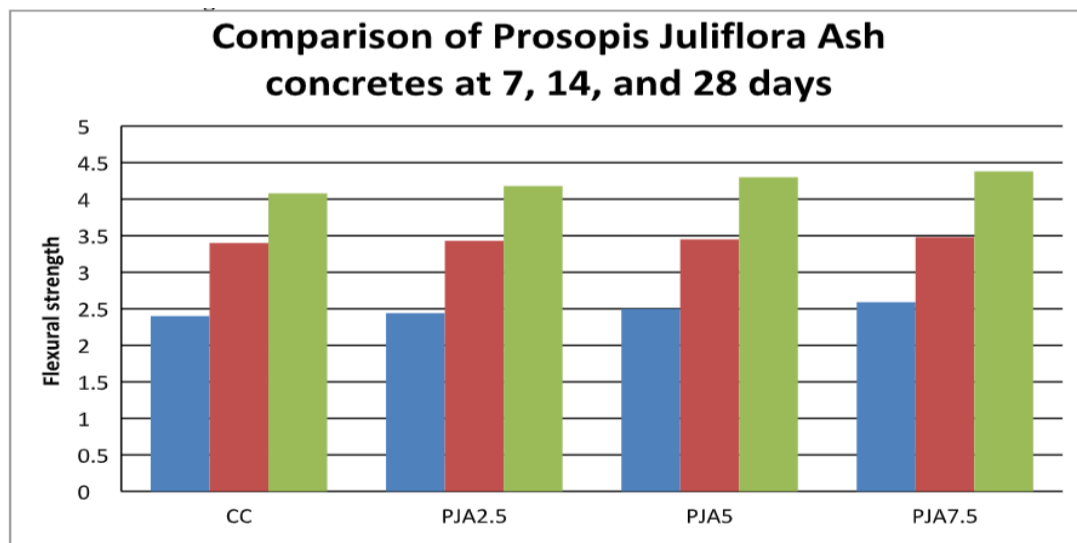
Compressive strength of concrete cube test provides an idea about all the characteristics of concrete. Cube Test Result Samples with 5%, 10%, 15% and 20% 25% and 30% replacement of cement with PA ash were casted. The cubes were casted as per the procedure specified in IS: 10262 (1982), IS 516:1959 and IS 456:2000. The strength of 3 samples was tested at 3, 7, 14 and 28 days using compression testing machine. The compressive strength values were compared with that of conventional concrete mix of M30. The obtained results are shown in graph. Regards compressive strength gradually increases at up to 25%, after 30% suddenly decreased so they 25% (PJA +WGP) gets maximum strength. Fig. 5.

3.2 Split tensile strength

The tensile strength of concrete is one of the basic and important properties which greatly affect the extent and size of cracking in structures. Moreover, the concrete is very weak in tension due to its brittle nature. Hence, it is not expected to resist the direct tension. So, concrete develops cracks when tensile forces exceed its tensile strength. Therefore, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack. Furthermore, splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The procedure based on the ASTM C496 (Standard Test Method of Cylindrical Concrete Specimen) which similar to other codes IS 5816 1999. Finally, different aspects split cylinder test of concrete specimen will be discussed in the following sections Fig. 6.



3.3. Flexural strength test



Flexure tests are generally used to determine the flexural modulus or flexural strength of a material. A flexure test is more affordable than a tensile test and test results are slightly different. The material is laid horizontally over two points of contact (lower support span) and then a force is applied to the top of the material through either one or two points of contact (upper loading span) until the sample fails. Flexural strength is defined as the maximum stress at the outermost fiber on either the compression or tension side of the specimen. Flexural modulus is calculated from the slope of the stress vs. strain deflection curve. These two values can be used to evaluate the sample materials ability to withstand flexure or bending forces. In this graph explained 25% replacement of PJA and WGP as maximum strength attained. Fig. 7.

IV. CONCLUSION

The 28-day compressive strength of cube with all the three percentages of replacement satisfied the strength requirement. The 3, 7, 14 and 28-day compressive strength of cube with 25% replacement of cement with Juliflora ash was founded as Optimum value. Objectives are concluded with the values. The utility of Prosopis Juliflora ash as a partial replacement of cement in concrete in correct way as per IS Codal Provisions up to 25% at maximum. Compare the performance with standard concrete and Prosopis Juliflora ash concrete in the Results can be acceptable to IS codes. It is also act as SELF RETARDER parameter to increase the Setting time as well as increased. Material Properties of

Materials and PJA can be completed. To found out the mechanical and durability of concrete. Based on the experimental investigation on concrete with cement is partially replaced by Prosopisjuliflora as 15% on 7,14 & 28 days the following conclusions were made:

1. Compressive strength of concrete increases with the amount of Prosopisjuliflora by 15 % on various days of curing respectively.
2. After that strength gradually slips while increasing the percentage of Prosopisjuliflora.
3. The replacement of cement with Prosopisjuliflora up to 15% is desirable, as it is cost effective.
4. As a result of these, this research work concludes that more than 15% of Prosopisjuliflora is not a suitable material for cement replacement in concrete.

REFERENCES

1. M.Harikaran and N.Balasundaram, "Performance enhancement of concrete by replacing coarse aggregate with tyre rubber: A Study", Ecology, Environment And Conservation, Vol. 25, Issue No.2 , ISSN No. 0971-765X, pp.702-705, Date of publication (January 2019)
2. M.Sanchaya, M.Harikaran, K.Cheran, M.Varoon, P.Jayaprakash, G.Navin, Experimental investigation on rice husk ash and coconut shell used in building materials, Materials Today: Proceedings, <https://doi.org/10.1016/j.matpr.2022.08.264>
3. B.Sasivarman, Dr.R.Nagalakshmi, Dr.M.Harikaran, Treatment of wastewater by slow sand process with polystyrene, Materials Today: Proceedings, <https://doi.org/10.1016/j.matpr.2022.08.082>
4. M.Harikaran and N.Balasundaram, "Evaluation of Concrete Using Reshaped Waste Tyre Rubber as Partial Replacement of CoarseAggregate", International Journal of Recent Technology and Engineering, Vol. 7 ,Issue No.6S5 , ISSN No. 2277-3878, , Date of publication (April 2019)
5. M.Harikaran and N.Balasundaram, "Deflection Behavior of RC Beams using Reshaped Waste Tyre Rubber as Partial Replacement of Coarse Aggregate ", International Journal of Recent Technology and Engineering, Vol.8 ,Issue No.2 , ISSN No. 2277 -3878,Date of publication (July 2019), DOI: 10.35940/ijrte.B3189.078219.
6. Dr.R.Shanmugam.,Dr.M.Harikaran., S.Gokulakannan., P.KeerthanaDevi. Compressive Axial Behavior of Short Columns Incorporating Bottom Ash and Reshaped Waste Tyre Rubber, Journal of Xi'an Shiyou University, Natural Science Edition, 19, 02, 2023
7. M. Harikaran, R. Vijayan, P. Senthilkumar, R.S. Suganth, R. Nithishkumar, Vijay,V. Experimental Study on Properties of Paver Block using Coconut Fibre & Nylon Fibre, Grenze International Journal of Engineering and Technology, 9, 1, 2023
8. Dushyanth V Babu R., Mukesh P., Menkapandey.,Harikaran M., Balaji G., Monisha K M, Experimental Study Of Concrete By Replacement Of Cement With Polymer Resin, IOP Conf. Series: Earth and Environmental Science, DOI 10.1088/1755-1315/1125/1/012014
9. Dr.M.Harikaran, P.Mukesh, P.Senthilkumar, R.S.Suganth, R.Nithishkumar, V.Vijay, Study of structural bonding strength with tyre rubber instead of coarse aggregate and water hyacinth ash instead of cement, Materials Today: Proceedings, Volume 68, Part 5, 2022, Pages 1330-1334, <https://doi.org/10.1016/j.matpr.2022.06.359>.
10. M. Harikaran, P. Kulanthaivel, A.R. Krishnaraja, P.C. Murugan, Performance enhancement of concrete by using ceramic waste as a partial replacement for coarse aggregate, Journal of Ceramic Processing Research, Volume 24, Issue 2, 266-273.
11. Sankar. P, P. Suresh, T. Aravind, V.K. Buvanesvari, M. Harikaran, R. Raja, Investigation on Supply Chain Distribution Network Problem using RFID Technique, International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), 12, 1, 2023, DOI:10.15680/IJIRSET.2023.1201094
12. Sankar. P, P. Suresh, T. Aravind, V.K. Buvanesvari, M. Harikaran, R. Raja, Analysis and Optimization of Supply Chain Travelling Salesman Problem Using K-Means Cluster based Genetic Algorithm, 12, 1, 2023, DOI:10.15680/IJIRSET.2023.1201095
13. M. Harikaran, P. Keerthanadevi, S. Inbarasan, N. Tamilan, R. Manimaran, S. Jayavikram, Experimental examination of concrete using hazardous plasti-fiber and rub – fiber, Materials Today: Proceedings, 2023, <https://doi.org/10.1016/j.matpr.2023.04.598>
14. M. Harikaran, S. Gokulakannan, A. Loganathan, R.D. Chandiran, M. Ajith, V. Dhanasekar, Metakaolin cement concrete evaluation using industrial by-products as fine aggregate, Materials Today: Proceedings, 2023, <https://doi.org/10.1016/j.matpr.2023.04.586>
15. S. Gokulakannan, M. Harikaran, K. Mounesh, S. Sankaranarayanan, R. Sathishkumar, R. Sivakumar, Experimental studies on durability and deflection behavior of concrete in metakaolin cement concrete, Materials Today:

Proceedings,2023,ISSN 2214-7853,<https://doi.org/10.1016/j.matpr.2023.05.236>.

(<https://www.sciencedirect.com/science/article/pii/S2214785323028687>)

16. P. Keerthana Devi, M. Sanchaya, M. Harikaran, J. Gopi Krishna, V. Kaviyaran, N. Venkatesh, Effective utilization of waste paper sludge ash as a supplementary material for cement, Materials Today: Proceedings,2023,ISSN 2214-7853,<https://doi.org/10.1016/j.matpr.2023.05.599>.
(<https://www.sciencedirect.com/science/article/pii/S2214785323032339>)
17. M.Harikaran, SampathBoopathi, M. Rajkannan, S. Gokulakannan, Impact analysis of ceramic tile powder aggregates on selfcompacting concrete, Engineering Research Express, 5 (2023) 025069, <https://doi.org/10.1088/2631-8695/acde48>
18. Harikaran.M, Kulanthaivel.P, Gokulakannan.S, Vinodhkumar.S, Eco-friendly soil stabilization: a combined approach using lime and waste eggshell powder, Global NEST Journal, Vol 25, No 7, pp 120-130, <https://doi.org/10.30955/gnj.005077>
19. A. Loganathan, R.D. Chandiran, M. Harikaran, M. Sanchaya, Experimental Investigations on Building Demolition Waste Using as a Fine Aggregate in Concrete, International Research Journal of Engineering and Technology (IRJET), Volume: 10 Issue: 07 , Pages 2395-0056, 2023.
20. M. Harikaran, SampathBoopathi, S.Gokulakannan: M. Poonguzhali, Study on the Source of E-Waste Management and Disposal Methods, Sustainable Approaches and Strategies for E-Waste Management and Utilization, 39-60, 2023, DOI: 10.4018/978-1-6684-7573-7.ch003
21. M.Harikaran; P.Kulanthaivel; P.KeerthanaDevi; M.Sanchaya, Impacts of Nanomaterials on Enhancing Concrete Quality: A Comprehensive Analysis, Sustainable Utilization of Nanoparticles and Nanofluids in Engineering Applications, DOI: 10.4018/978-1-6684-9135-5



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