North Asian International Research Journal of Sciences, Engineering & I.T.

IRJIF. I.F. : 3.821

ISSN: 2454-7514 Vol. 8, Issue-6 June-2022

Index Copernicus Value: 52.88 Indian Citation Index Thomson Reuters ID: S-8304-2016

NAIRJC *A Peer Reviewed Refereed Journal*

DOI: 10.5949/NAIRJC_joe_00007.55

PARTIAL REPLACEMENT OF CEMENT WITH POFA AND FINE AGGREGATE WITH GROUND NUT SHELL IN CONCRETE

SUHAIL SAQIB[1], MANISH KAUSHAL[2]

[1]*M. Tech Scholar, Department of Civil Engineering, RIMT University, Mandi Gobingarh, Punjab, India*
[2]*Assistant Professor, Department of Civil Engineering, RIMT University, Mandi Gobingarh, Punjab, India*

ABSTRACT

Concrete being one of the most versatile materials finds use in all constructions. Thus, for infrastructural development of a country concrete plays a very important role. However, in recent times cost of concrete has seen a sharp jump, this rise in price has been due to increase in the ingredients of concrete especially cement. Production of cement is not only expensive but also damages our atmosphere. Thus, in recent times more of a need has risen for replacement of cement in concrete. These replacements have been more economical and beneficial with the use of waste materials. The use of waste materials in concrete helps dispose off these materials in a more ecofriendly manner else they would be dumped in ground fills or burned which release harmful gases in the atmosphere.

In our research paper we used two of such agricultural wastes in concrete and see the impact they have on strength of concrete. We replaced cement with POFA in the percentages of 5, 10, 15 and 20 percent. Then after a series of strength tests on hardened concrete the optimal value of replacement comes out to be 10%. Further fine aggregates were replaced with ground nut shell in percentages of 15, 25, 35 and 45 %. The optimal value at which we got the maximum value of compression, flexure and split tensile strength came out to 15%. Increase of replacement percentages beyond optimal values caused a decrease in strength as well decreased the workability.

***KEYWORDS**: Cement, Pofa, Ground Nut, Concrete*

1. INTRODUCTION

Concrete is a mixture of naturally occurring, and readily available ingredients such as cement, sand, aggregate, and water. After water, cement is the most commonly used material on the planet. The rapid production of cement causes significant harm to the environment. The first environmental issue is CO2 emissions from the cement manufacturing process. CO2 emissions are extremely harmful, causing significant changes in the environment. When one tone of ordinary Portland is manufactured, one tone of carbon dioxide is released into the atmosphere, according to estimates. Because there is no alternative building material that can completely replace cement. The hunt for such material, which can be used as an alternative or supplement to cement should result in global sustainable development and least amount of environmental impact. Agricultural and industrial waste materials are causing waste management and employment issues. As a result, the use of agricultural and industrial wastes in the construction field provides both practical and economic benefits. Today 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. Waste materials typically have no commercial value and are only available locally for transportation costs. Waste materials in the construction industry make a significant contribution to the conservation of natural resources and the protection of the surrounding environment.

The global mission of "zero waste" generation, utilisation of byproduct wastes such as POFA as OPC replacement, provides an opportunity to reduce carbon footprints, increase cost savings, and mitigate and reduce waste materials in landfills. To reduce global cement consumption, one of the productive disposal solutions is to reuse POFA in cementitious materials as an additive or partial substitute. Because of the abundance of POFA generation and its high pozzolanic properties, significant research has been conducted to evaluate its physical, mechanical, and physic-mechanical properties as a supplementary cementing material in various types of concrete such as lightweight, aerated, high strength, high-performance concrete, and so on. Groundnut shells account for approximately 20% of the weight of a dried peanut pod, indicating that there is a significant amount of shell residual left after groundnut processing. Increased groundnut production results in an accumulation of groundnut shells that are not used and are thus either burned or buried. Groundnut shells can be used in a variety of ways because they are high in functional compounds and contain cellulose, hemicellulose, and lignin.

1.1 PALM OIL FUEL ASH

Palm Oil Fuel Ash (POFA) is a by-product produced when palm oil fibers, empty fruit bunches, and shells are burned as fuel in palm oil mill boilers. Typically, 85 percent of the time, fibres in the boiler, 15% of the shells and empty fruit bunches are burned. To generate energy at a temperature of around 900-1000°C crude palm oil extraction process. Waste ash of about 5% is obtained and then disposed of to open fields causing traffic hazard besides potential of health hazard leading to bronchi and lung diseases. The physical properties of POFA are greatly influenced by the burning condition, particularly burning temperature. Generally, unground POFA is light grey in color. This is due to the unburnt carbon content left at relatively low burning temperature. The unburnt carbon content becomes very low when the burning temperature is high. The relative density of unground POFA is about 60% lower than the relative density of OPC. The specified minimum pozzolanic activity index of highly reactive supplementary cementing material is generally 85%. Ground POFA possesses a good pozzolanic activity index .

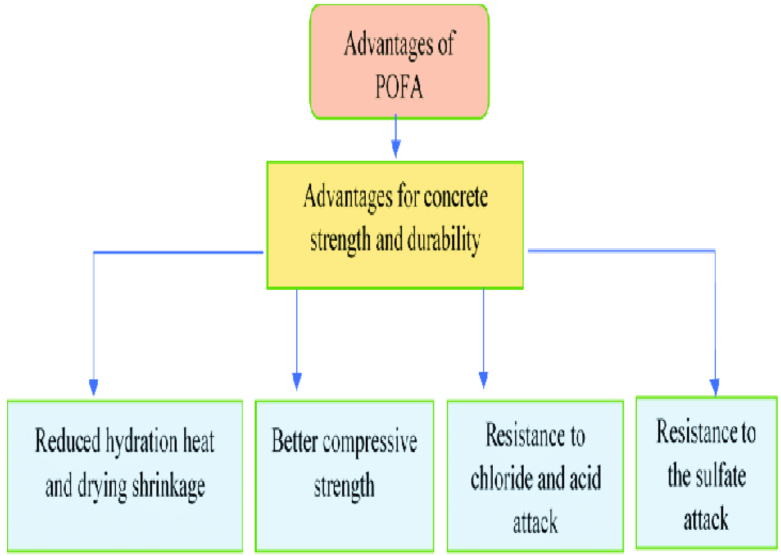

Fig 2.2: Advantages of palm oil fuel ash

1.2 GROUND NUT SHELL

Groundnut shells are rich in functional compounds. Groundnut shells are composed of cellulose, hemicellulose and lignin. Renewable resources, it could be used in the food, feed, paper, bioenergy industries. Groundnut shell can be used in Biodiesel and Bioethanol production. The ground nut industries produce waste such as ground nut shell ash which are usually dumped in the open site by affecting of surrounding without any economic benefits.Groundnut shells account for approximately 20% of the dried peanut pod by weight, meaning there is a significant amount of shell residual left after groundnut processing. Increased groundnut production leads to the accumulation of these groundnut shells which is not utilized, thus either burnt or buried. As Groundnut shells are rich in many functional compounds and composed of cellulose, hemicellulose and lignin, it can be utilized in multiple ways. Groundnut shells can be converted in various bio-products such as biodiesel, bioethanol, nano-sheet and also has applications in enzyme and hydrogen production, dye and heavy metal degradation etc. An efficient management strategy is required to convert this otherwise considered waste into valuable bio-products to achieve zero waste production system.

2. OBJECTIVES

- To find a suitable mix proportion that will retain workability without compromising concrete strength.
- Performing compressive strength test on cubical specimen, determine the compressive strength of cured concrete.
- Performing split tensile test on a cylindrical specimen, determine the tensile strength of cured concrete.
- Performing flexural strength test on a beam specimen, determine the flexural strength of cured concrete.

3. MATERIAL & METHODOLOGY

3.1 CEMENT

The cement that will be used in the research will be opc 43 grade Khyber cement. Cement will be purchased locally from the local supplier.

Fig 1: Cement

Fig 2: Fine aggregate

3.2 FINE AGGREGATE

The fine aggregate that will be used will be natural river sand, brought from local supplier sourced from Jhelum River in Kashmir

3.3 COARSE AGGREGATE

The coarse aggregate of size 12 to 20 mm will be used from a local crusher plant in Lasjan.

Fig 3: Coarse aggregate

3.4 PALM OIL FUEL ASH

The palm oil fuel ash will be purchased from india.tradekey.com which is sourced from oil palm limited Kerala. POFA will be sieved through a 90 micron sieve before use.

Fig 3.4: Palm oil fuel ash

3.5 GROUND NUT SHELL

Ground nut shell will be sourced locally grounded and passed through a 4.75 mm sieve.

3.6 EXPERIMENTAL PROCEDURE

STAGE 1: Collection of raw materials cement, sand, coarse aggregate, POFA, Ground nut shell

STAGE 2: Determine the physical properties of cement, fine aggregate, coarse aggregate.

STAGE 3: Preparing the design mix of M40

STAGE 4: Mixing of the ingredients, casting of specimens and curing of specimen for conventional concrete

STAGE 5: Mixing of the ingredients, casting of specimens and curing of specimen for concrete with partial replacement of cement with POFA in the percentages of 5%, 10%, 15% AND 20%.

STAGE 5: Performing Compressive strength and split tensile test on specimen after a curing of 14 and 28 days for conventional concrete.

STAGE 6: Mixing of the ingredients, casting of specimens and curing of specimen for
Varying partial replacement of fine aggregate with Groundnut shell in the percentages of 15%, 25%, 35% and 45%.

STAGE 7: Performing Compressive strength, flexural strength test, split tensile test on specimen after a curing of 14 and 28 days to find the value at which the strength is maximum.

Table 1: Properties of cement and aggregate

Properties	Values	Permissible Values	Aggregates
Specific Gravity	3.14	3.15	2.75
Initial setting time	28 min	30 min	-
Consistency	30 %	25-35%	-
Final setting time	9 hours	10 hours	-
Crushing value	-	30 %	28%

4. RESULTS AND DISCUSSION

4.1 EFFECT OF WORKABILITY

The workability of the mix decreases as we increase the percentage of POFA replaced with cement in the concrete mix. The addition of Groundnut shell further decreases the workability of the concrete.

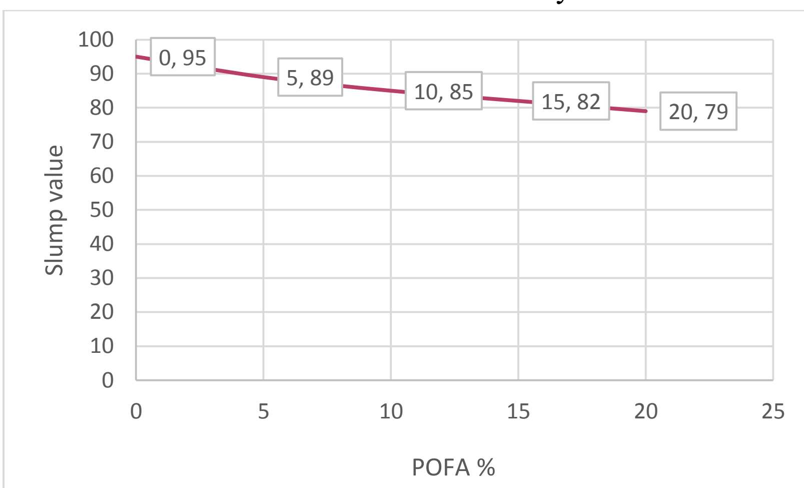

Fig 4.1 POFA % vs Slump value graph

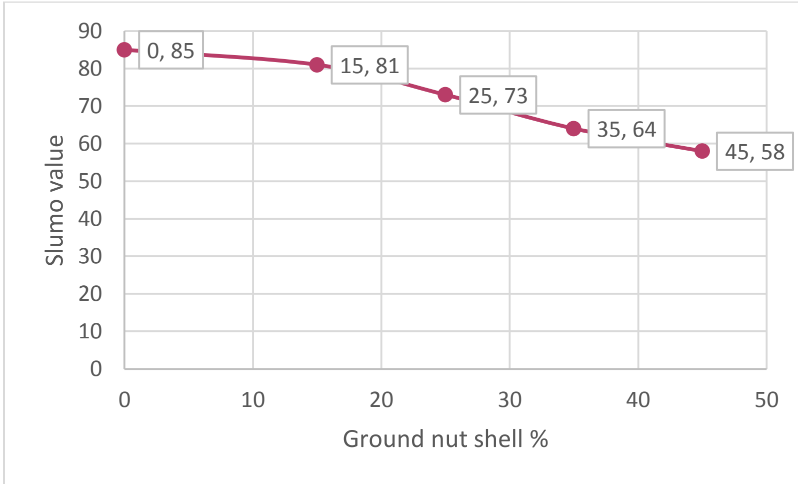

Fig 4.2 Ground nut shell % vs Slump value graph

4.2 EFFECT OF COMPRESSIVE STRENGTH

The compressive strength of the cube increases when we increase the percentage of POFA in the concrete. The replacement of 10% cement with POFA gives us the maximum value for compression which is 46.36 N/mm^2. However, further replacements of cement decrease the compressive strength. Thus 10% POFA is taken as the optimum replacement percentage.

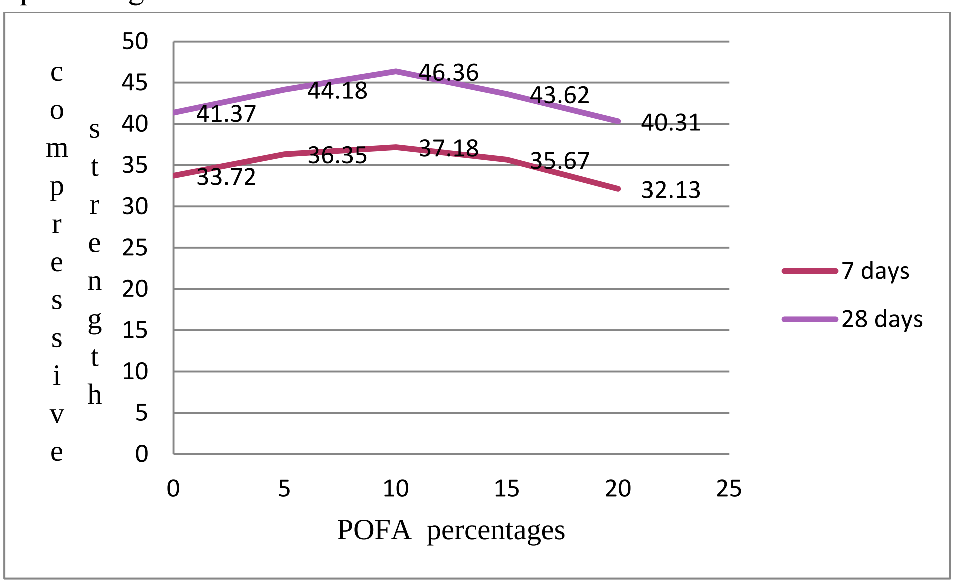

Figure 4.3: Compressive strength vs. POFA % graph

We observe that the compressive strength for the cubes with 10 % of cement replaced with POFA and further replacements of fine aggregate with ground nut shell in various percentages increases till 15% replacement and further replacement, causes a decrease in compressive strength. Thus 15% replacement is the optimum value of replacement which gives a value of 48.48 N/mm^2 as compressive strength.

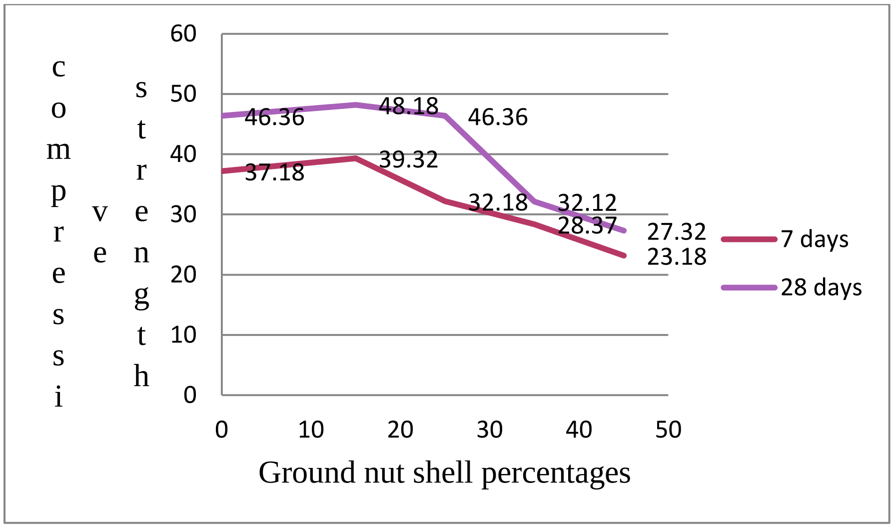

Figure 4.4: Compressive strength vs. ground nut shell % and 10% POFA graph

4.3 EFFECT OF FLEXURAL STRENGTH

The flexural strength of the beams increases when we increase the percentage of POFA in the concrete. The replacement of 10% cement with POFA gives us the maximum value for flexure which is 4.10 N/mm^2. However, further replacements of cement decrease the flexural strength. Thus 10% POFA is taken as the optimum replacement percentage.

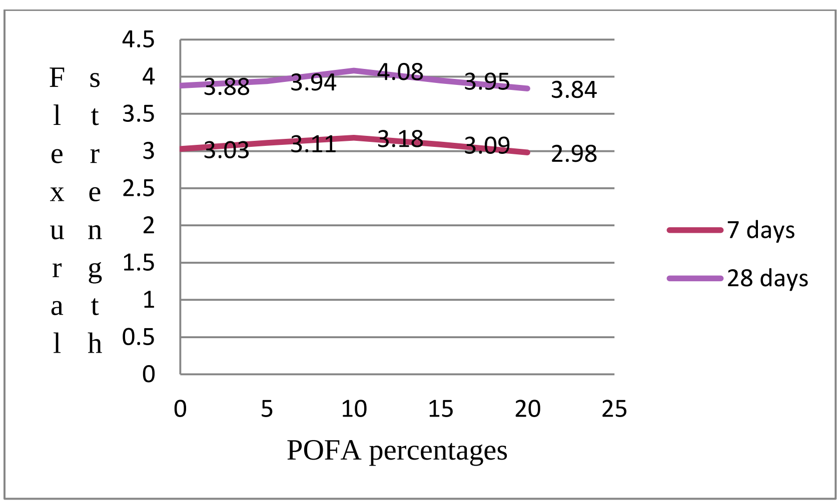

Figure 4.5: Flexural strength vs. POFA % graph

We observe that the flexural strength for the beams with 10 % of cement replaced with POFA and further replacements of fine aggregate with ground nut shell in various percentages increases till 15% replacement and further replacement, causes a decrease in flexural strength. Thus 15% replacement is the optimum value of replacement which gives a value of 4.21 N/mm^2 as flexural strength.

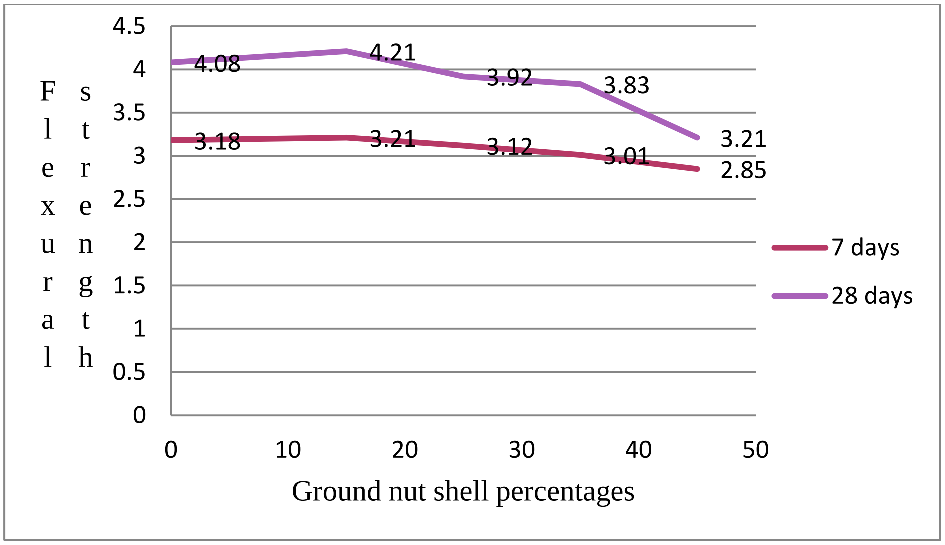

Figure 4.6: Flexural strength vs. ground nut shell % and 10% POFA graph

4.4 EFFECT OF SPLIT TENSILE STRENGTH

The split tensile strength of the beams increases when we increase the percentage of POFA in the concrete. The replacement of 10% cement with POFA gives us the maximum value for split tensile which is 3.28 N/mm^2. However, further replacements of cement decrease the split tensile strength. Thus 10% POFA is taken as the optimum replacement percentage.

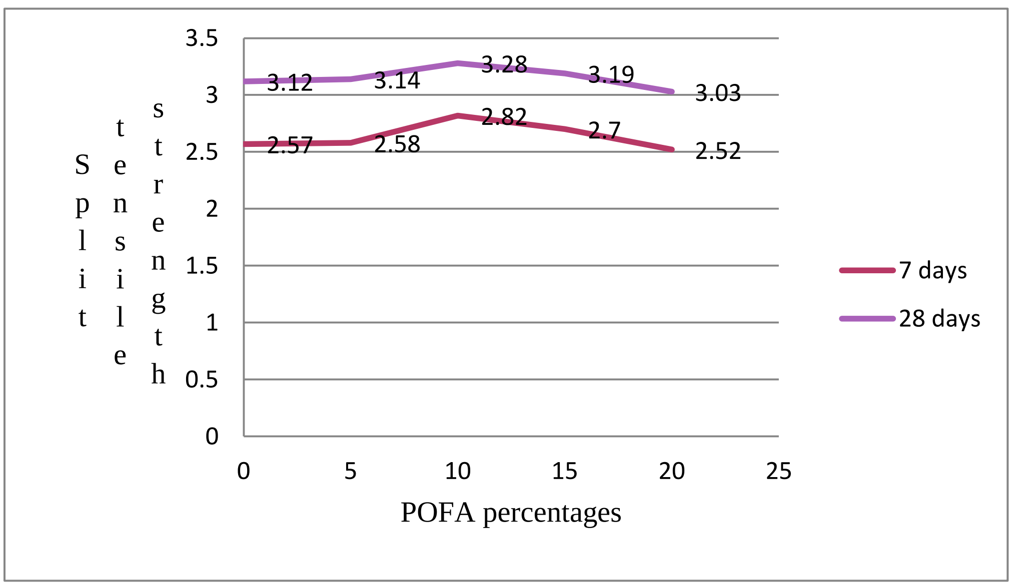

Figure 4.7: Split tensile strength vs. POFA % graph

We observe that the split tensile strength for the beams with 10 % of cement replaced with POFA and further replacements of fine aggregate with ground nut shell in various percentages increases till 15% replacement and further replacement, causes a decrease in split tensile strength. Thus 15% replacement is the optimum value of replacement which gives a value of 3.72 N/mm^2 as split tensile strength.

5. CONCLUSIONS

The tests performed on concrete in this research were workability test, compressive strength test, and flexural strength test and split tensile strength test on specimen with cement partial replaced with POFA and fine aggregate with Ground nut shell at varying percentages.

From the results of slump test, we can see that as the percentages of POFA and Ground nut shell are increased there is decrease in workability. Concrete specimen with 10% of cement was replaced with POFA have the most increase in compressive strength, flexural strength and split tensile strength. However, as the percentage is increased there is a decrease in all the three strengths.

For concrete specimen in which we had replaced cement with POFA at 10% and fine aggregate at varying percentage with ground nut shell, we can conclude from the results that there is an increase in all the three strengths till 15% replacement of ground nut shell. Further increase in ground nut shell caused the strength to decrease.

Thus, the optimal replacement percentages are 10% for POFA and 15% for ground nut shell in concrete.

REFRENCES

1. Oyejobi, D. O., Abdulkadir, T. S. and Ahmed, A.T, 2015, A Study of Partial Replacement of Cement with Palm Oil Fuel Ash in Concrete Production", Journal of Agricultural Technology 2015 Vol. 12(4):619 -63.
2. Nadiminti Venkata Lakshmi, Polinati Satya Saga, 2017, "Study on partial replacement of groundnut shell ash with cement", Challenge Journal of Concrete Research Letters 8 (3) (2017) 84–90.
3. O., Hussin, M. W. and Mohamed, A. I. (2013), Palm Oil Fuel Ash: Promising Supplementary Cementing Materials. Korean Society of Civil Engineers (KSCE) Journal of Civil Engineering 17(7): pp1708-1713.
4. Lathamaheswari, R., Kalayaan, V and Mohan Kumar, G, 2017, "Palm Oil Fuel Ash: Promising Supplementary Cementing Materials", International Journal of Engineering Research and Development, Volume 13, Issue 1 (January 2017), PP.01-06.
5. Harsha V N, Aiswarya V S, Beyoola Wilson, Preethi M, March, 2017, "Palm Oil Fuel Ash as Partial Replacement of Cement in Concrete", Volume 06, Issue 03 (March 2017).
6. Dr. M. Vijaya Sekhar Reddy, K. Sasi, K. Ashalatha, M. Madhuri, 2017, "Palm Oil Fuel Ash as Partial Replacement of Cement in Concrete", Research J. Science and Tech. 2017; 9(3): pp. 313-316.
7. B.H. Sadaa , Y.D. Amarteyb , S. Bakoc, 2013, entitled "An Investigation Into The Use Of Groundnut Shell As Fine Aggregate Replacement", Nigerian Journal of Technology (NIJOTECH) Vol. 32, No. 1, March, 2013, pp. 54–60.
8. Adaba C.S, Agunwamba, J.C, Nwoji, C.U. Onya, O.E. and Ozeh, O. Comparative Cost and Strength Analysis of Cement and Aggregate Replacement Materials. Nigerian Journal of Technology, Vol. 31, No. 2, 2012 pp 111-116.

9. C.S. Adabaa , J.C. Agunwambab , C.U. Nwojic , O.E. Onya, S. Ozeh, 2012, "An Investigation Into The use of Groundnut Shell As Fine Aggregate Replacement", Nigerian Journal of Technology (NIJOTECH) Vol. 31, No. 2, pp. 111–115.