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Experimental Study of Effect of Palm Kernel Shell and Coconut Shell on Strength of Concrete

Prof. Sagar E. Bhoyar[1], Prathamesh Ramesh Gavate[2], Vaibhav Kishor Rite[3], Anil Prakash Sangale[4], Sumit Santosh Tatale[5]
[1]Assistant Professor, Department of Civil Engineering
[2-5]Student, Department of Civil Engineering
Sinhgad Institute of Technology and Science, Pune, India

Abstract: *In India today environmental challenge is to dispose of waste Palm kernel shell and coconut shell. The use of Palm kernel shell and coconut shell has been increased day by day at all levels in the industry as well as domestic level. This waste Palm kernel shell and coconut shell remains in environment for 1000 years and these are biodegradable but in lack of waste form that's why its quantity is getting accumulated each year. The present work, the concrete is made by adding waste Palm kernel shell and coconut shell in shredded form. As per mix design concrete is prepared by addition of varying quantity of shredded Palm kernel shell and coconut shell. All the materials like cement, sand, coarse aggregate and Palm kernel shell and coconut shellis taken as per IS code. Finally concrete is tested for 7 daysand 28 days. The results of compressive strength of concrete with different percentage of Palm kernel shell and coconut shell are compared.*

Keywords: Palm Kernel shell and Coconut shellconcrete, compressive strength, workability

I. INTRODUCTION

Concrete is the most commonly used material employed for construction purpose in the world today, the expensive cost of concrete constituents such as cement, fine and coarse aggregate has necessitated the need to search for alternative construction materials . The general importance of concrete application in construction projects and civil works cannot be overemphasized. The overwhelming demand for concrete in construction adopting normal weight aggregates (NWAs), such as gravel and sand has led to tremendous depletion in naturally occurring aggregates causing numerous damage to the environment which are irreparable. As a result, the need to search for more sustainable and renewable materials has been intensified. Some waste agricultural materials such as saw dust, maize comb, rice husk, and coconut shell, palm kernel shell etc. can serve as a good substitute or admixture for some of these traditional construction materials. These local materials are in most cases dumped as waste in our environments, causing environmental pollution. Many of which can be used as lightweight aggregate (LWA) to produce light weight concrete which has the advantage of reducing the self-weight of concrete structures as compared to conventional concrete which possess heavy dead load, they can also be used for purposes of structural stability and versatility as well as economic viability. Hence incorporating these waste materials will help reduce the rate of exploitation of nonrenewable natural resources and provide more sustainable concrete. Furthermore, the idea of using raw materials as concrete constituents is capable of proffering solution to energy saving problems encountered in many agro industries.

An agricultural waste that has proven successful in concrete production is palm kernel shell (PKS). In the last three decades, palm kernel shell (PKS) has been used by scientists as LWA to substitute conventional NWA in building and road construction **in** Africa and Southeast Asia. One of the advantages of PKS is that it has better impact resistance compared toNWA. Innumerable articles have been published on the physical, mechanical, structural and functional properties using PKS as Lightweight aggregate.

PKS is extracted from the oil palm tree as a waste product. It is majorly located in Eastern and Western Africa with a scientific name of Elaeisguineensis. In the past, growing of palm oil tree was sequestered in the Eastern part of Africa as history records that the founding of palm oil trees dates back to the era of Pharaohs some 5000 years ago but currently, the cultivation of palm oil trees have become a major priority in some South East Asian countries such as

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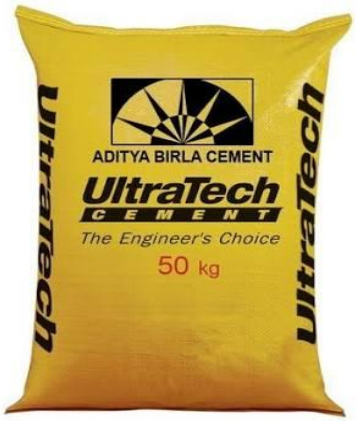
Indonesia and Malaysia. In a report by Olanipekun et al. large quantities of palm oil trees can be located in Asia, America and some part of Africa specifically Nigeria. The total production of palm oil in Malaysia alone is 52.8% and about 90% of the world's palm oil exportation comes from Malaysia and Indonesia. The palm oil nut contains two kinds of oil; one is palm oil which is extracted from the fleshy and oily layer called the mesocarp and the other is palm kernel oil which is extracted from the inner core, known as palm kernel (endosperm). A endocarp layer which envelops the Palm kernel is called palm kernel shell.

Over 4 million tons of PKS are produced by Malaysia annually and from Ramli investigation a total of 5million hectare (ha) palm oil trees are expected by the year 2020. By virtue of its position as the second largest palm oil producing country in the world, it is expected that huge amount of palm kernel shell wastes will be found in Malaysia. As part of measures to facilitate and enhance the preservation of the environment, scientists have decided to look into the resourcefulness of PKS as LWA [3, 12, 13]. Proposals were made to alternatively use PKS as road based materials rather than asphalt on numerous accounts [9, 13, 14]. In an investigation by Teo et al. [13, 15] PKS was employed as LWA to construct a building with one suspended floor and a foot bridge and the structural behavior were closely monitored on both accounts. PKS is also used as granular filter material for water treatment [9, 16], road based material and floor roofing [13]. Okpala [7] observed the heat conductivity of 0.19 Wm−1 K−1 for PKS which is much lower than the value of 1.4 Wm−1 K−1 for normal coarse aggregate. Hence a more conducive environment and low energy usage can be achieved with lightweight concrete made with PKS as a result of the high insulation capacity and low thermal conductivity. In recent times, experiments have been made to substitute PKS as a replica for poor lateritic soil.

II. EXPERIMENTAL PROGRAM

1.Materials:

Cement:



Img.3.1 Cement bag

Main ingredient used for making concrete is cement strength and durability concrete mainly depends on cement. In this experiment we have considered ordinary Portland cement of 53 grades. We take 53 grade of cement for experimental investigation because for low heat of hydration and the industrial material which is used for investigation has own cementing properties.

2.Coarse Aggregate:

Aggregates are inert granular materials such as sand, gravel or crushed stone that are an end product in their own right. They are also the raw materials that are an essential ingredient in concrete. For a good concrete mix, aggregates need to be clean, hard, strong particles free of absorbed chemicals or coatings of clay and other fine materials that could cause the deterioration of concrete

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3.Fineaggregate:

When the aggregate is sieved through 4.75mm sieve, the aggregate passed through it called as fine aggregate. Natural sand is generally used as fine aggregate, silt and clay are also come under this category. The soft deposit consisting of sand, silt and clay is termed as loam. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.

4. Palm Kernel Shell:

Palm Kernel Shell (PKS) is one of the waste material obtained during the crushing of palm nuts in the palm oil mills for palm oil extraction. These are agricultural waste products and are available in large quantities in the tropical regions of the world. Palm kernel shells are mostly used as a source of fuel for domestic cooking in most areas where they occur. Normally, the Palm kernel shell is obtained by breaking the palm nut. Shells are lightweight in nature, but hard and come in different shapes and sizes. Further, the shells are often dumped as waste products of the oil palm industry.
In South East Asia, Palm Kernel Shell (PKS) is one of the most quantitative waste materials produced every year. Among different countries Malaysia produces approximately 4 million tons of palm kernel shells annually. Hence, utilizing Palm Kernel Shell would impose lower construction costs compared to other waste materials like rubber crump, Palm Kernel Shell And Coconut Shell waste etc. Every year, palm oil industries produce large volume of Palm kernel shell as waste material after the production of palm oil. Nearly five million hectors of oil palm trees is expected by the year 2020 in Malaysia alone. This will increase the production of both palm oil and its wastes such as palm kernel shells. Palm kernel shells are not fully utilized and it has contributed to environmental pollution. This kind of waste material can be utilized to substitute the conventional coarse aggregate to produce

Palm Kernel Shell

5. Coconut shell :

Coconut shell is one of the solid disposal wastes from agricultural activities. The use of coconut shells as one of the composite materials in the production of concrete was driven by the problem caused by the disposal of solid waste. coconut shells represent more than 60% of domestic waste volume. Coconut shells present serious disposal problems for local environments. However, these wastes can be used as potential material or replacement material in the construction industry. coconut shells are by-products of coconut oil production. Coconut shells are used in the production of activated carbon due to its hardness and high carbon content. coconut shells are potential candidates for the development of new composite material in concrete mix design because of their high strength and modulus properties.

Coconut shell

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Mix Proportions:

Control Mix: Conventional concrete mix without any waste materials

Palm kernel shell and Coconut shell : Concrete mixes with varying percentages (5%, 10%, 15%) of Palm kernel shell and Coconut shell replacing coarse aggregates

Specimen Preparation:

Mixing: Thoroughly mix the cement, aggregates, waste materials, and water according to themix proportions.

Molding: Cast concrete specimens (cubes) of standard dimensions forcompressive strength,

Curing: Cure the specimens in a controlled environmentfor a 7 days and 28 days.

Results

Table: Compressive Strength Of Concrete

Sr. no.	Proportion of waste added in concrete	Compressive strength in N/mm^2	
		7 days	28 days
1	0 %	16.9	28.79
2	5%	16.48	27.71
3	10 %	19.99	30.99
4	15%	16.07	26.32

Table Workability Of Concrete

Sr. no.	Proportion of waste added in concrete	SLUMP (mm)	Workability
1	0 %	35	Low
2	5 %	30	Low
3	10 %	35	Low
4	15 %	45	Low

III. CONCLUSION

The percentage of waste mix 10% increase the compressive strength of concrete. After the 10% mix the compressive strength decreases. So the optimum proportion of waste mix is 10%. However, excessive amounts of waste negatively affected concrete strength. Utilizing waste materials in concrete production can promote sustainability and the circular economy in construction.

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