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Experimental Study of Replacement of Coarse Aggregate with Palm Shell

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Abstract : This Experimental study of concrete using palm oil shell as coarse aggregate, performed to evaluate the feasibility of palm oil shell in concrete and in reinforced concrete without affecting the mechanical properties of the concrete. For that various tests were performed to check suitability of palm oil shell in concrete. For the experimental study the replacement level of palm oil shell were taken from 12.5 % to 50 % for non-structural elements. Concrete cubes were cast, cured and crushed at the age of 7, 14, and 28 days. From the experimental analysis, four replacement of fine aggregate with palm oil shell, maximum strength and split tensile strength was obtained 25% replacement.
Key Words : Concrete, Coarse aggregate, Palm Shell.

1.0 Introduction

The continuous increase in the cost of construction is one of the major challenges the construction industry is encountering high quality discharge of great number of developmental project, as such projects are dependent on some factors of production which is the cost of materials. The coarse aggregates are the main ingredient of concrete. Here, palm oil shell is used as coarse aggregate. We all want that our buildings must be strong and should built with the construction materials of reasonable rates. Every construction industry totally relies on cement, sand, and aggregates for the production of concrete. now a days, most of the researchers are doing the research on the material which can reduce the cost of construction as well as increase the strength. Some of the waste materials are used in concrete according to their properties[1,2]. The use of waste materials in construction contributes to conservation of natural resources and the protection of the environment[1]. Williams et al focused on the assessment of characteristic strength of palm kernel shell concrete with the view to be used as lightweight aggregate. Were various tests are carried out in order to ascertain its use as lightweight aggregate. Were the granite aggregate is totally replaced with the PKS. Water cement ratio of 0.65 at a mix ratio of 1:2:3 is adopted. A total 24 beams and cubes were cast. They were cured for 7,14,21,28 days, tested and their physical and mechanical properties determined. The properties of PKS fresh concrete is however excellent, it is very workable, consistent and easily placed. Hardened palm kernel shell concrete(light weight concrete)developed sufficient strength that will help make it suitable for a wide range of uses. There for PKSC can be used as light weight concreteit should be designed with the corresponding design for NWC. It can therefore be concluded that palm kernel is a lightweight aggregate and can be used to produce lightweight concrete. Danil et al., reports on experimental investigations on the effects of replacing crushed granite in concrete with palm kernel shells on the strength, density and workability of concrete. The study identified possible cost reduction in replacing granite with palm kernel shells and recommended codification of the use of palm kernel shells as aggregates in concrete. The palm oil shell is a material which can be a substitute for aggregates. The use of palm oil shell aggregate makes the concrete light weight. The shell of the palm oil is mostly used as fuel for burning in palm oil industry as a source of activated carbon . The palm oil industry produces wastes such as palm kernel shells, palm oil fibers which are usually dumped in the open thereby impacting the environment negatively without any

economic benefits. Palm oil shells are hard, carbonaceous, organic by- products of the processing of the palm oil fruit. In India palm oil is cultivated in more than 15 states by covering about 50,000 hectares under irrigated conditions and this crop also cultivated under rain fed conditions. India currently produces just 60,000 tons of Palm Oil (2009 - 2010). However, it is also the main contributor to the nation's pollution problem as a solid waste in the form of shells, which involves n annual production of approximately 1,00,000 tons. Palm oil shell, which presents serious disposal problems for local environment, is an abundantly available agricultural waste from palm oil shell industries. In developing countries where abundant agricultural and industrial wastes are discharged, these wastes can be used as potential materials or replacement material in the construction industry. This will have the double advantage of reduction in the cost of construction materials and also has a means of disposal of wastes.

1.1 Methodology

Preliminary investigation is done to experimentally study the properties and behavior of concrete in which coarse aggregate is replaced by palm oil shell to arrive at an optimum replacement of coarse aggregate. The parameters are considered for the proposed study were the workability, cube compressive strength, split tensile strength. M20 grade of concrete was prepared. The coarse aggregate was replaced with palm oil shell of 12.5%, 25%, 37.5% and 50%.

2.0 Materials and Methods

2.1 **Materials**

Palm oil shell has size ranging from 10mm to 20mm. The strength of palm oil shell depend upon it genetic variety. It has density 1600 to 2050kg/m3. The surface texture was fairly smooth. One month sun dried shells are use in concrete. The specific gravity of palm oil shell is 1.61. The water absorption capacity is 8%. The shells are crushed manually. Ordinary Portland cement 53 grade, river sand, coarse aggregate 20mm, palm oil shell and ordinary tap water were used for making the various concrete mixes considered in this study.

Specific gravity of the materials are given in the Table 1.

Table 1Specific gravity of the materials

Cement	F.A	C.A	PSK
3.15	2.58	2.68	1.62

Aggregate impact value and aggregate crushing values are given Table 2

Table 2 Aggregate impact & crushing values

Aggregate impact value	C.A	27.6%
	PSK	1.14%
Aggregate crushing value	C.A	0.5%
	PSK	8.0%

The test conducted above showed the water absorption of palm oil shell is high compared to that of coarse aggregate. All other properties of palm oil shell is lower than that of coarse aggregate.

The test conducted for finding the properties of palm oil shell and aggregate showed that water absorption of palm oil shell is very high compared to the aggregates. this property of palm oil shell increases the strength of concrete. the introduction of palm oil shell into concrete reduces the workability of the mix.

2.2 Mix Proportion

M20 grade of concrete was prepared. The coarse aggregate was replaced with palm oil shell of 12.5%, 25%, 37.5% and 50%by volume. The casting was done in cast of size 150mm × 150mm × 150mm internally. A total of 15 cubes and 15cylinders were casted. After casting, the moulds were covered with plastic sheets to

prevent loss of water. The specimens were removed from the mould after twenty four hours and immersed in a curing tank to hydrate for strength gain for crushing at 7days, 14days, and 28 days. The cubes were removed from the curing tank and left in the open air for about two hours to dry before crushing

Mix proportion of palm oil shell in concrete is given in Table 3

Table 3 Mix proportion per m^3

Mix description	w/c	OPC	FA	CA	
				CA	PK
		(kg/ $m^{3)}$			
A1	0.5	383	542	1203	0
A2	0.5	383	542	10526	150.4
A3	0.5	383	542	902.2	300.8
A4	0.5	383	542	751.9	451.1
A5	0.5	383	542	601.5	601.5

3.0 Test on Concrete

3.1 Tests on Hardened concrete

Compressive tests and split tensile tests are carried out as per IS : 516-1959[5]. Three specimens were prepared for each mix.

4.0 Results and Discussions

4.1 Compressive strength

Compressive strength results are given in Table 4.

Table 4 Compressive strength

Mix description	Average Compressive Strength (N/mm^2)		
	7 Days	14 Days	28 Days
A1	17.64	22.73	26.96
A2	15.45	19.67	21.86
A3	13.58	16.39	19.48
A5	11.58	13.69	16.29
A1	9.97	10.21	13.48

It is seen from the table the compressive strength decreases the as palm kernel shells content increases. But the compressive strength increases with the curing time[3,4]. The maximum compressive strength compressive strength was attained at 28 days of curing for all replacement level. Thecompressive strength is maximum at 0% replacement by PKS and minimum at 50% replacement.

The compressive strength achieved for various proportions are given in Figure 1

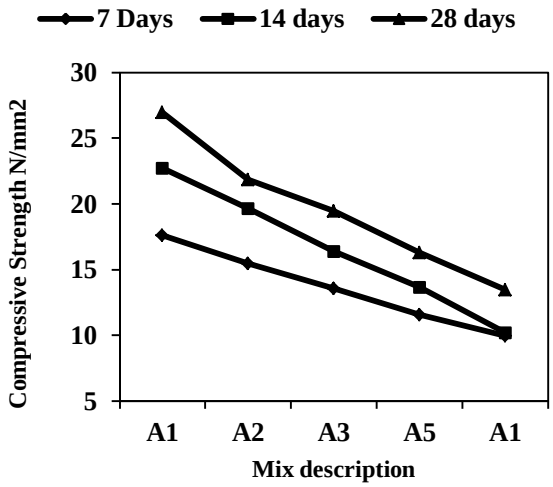

Figure 1 Compressive Strength

4.2 Split Tensile Strength

Split tensile strength results are given in table 4 and Figure 2.

Table 4 split tensile strength at 28th day

Mix description	Split tensile Strength at 28 days(N/mm^2)
A1	2.5
A2	2.2
A3	1.8
A4	1.5
A5	1.3

It is seen from the table the split tensile strength decreases the as palm kernel shells content increases. But the split strength increases with the curing time. The split tensile strength is maximum at 0% replacement by PKS and minimum at 50% replacement.

The split tensile strength achieved for various proportions are given in Figure2.

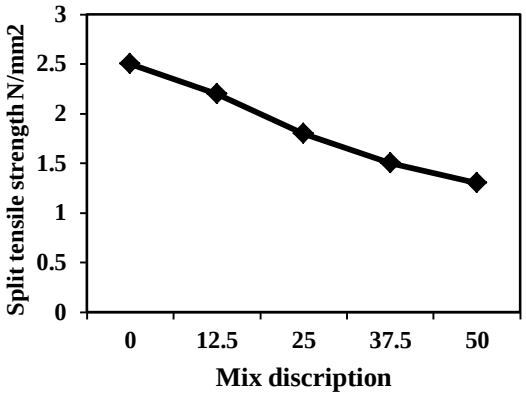

Figure 2 Spilt Tensile Strength

5. Conclusions

- From the results there is an increase in compressive strength by 9% than the control specimen for 12.5% replacement of palm oil shell and the compressive strength decrease up to 30% at 50% replacement levels for 28 days of water curing.
- Split tensile strength of M20 grade Concrete after 28 days of curing, for10% replacement strength increases by 7.5% than the control specimen and strength decreases up to 35% for 40% replacement levels.
- From the studies it is made clear that palm oil shell in concrete can be further explored for applications in construction and it can be used for non structural applications. Further it is also contribute to the nation's pollution problem as a solid waste in the form of shells.

6.0 References

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