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Strength Properties of Concrete Palm Oil Fuel Ash

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Abstract: ***Utilization of agro waste materials in the field of construction is increasing day by day, and is expected to increase with the advancement in tools and the desire to achieve economical and flawless material. In this study the properties of concrete with palm oil fuel ash is being studied. In this study cement is replaced with palm oil fuel ash with varying percentages of 5, 7.5, 10, 12.5, 15%, and 17.5% of pofa with a constant water-cement ratio of 0.5. In this study workability properties of concrete like slump test were done and it has shown satisfactory results and strength property, flexural strength is done. At 15% it has shown increase in strength.***

Keywords: Palm oil fuel ash, workability, slump test, flexural strength

1. Introduction

Palm oil tree is a tall tree belonging to palmea family. Equatorial countries have huge production of palm oil and their products, which resulting in a huge generation of solid waste of nearly 30 tons a year in India. In this mill to the kernels of palm oil and its leaves are used as fuel. The ash thus generated is called as palm oil fuel ash. This ash is disposed freely in atmosphere which is becoming a threat. The produced waste has to be dumped into a landfill which is also a problem to environment. It has been found that this palm oil fuel ash contains pozzolanic properties which can be used in concrete by replacing cement. The ash which we obtain will be of non uniform size, it is pulverized in to fine powder and used. In this study the pofa is replaced with cement and it's workable and strength properties are studied.

2. Experimental Procedure

2.1 Materials

- **Cement**
  Portland cement is produced by burning finely divided clay or shale and chalk or limestone at a temperature of around 1500^0 C, which is a both adhesive and cohesive in nature. OPC of grade 55 is being used in this study.
- **Coarse Aggregate**
  The selection of coarse aggregate is very important as most of the strength properties depend on it. Few properties which effect are workability and bond in concrete matrixes. In this study the crushed aggregate of angular shape and of size 10mm is used.
- **Fine Aggregate**
  One of the most important factors which affect the strength of concrete is the proper selection of fine aggregate i.e sand. Necessary care should be taken in the selection of sand.
- **Water**
  The chemical reaction between cement and water is most important to produce required strength. Thus it is necessary that the water used should be from any type of pollution or any substance which affect the chemical reaction between water and cement which results in the reduction of strength of concrete.
- **Palm Oil Fuel Ash**
  Palm oil fuel ash is the byproduct obtained from burning palm oil fruit, palm shell and dry palm oil tree leaves in the palm oil mill. Generally the ash which is located at the shaft of the tower where we will have all the fine ashes trapped while escaping from the burning chamber of the boiler is collected. Among those ashes, only the grayish colored ash will be collected. Here the dried ashes will be sieved to remove bigger size of ash particles and other impurities then the fine ashes passing through 300µm will be used.

3. Results and Discussions

3.1 Slump Test

A workable concrete is one which can be transported, placed, compacted and finished easily without segregation. Slump test is conducted on concrete to determine its workability with 5%, 7.5%, 10%, 12.5%, 15% and 17.5% POFA replaced with cement. In this study 3 batches of concrete were tested for workability. The results are shown in table 1.

Table 1

Percentage of POFA	Batch No	Slump	Average Slump
0%	1	61.50	62.83
	2	62.00	
	3	65.00	
5%	1	68.00	71.83
	2	72.50	
	3	75.00	
7.5%	1	77.00	80.83
	2	80.00	
	3	85.50	
10%	1	88.50	91.83
	2	90.00	
	3	97.00	
12.5%	1	94.5	95.83
	2	95.5	
	3	97.5	
15%	1	98.5	97.83
	2	98.00	
	3	97.00	
17.5%	1	99.50	101.83
	2	100.50	
	3	105.50	

3.2 Compaction Factor Test

This test is done on fresh concrete. Here also 3 batches of concrete were tested for the workability. The results of this test are shown in the below table 2

Table 2

Percentage of POFA	Batch No	Compaction factor	Average compaction factor
0%	1	0.93	0.93
	2	0.94	
	3	0.92	
5%	1	0.94	0.93
	2	0.93	
	3	0.93	
7.5%	1	0.94	0.93
	2	0.95	
	3	0.92	
10%	1	0.95	0.94
	2	0.93	
	3	0,94	
12.5%	1	0.95	0.95
	2	0.95	
	3	0.95	
15%	1	0.94	0.95
	2	0.96	
	3	0.95	
17.5%	1	0.96	0.96
	2	0.95	
	3	0.97	

From the above results it can be noted that the compaction factor is increasing and it is high at 17.5%.

3.3 Flexural Strength Test

Flexural strength is the capacity of the beam or a slab to resist failure against bending, this is also known as modulus of rupture. The flexural strength is tested for 7, 14 and 28 days. The results are shown in the below table

Table 3

% of POFA	*Flexural Strength*		
	7 DAYS	*14 DAYS*	*28 DAYS*
0%	2.02	3.08	3.78
5%	2.01	2.98	3.23
7.5%	1.96	3.03	2.10
10%	1.78	2.50	3.23
12.5%	1.21	1.98	3.43
15%	1.20	1.78	4.23
17.5%	0.85	1.50	3.50

4. Conclusion

After careful experimentation on concrete with varying percentage of POFA. The study of the results of the tests like slump test, compaction factor test and flexural strength test are discussed below

1) There is a increase in the slump with the addition of POFA and compaction factor test results can also be correlated with it.
2) Consumption of POFA as an cementing agent will reduce the environmental problem associated with its disposal.
3) Flexural strength is slightly increased with the addition of POFA at 15%.

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