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EFFECT ON STRENGTH PROPERTIES OF CONCRETE BY PARTIALLY REPLACING CEMENT WITH PALMOIL FUEL ASH

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ABSTRACT

Rapid growth of infrastructure has led to the use of concrete almost everywhere, and one of the main products required in manufacturing concrete is cement, with the increase in the amount of cement used, heat of hydration increases which will lead to the formation of cracks in concrete accompanied by shrinkage effect. In order to control this, palm oil fuel ash, an agro waste which contains some amount of silica act as a pozzolanic material is being used as cement replacement and its strength is compared with conventional concrete of grade M30. Palm oil fuel ash which is obtained by burning palm fruit and dry leaves of palm oil tree in palm oil mills is also used to control heat of hydration effect on concrete, after pulverizing and making it into a fine powder. In this study cement is being replaced with palm oil fuel ash by 5%, 10%, 15%, 20%, 25% up to 40% and the strength tests like compressive strength test, tensile strength test, flexural strength test are performed and are compared with the results of conventional concrete of grade M30 for 3,7 and 28 days.

Key words: palmoil fuel Ash, pozzolanic materil, Compressive strength, Tensile Strength

I.INTRODUCTION

With the development of cities and their infrastructure and the advancements of tools the usage of concrete is gaining importance. Due to advancements in material technology concerts up to 100Mpa are used, generally these high strength concrete requires high amount of cement which leads to increase in the heat of hydration leading to formation of cracks. This higher usage of cement leading to increase in heat of hydration can be tackled by reducing the amount of cement with some other cementing agents, and one such among is PALM OIL FUEL ASH. This palm

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oil fuel ash is the agro waste produced in manufacturing palmoil, this is produced by burning palm oil fruit and its leaves. This is being disposed in huge amount which is becoming a threat to environment.

reduction in cost of concrete as the utilisation of cement is replaced with palm oil fuel ash, environmental damage can be minimised as the freely disposed palm oil fuel ash is being used in manufacturing concrete also the durability, appearance and strength of concrete can be increased by eliminating the formation of crack

II.LITERATURE REVIEW

Chindaprasirt et al. (2007) used ground POFA in concrete and found that POFA has a good potential for concrete production. They observed that the partial replacement of OPC by ground POFA resulted in a higher water demandfor a given workability of concrete. Moreover, they observed that the compressive strength of concrete with 20% ground POFA was as high as OPC concrete. The strength decreased when the POFA content became higher than 20%. A POFA content higher than 20% also increased the permeability of concrete. Hence, the optimum POFA content found by Chindaprasirt et al. (2007) was 20%. In addition, Hussin and Ishida (1999) used 20–40% ground POFA by weight of OPC in concrete. They determined the compressive strength, modulus of elasticity, Poisson's ratio, shrinkage and creep of concrete, and found that, up to 30% POFA content, the aforementioned properties of hardened concrete are comparable to those of OPC concrete

Tay (1990) used unground POFA to partially replace ordinary portland cement (OPC) and showed that it had a low pozzolanic property, and therefore recommended that POFA should not be used with a content higher than 10% of cement by weight. Later many researchers showed that ground POFA can be successfully used as a upplementary cementing material in concrete due to its good pozzolanic property (Chindaprasirt et al. 2007; Hussin and Awal 1997; Sukantapree et al. 2002; Tangchirapat et al. 2003). Tonnayopas et al. (2006) used 5–30% ground POFA by weight of OPC and found that the incorporation of POFA in concrete decreased the strength at early ages (3 to 21 days) but the strength achieved at and after 28 days for the concretes with 5–15% POFA met the ASTM C618 requirement (ASTM C618-08a 2008). .[4] analyzed microwave waveguides and components such as microwave T junctions , circulators, attenuators and Isolators.

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III.CONSTITUENT MATERIALS

A. MATERIALS USED

The ingredients used in this work are same as those used in conventional concrete. But here we introduce palm oil fuel ash as a partial replacement for cement. The materials used are cement, sand, coarse aggregate, palm oil fuel ash and water.

CEMENT

ordinary cement of 53 grade conforming to IS:12269-1987 has been used. The physical properties of the cement obtained on conducting appropriate test as per IS:269/4831.

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Table 1 properties of cement

Grade	OPC 53
Specific gravity	3.1
Initial setting time	120 min
Final setting time	400 min
Standard consistency	33%
Fineness	4.95

FINE AGGREGATE

Those fractions from 4.75mm to 150 microns are termed as fine aggregate. The river sand and crushed sand is used in combination as fine aggregate conforming to the requirements of IS:383. The river sand is washed and screened, to eliminate deleterious materials and oversize particles.

Table 2 properties of fine aggregates

Si no	Particulars	Values
1	Specific gravity	2.7
2	Fineness modulus	2.37

PALM OIL FUEL ASH

Palm oil fuel ash is a agro waste generated in palm oil industry. palm kernel shell and fiber husk wastes are burned in boilers as fuels the generation of ene rgy. In order to collect the very fine particles of ash water is sprinkled over the chimney to increase the weight of particles. This collected ash from storage shaft was further pulverized , oven dried and passed through 90micron sieve and used for cement replacement

Table 3 properties of palm oil fuel ash

PROPERTY	**% CONTENT**
SiO_2	63.4
Al_2O_3	5.5
Fe_2O_3	4.2
CaO	4.3
MgO	3.7
K_2O	6.3
SO_3	0.9
LOI	6.0

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Fig 1 palm oil fuel ash

COARSE AGGREGATE

The fractions from 20mm to 4.75mm are used as coarse aggregate. The coarse aggregate from crushed basalt rock, conforming to IS:383 is being use. The flakiness and elongation index were maintained below 15%

Table 4 properties of coarse aggregates

Si no	Particulars	Values
1	Specific gravity	2.78
2	Fineness modulus	8.27

WATER

Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to from the strength giving cement gel, the quantity and quality of water to be **looked in to very care**

IX PROPORTION

the concrete mix is designed as per IS10262-2009 and IS456-2000 for the normal concrete. The grade of concrete adopted is M30 with a water cement ratio of 0.45.five mix proportions were made. First was control mix(without palm oil fuel ash) and the other four mixes contained palm oil fuel ash. Cement was replaced with palm oil fuel ash by weight. the proportions of cement replaced ranged from 10% to 40%. Mix proportions are given in table 5

Table 5 Mix proportions

Mix no	C	P1	P2	P3	P4
Cement (kg/m^3)	437.78	394	350.22	306.45	262.6
POFA(%)	0	10	20	30	40
POFA(kg/m^3)	-	43.78	87.56	131.33	175.11
Water (lts)	197	197	197	197	197
Sand(kg/m^3)	643.68	643.68	643.68	643.68	643.68
C A(kg/m^3)	1104.36	1104.36	1104.36	1104.36	1104.36

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IV RESULTS AND DISCUSSIONS

The concrete properties such as compressive strength test, splitting tensile strength test and flexural strength test were performed in accordance with the provisions of the IS standard specification IS516-1959

A. COMPRESSIVE STRENGTH TEST RESULT

It is one of the most important test conducted on hard concrete. The compressive strength tests are conducted on POFA concrete for different mixes. The test is conducted for 3, 7 and 28 days under compressive strength test machine. The results obtained after conducting tests are shown in the below table .from the results it can be noted that upto 20% replacement of cement by POFA ,a compressive strength of 30N/mm^2 can be obtained. When more than 20% is replacing , the compressive strength goes below than targeted strength of 30N/mm^2

Table 6: compression behavior of palm oil fuel ash concretes

Mix type	Compressive strength N/mm^2	
	7 days	28 days
C	28.07	36.89
P1	29.41	35.63
P2	27.71	32.7
P3	23.04	28.44
P4	18.59	23.48

Fig 2 : compression test

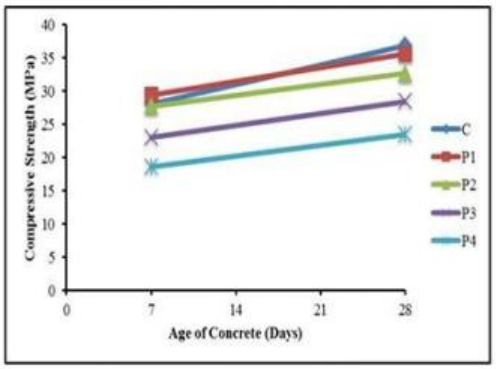

fig 3:variation of compressive strength with age

B. SPLITTING TENSILE STRENGTH TEST RESULT

the results of splitting tensile strength of concrete with and without palmoil fuel ash measured at 28 days are given in below table .the test result indicate that the splitting strength increases as the percentage of the POFA increases from 0% to 10%. However for 20% ash added, the tensile strength development was the same as the control samples. When the replacement of POFA is increased to 30%, strength goes on decreasing. It is observed that mix P1 and P2 containing 10% and 20% POFA respectively performed similar to control mixes.

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Table 7: splitting tensile behavior of palm oil fuel ash behaviour

mix type	splitting tensile strength(N/mm^2) at 28 days
C	2.62
P1	2.69
P2	2.62
P3	2.33
P4	1.99

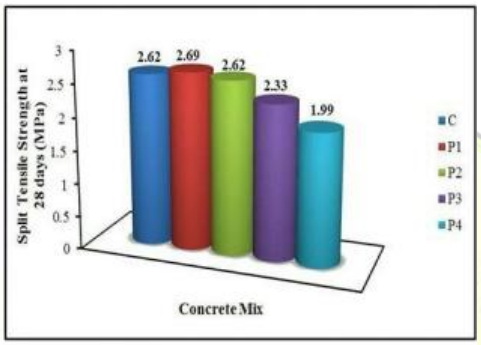

Fig 4: split tensile test fig 5 : variation of split tensile strngth

C. FLEXURAL STRENGTH TEST RESULT

The flexural strength test results of palmoil fuel ash concrete are given in below table. From the results it is well understood that P2 mix achieved the highest flexural strength. It is seen that 28 days flexural strength of 10% replacement of cement with POFA is similar to that of the control mix.when the replacement proportion is increased to 20%, the flexural strength also increases. But further increase in proportion of POFA causes a reduction of Flexural strength.

Table 8: flexural behavior of palm oil fuel ash concrete

mix type	flexural strength(N/mm^2) at 28 days
C	5.71
P1	5.71
P2	6.12
P3	4.89
P4	4.28

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Fig 6: flexural strength test

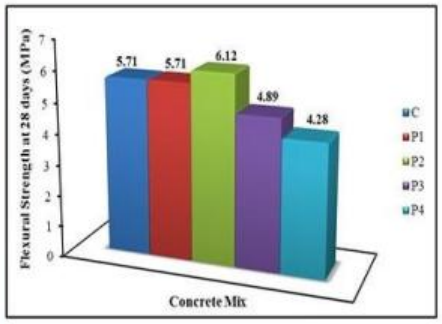

fig 7: variation of flexural strength

V.CONCLUSIONS

The following conclusions could be arrived at from the study:

- Compressive strength ,splitting tensile strength and flexural strength of cement replaced palm oil fuel ash concrete specimens were found to be lower than those of normal OPC concrete
- Results suggests that 20% replacement of POFA could be the optimum level for the production of concrete because strength of concrete reduced gradually beyond this replacement level
- palm oil fuel ash used as cement replacement enables the large utilization of waste product
- long term studies on the development of strength as well as durability aspect of concrete containing POFA have been recommended for further investigation.

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