International Journal of Futuristic Trends in Engineering and Technology
ISSN: 2348-5264 (Print), ISSN: 2348-4071 (Online)
Vol. 3 (05), 2016

Effect of Palm Oil Fuel Ash on Hardened Properties of Concrete

(Paper ID: 35ET3004201619)

Patel Harsh S.
Civil (structure engineering)
L.J institute of engineering and technology
Ahmadabad (Gujarat)India
harshpatel199368@gmail.com

Mr. Vaibhav Doshi
Assistant Professor Civil engineering dep.
L.J institute of engineering and technology
Ahmadabad (Gujarat)India
doshivaibhav@outlook.com

Abstract: The usage of pozzolanic materials in solid development is expanding, and this pattern is relied upon to proceed in the years ahead as a result of mechanical headway and the yearning for practical advancement. One of the most recent increments to this is Palm oil fuel slag (POFA), a waste material got from blazing of palm oil husk and palm piece shell as fuel in palm oil plant boilers, which has been recognized as a decent pozzolanic material. Palm oil fuel slag which contains siliceous creations delivers a more grounded and denser cement. Viable utilization of POFA in cement, would diminish the expense of solid generation, could decrease negative natural impact, furthermore would take care of the landfill issue for the transfer of these squanders.

In this study, the adequacy of agro waste fiery remains by-item in particular palm oil fuel cinder (POFA) was produced as an option material to supplant OPC. POFA bond based cement is a solid delivered by coordinating POFA as a pozzolan in cement. This paper will talk about the quality properties of POFA cement in various supplanting level furthermore contrasts and control blend. Solid examples containing 10%, 20%, 30% and 40% POFA were made at a water-concrete proportion of 0.45. Quality properties, for example, Compressive quality, Flexural Strength and Split Tensile Strength were contemplated, and contrasted and that of cement containing 100% OPC as control. It is uncovered that POFA is an amazing pozzolanic material and can be utilized as an option bond substitution in cement. It is suggested that the ideal substitution level of OPC by POFA is 20% for a decent quality in compressive test.

Keywords: Palm Oil Fuel Ash, Pozzolanic material, Compressive Strength.

I. INTRODUCTION

It is realized that there are a few reasons for a worldwide temperature alteration, including CO2 from bond. Around 5% of aggregate CO2 emanation is discharged to environment, with around 0.7–1.1 ton of CO2 being radiated for each ton of bond generation. Keeping in mind the end goal to decrease the measure of CO2 emanation, bond fabricates can help by enhancing creation process. For solid creation, the decrease of bond substance in cement can be accomplished by use of supplementary cementitious materials, for example, fly fiery remains, impact heater slag, common pozzolans, and biomass cinder. Likewise, the era of expansive amounts of mechanical by-items consistently by substance and rural procedure businesses has made ecological contamination and also expanding the consumption of the business for arranging this waste. Subsequently, strong waste administration has ended up one of the major ecological worries on the planet.

II. LITERATURE REVIEW

During recent decades, many researches have been conducted for the use of agro waste ashes. Some of them are summarized below.

Karim et al., (2011) discovered that the concrete produced using a particular level of POFA replacement achieved same or more strength as compared to OPC concrete. No significant strength reduction of concrete is observed up to about 30% replacement of POFA. Awal et al., (2011) investigated that high volume palm oil fuel ash concrete, like concrete made with other pozzolanic materials, showed a slower gain in strength at early age. Safiuddin et al., (2010) reviewed that the use of POFA is limited to a partial replacement, ranging from 0-30% by weight of the total cementitious material in the production of concrete. Indeed, the partial.

substitution beneficially affects the general properties of concrete and additionally cost. Sata et al., (2010) researched that the quality improvement of POFA cements with w/c proportions of 0.50, 0.55, and 0.60 had a tendency to be in the same course. At early ages, cements containing POFA as a bond substitution of 10, 20, and 30% had lower quality advancement than control cements while at later age 28 days, the substitution at rates of 10 and 20% yielded higher quality improvement. Mohammed Warid Hussin et al., (2009) contemplated concrete supplanted with POFA with a water to fastener proportion of 0.45, were seen to create quality surpassing the outline quality of right around 60MPa at 28-day. Hussin et al., (2008) found that incorporation of 20% POFA would deliver concrete having most astounding quality when contrasted with whatever other substitution level. Ahmad et al., (2008) studied that one of the potential reuses material from palm oil industry is palm oil fuel fiery debris which contains siliceous structures and responded as pozzolans to deliver a more grounded and denser cement.

Malhotra et al., (2005) explored that a pozzolanic material has practically no establishing properties. Notwithstanding, when it has a fine molecule size, within the sight of dampness it can respond with calcium hydroxide at common temperatures to give the solidifying property. Tangchirapat et al., (2003) reported that the synthetic arrangement of POFA contains a lot of silica and can possibly be utilized as a bond substitution. Sukantapree et al., (2002) have found that POFA can be utilized as a part of the development business, particularly as a supplementary cementitious material in cement. Hussin et al., (1996) concentrated on the compressive quality of cement containing POFA. The outcomes uncovered that it was conceivable to supplant at a level of 40% POFA without influencing compressive quality. The most extreme compressive quality increase happened at a substitution level of 30% by weight of cover. Tay et al., (1990) explored that supplanting 10–50% fiery debris by weight of cementitious material in mixed bond had no noteworthy impact on isolation, shrinkage, water ingestion, thickness, or soundness of cement.

III. Experimental Investigations

A) *Materials Used*

a) *Cement*

Ordinary Portland Cement 53 grade conforming to IS: 8112-1939 was used. Its properties are shown in Table 1.

Table 1. Cement Test Results

Sl. No.	Characters	Experimental Value	As per IS:8112 - 1989
1.	Consistency of Cement	32%	-
2.	Specific Gravity	3.15	3.15
3.	Initial Setting Time	50 minutes	>30 minutes
4.	Final Setting Time	460 minutes	<600 minutes

b) *Palm Oil Fuel Ash (POFA)*

Palm Oil Fuel Ash is the product of burning palm oil husk and palm kernel shell in the palm oil mill. POFA obtained from Oil Palm India Limited, Kottayam in Kerala was used in the investigation. The specific gravity of Palm oil fuel ash was 1.65.

Fig. 1. Palm Oil Residues

Fig. 2. Palm Oil Fuel Ash (POFA)

Table 2.

Chemical composition	% in POFA
Silica	21.81
Aluminium	2.76
Iron	3.20
Calcium	5.70
Magnesium	3.978
Potassium	3.23
Sodium	0.76
Phosphorus	3.58
Chlorine	0.34
Sulphur	1.28
LOI	2.99

c) *Fine Aggregate*

Natural sand conforming to Zone II with specific gravity 2.62 was used as the fine aggregate. The maximum size of fine aggregate was taken to be 4.75 mm. The testing of sand was done as per Indian Standard Specifications IS: 383-1970. The sieve analysis result is shown in Fig. 3.

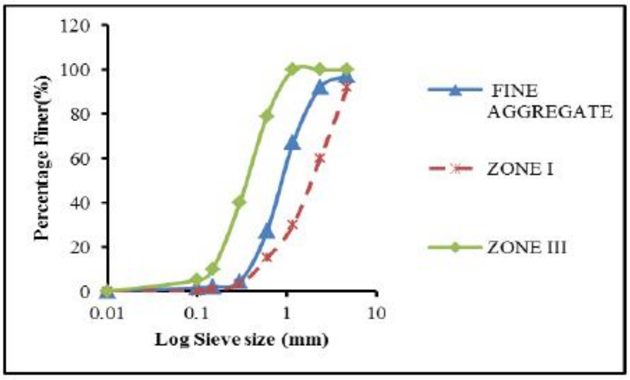

Fig. 3. Particle Size Distribution of Fine Aggregate

d) *Coarse Aggregate*

Coarse aggregate was used with 12mm and 20mm nominal size and specific gravity 2.64, and were tested as per Indian Standard specifications IS: 383-1970. The sieve analysis result is shown in Fig. 4.

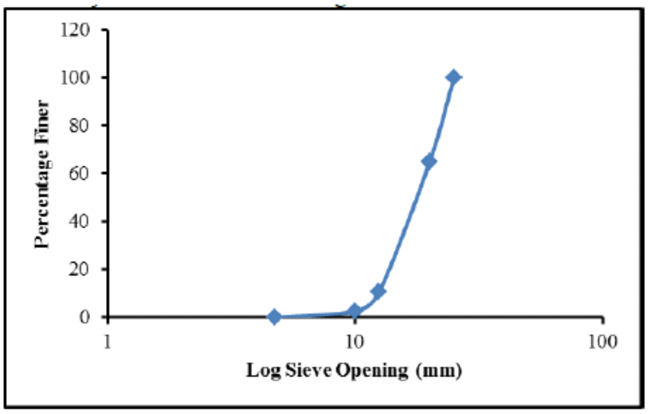

Fig. 4. Particle size distribution of Coarse Aggregate

e) Water

Fresh potable water, which is free from acid and organic substance, was used for mixing the concrete.

B) Mix Proportion

The concrete mix is designed as per IS: 10262 – 2009 and IS 456-2000 for the normal concrete. The grade of concrete adopted is M30 with a water cement ratio of 0.45. Five mixture 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 3. The controls mix without palm oil fuel ash was proportioned as per Indian standard Specifications IS: 10262-1982, to obtain a 28-days cube compressive strength of 30 MPa. The ingredients of concrete were thoroughly mixed in a mixer machine till uniform consistency was achieved.

Table 3. Mix Proportions

Mixture no.	C	P_1	P_2	P_3	P_4
Cement (kg/m^3)	437.78	394	350.22	306.45	262.67
Palm Oil fuel ash (%)	0	10	20	30	40
Palm Oil fuel ash (kg/m^3)	-	43.78	87.56	131.33	175.112
Water (lts)	197	197	197	197	197
Sand (kg/m^3)	643.68	643.68	643.68	643.68	643.68
Coarse aggregate (kg/m^3)	1104.36	1104.36	1104.36	1104.36	1104.36

C) Casting and Curing of Specimens

The 150 mm size solid shapes, solid light emissions 100 mm x 100 mm x 500 mm and chambers of 150 × 300 mm size were utilized as test examples to decide the compressive quality and flexural quality and Splitting Tensile Strength separately. Subsequent to throwing, all the test examples were done with a steel trowel. All the test examples were put away at temperature of around 30oC in the throwing room and are demoulded following 24 hours for water-curing. At the point when the test age is achieved, they are tried for Compressive quality, Splitting elasticity and Flexural Strength.

D) Test Procedure

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 Indian Standard Specification IS: 516-1959.

a) Compressive strength Test

This test will provide the breaking strength of the cube which is made particularly for the purpose of testing the compressed concrete compression strength. The compressive strength of the specimen is determined by dividing the maximum load carried by the specimen during the test by the average cross sectional area.

IV. RESULTS AND DISCUSSIONS

The various aspects studied include the effect on compressive, flexural and splitting tensile strength using palm oil fuel ash in varying percentages as a partial replacement of cement. The results are given below:

A) Compressive Strength

Compressive quality of cement blends made with and without palm oil fuel fiery remains was resolved at 7 and 28 days. The test outcomes are given in Table 4 and are spoken to in Fig. 6. The compressive quality abatements as the rate of fiery debris increments. Notwithstanding, for 10% powder included, the compressive-quality advancement at 7 days was more noteworthy than the control tests, and the 28 day compressive quality was closer to the control tests. As appeared in Fig. 4.4, the 28-day compressive qualities for solid 3D shapes with 0, 10, 20, 30, and 40% supplanting of bond with fiery debris diminish from 36.89 MPa to 35.63 MPa, 32.7 MPa, 28.44 MPa, and 23.48 MPa, separately. According to IS 456 : 2000, the predefined trademark Compressive quality of 150 mm 3D shape at 28 days for a M30 grade cement is 30N/mm2. From the outcomes it can be watched that upto 20% substitution of concrete by POFA, a compressive quality of 30N/mm2 can be gotten. At the point when more than 20% is supplanting, the compressive quality goes beneath than focused quality of 30N/mm2.

Table 4. Compression behaviour of Palm Oil Fuel Ash Concrete

Mix Type	Compressive Strength (N/mm^2)	
	7 days	28 days
C	28.07	36.89
P_1	29.41	35.63
P_2	27.71	32.7
P_3	23.04	28.44
P_4	18.59	23.48

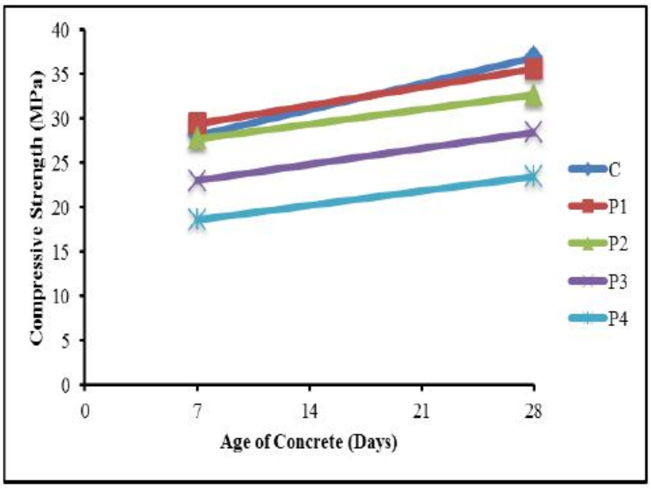

Fig. 5. Variation of Compressive Strength with age

The consequences of part elasticity of cement blends with and without palm oil fuel cinder measured at 28 days are given in Table 5. Test results. demonstrate that the elastic part quality increments as the rate of the POFA increments from 0% to 10%. In any case, for 20% slag included, the rigidity advancement was the same as the control tests. At the point when the substitution of POFA is expanded to 30%, quality continues diminishing. These outcomes are spoken to graphically beneath in Fig. It is watched that blends P1 and P2 containing 10% and 20% POFA individually performed like control blends. Likewise, it can be induced that blend P1 add to the change of malleable part quality than others.

Table 5. Splitting tensile behaviour of Palm Oil Fuel Ash concrete

Mix Type	Splitting Tensile Strength (N/mm^2) at 28 days
C	2.62
P_1	2.69
P_2	2.62
P_3	2.33
P_4	1.99

B) Flexural Strength

The flexural strength test results of palm oil fuel ash concrete are given in Table and shown in Fig. respectively. From the results it is well understood that P_2 mix achieved the highest flexural strength. It is seen that 28 day 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.

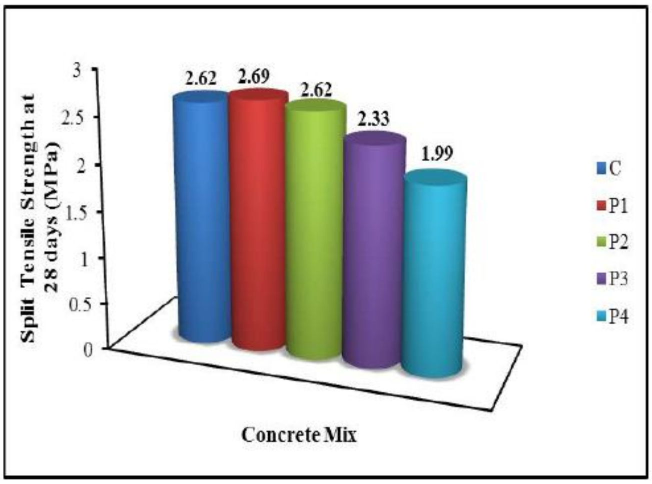

Fig. 6. Variation of Split Tensile Strength

V. CONCLUSIONS

The following conclusions could be arrived at from the study:

- Compressive strength, Splitting tensile strength and of cement replaced palm oil fuel ash concrete specimens were found to be lower than those of normal OPC concrete.
- Results suggest 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.

REFERENCES

[1] Shetty, M. S."Concrete Technology",S. Chand & Company Ltd., 2005, New Delhi.

[2] Abdul Awal A.S.M & Shehu Abubakar., "Properties of concrete containing high volume palm oil Fuel ash: A short-term investigation", Malaysian Journal of Civil Engineering Vol. 23(2), 2011, pp. 54-66.

[3] Abdul Awal A.S.M & Warid Hussin M., "Effect of Palm Oil Fuel Ash in Controlling Heat of Hydration of Concrete", Procedia Engineering, Vol.14 , 2011, pp. 2650–2657.

[4] Ahmad M. H., Omar R. C., Malek M. A., Noor N & Thiruselvam S., "Compressive Strength of Palm Oil Fuel Ash Concrete", ICCBT 2008 - A - (27) – pp297 – 306.

[5] Mohd Warid Hussin., Mohamed A. Ismail., Ahmed Budiea., & Khairunisa Muthusamy., "Durability of high strength concrete containing palm oil fuel ash of different fineness", Malaysian Journal of Civil Engineering, Vol.21 (2), 2009, pp.180-194.

[6] Rezaul Karim., Zain M.F.M., Jamil M. & Nazrul Islam., "Strength of Concrete as Influenced by Palm Oil Fuel Ash", Australian Journal of Basic and Applied Sciences, Vol. 5(5), pp. 990-997, 2011, ISSN 1991-8178.

[7] Vanchai Sata., Chai Jaturapitakkul., & Chaiyanunt Rattanashotinunt., "Compressive Strength and Heat Evolution of Concretes Containing Palm Oil Fuel Ash", Journal of Materials in Civil Engineering, Vol. 22, No. 10, October 1, 2010. ©ASCE, ISSN 0899- 1561/2010/10-1033–1038.