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Properties of Palm Ash Concrete

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Abstract: *Cement is the main construction material for making concrete. It provides good bonding between aggregates and also provides strength. But at the time of manufacturing, cement releases high amount of CO2. In order to reduce the environmental impact and to improve the property of concrete, Palm ash concrete are used. Palm ash concrete containing palm ash as partial substitute for cement. The replacement percentages are 10%, 20%, 30%. In these investigations, compressive strength and durability of palm ash concrete and normal concrete were found out. Results are tabulated and discussed. The properties of palm ash concrete are also compared with the conventional concrete. The palm ash concrete is very economical and also ecofriendly concrete.*

Keywords: *Palm ash, Compressive Strength, Split Tensile Strength, Durability.*

I. Introduction

In concrete, cement gives good binding among aggregates and also gives strength. But for manufacturing, the amount of co_2 released is 1.2 ton per ton of cement, which is hazard to environment. The amount of co_2 released from cement industry contributes 8% among total co_2 released to atmosphere. The cost of cement is also high. To reduce the amount of co_2 released to atmosphere and for economic construction, cement is replaced by palm ash.

Palm ash is a ash obtained by incinerate the by-products of palm oil mill.. These ashes do not have sufficient nutrients to be used as fertilizer. It causes pollution. Therefore several investigations are going to utilize palm ash in good manner. The experimental investigation on palm ash shows the properties of palm ash concrete is similar to the properties of normal concrete. Therefore cement is replaced partially by palm ash in various percentages such as 10%, 20% and 30%. The concrete specimens were casted. The compressive strength, Split tensile strength at various age of curing is determined. The durability of concrete cubes is also determined. The results shows palm ash concrete give high strength, highly durable, economical and also ecofriendly.

II. Literature Review

Augustine U. Elinwa, Michael C. Arimanva, D.O.Onwukainvestigate the uses of Palm bunch ash as mineral admixture in cement and concrete production. The partial replacement of cement by palm bunch ash in concrete up to 20% improved the workability of concrete and also retards the setting time, suitable for hot weathering concrete.

A.S.M.A. Awal and M.W. Hussain examine the influence of palm oil fuel ash in reducing heat of hydration of cement of concrete. The partial replacement of cement by palm oil fuel ash is advantages particularly for mass concrete where thermal cracking is the main concern.

M.H.Ahamed, R.C.Omar, M.A.Malek, N.Md.Noor, S.Thiruselvam evaluate the compressive strength of palm oil fuel ash concrete. The partial replacement of cement by palm oil fuel ash up to 15% give strength as that OPC concrete compare to other pozzalonas and also increase the percentage of replacement of cement by palm ash, the workability will reduce.

III. Experimental program

Test matrix

Specimen having various percentage of palm ash about 0%, 10%, 20% and 30% by weight of cement in concrete mix of M_{20}.

Materials

Cement:

53 grade Ordinary Portland cement confirming to IS 8112-1976 is used in this project work. The specific gravity of cement is 3.16

Fine Aggregate: Sand of size below 4.75 mm with specific gravity- 2.61, fineness modulus -2.36 and bulk density- 1417 kg / m^3 was used.

Coarse Aggregate*:* Crushed stone of size 12mm is used as Coarse aggregate having specific gravity-2.66, bulk density- 1389 kg/ m^3 was used.

Palm ash: Palm ash is a waste material obtained by incinerating palm fibres, palm bunch and palm kernel shells after extraction of oil in palm oil industry. The palm ash having size 90µ and specific gravity of 2.6 is used in this project.The chemical composition is given in Table 1.

Table 1: Chemical composition

Component	% Content
CaO	19
SiO_2	62.5
Al_2O_3	4.5
Fe_2O_3	3.12
K_2O	2
SO_2	0.53

Mix proportion: For grade M20 concrete, the mix proportion was arrived by IS method. The mix proportions satisfied the IS 10262-2009 are given in Table 2.

Table 2: Mix proportion

Specimen	C(Kg/m^3)	PA(Kg/m^3)	FA(Kg/m^3)	CA(Kg/m^3)
CC	1.29	0	1.88	4.128
PAC10	1.161	0.129	1.88	4.128
PAC20	1.032	0.258	1.88	4.128
PAC30	0.903	0.387	1.88	4.128

IV. Specimen fabrication

Specimens were fabricated in the laboratory with a typical cross section of 150x150x150 mm and 150 x300 mm. The mix was prepared according to the mix proportion and poured in to the steel mould. The specimen was kept in the mould for 24 hours and then curing was done for 7, 14 and 28days. The number of specimens prepared for each percentage replacement of cement by palm ash for finding compressive strength, Split Tensile Strength and durability are given in Table 3 and 4.

V. Testing setup and procedure

At the end of curing period of 7, 14 and 28 days, take 3 cube of each proportion from curing tank. Wipe the cube with clean cloth and measure the dimension on face of the cubes. Take the weight of the specimen. Then place the concrete cube in the compression plate under the compression testing machine. Apply the load gently over the cube. The ultimate load at which cube will fail under compression is noted down. From which compressive strength is calculated.

Table 3: Specimen details-compressive strength

Specimen	No.of.cubes for Compressive Strength	No.of.cubes for Split Tensile Strength
CC	9	9
PAC10	9	9
PAC20	9	9
PAC30	9	9

Table 4: Specimen details-Durability

Specimen	No.of.cubes
CC	3
PAC10	3
PAC20	3
PAC30	3
Specimen	No.of.cubes
CC	3
PAC10	3
PAC20	3
PAC30	3

1.4 Testing setup and procedure

Specimen from each proportion is tested at the end of curing period of 7, 14 and 28 days, take 3 cube of each proportion from curing tank. The specimen is weighed before testing of the specimen. Then the specimen is

tested in the compression testing machine. Apply the load gently over the cube. The ultimate load at which specimen get failed is noted down. From which compressive strength and split tensile strength is calculated.

VI. Experimental results and discussion

1.5.1 Compressive Strength

The ultimate load carrying capacity of specimen was determined in the load testing. This data was used to obtain the optimum level of replacement. The PAC20 specimens have greater compressive strength than the control specimen. The strength was increased by 35%.

1.5.2 Durability

Durability is the ability of **concrete** to resist weathering action, chemical attack, and abrasion. The specimen is immersed in a H_2SO_4 solution for 45 days and 90 days. After the acid curing duration, the specimen is weighted. The specimen weight was decreased after the acid curing. Up to 20% replacement, acid cured specimen withstand in the compressive testing.

1.5.3 Split Tensile Strength

The split tensile strength of the specimen was determined in the load testing. The PAC20 specimens have greater tensile strength than the control specimen.

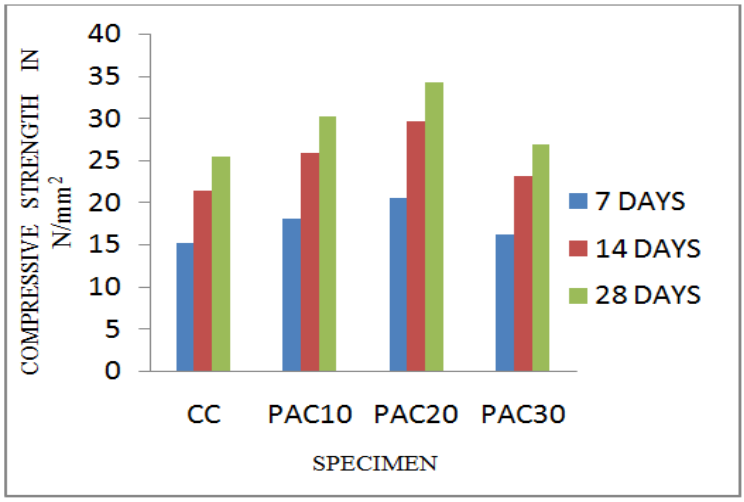

Figure 1. Specimen Vs Compressive Strength

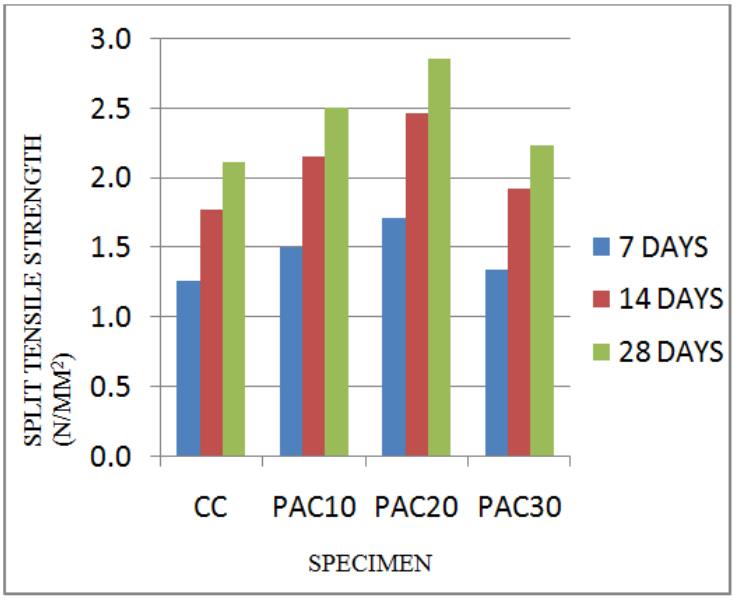

Figure 2. Specimen Vs Split Tensile Strength

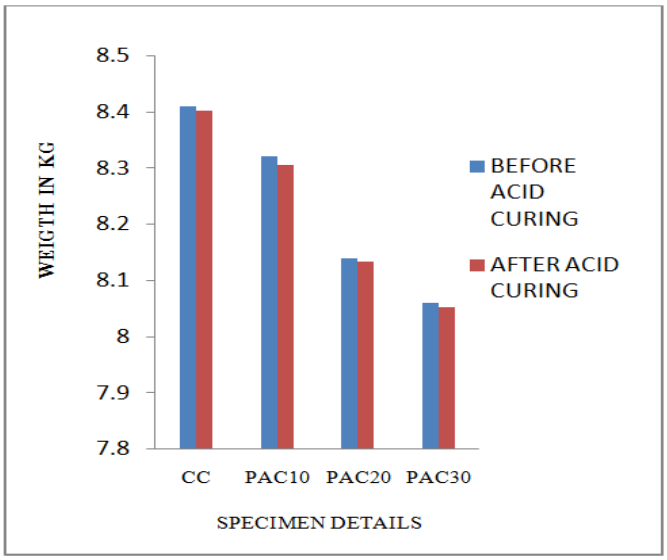

Figure 3. Specimen Vs Weight

VII. Conclusion

The following conclusions are made from this investigation

- Replacement of cement by palm ash in concrete causes strength variation.
- The palm ash shows high strength compare to conventional concrete.
- Replacement reduces the density of concrete and increases the acid resistance of palm ash concrete then conventional concrete
- The Optimum level of replacement of palm ash in concrete is 20%.
- Palm ash concrete reduces the pollutant and consider as eco-friendly material.

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