Experimental Investigation of Different Fly Ash In Concrete

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Abstract- *The principal binder in concrete is Portland cement. The cost of cement used in concrete is increased, yet the need for housing and other constructions requiring this material. The production of cement is a major contributor to greenhouse gas emissions that are implicated in global warming. So, thus we need to find the alternative binding material as replacement of cement. In this case, natural waste materials like rice husk ash, coconut coir pith ash, palm oil fuel ash, sugarcane bagasse ash as partial replacement of cement in concrete. The rice husk and coconut coir pith are incinerated at high temperatures. The concrete cubes were tested at the ages 7, 21, 28 days. The grade of concrete as M20 is used. Properties such as compressive strength, workability, setting time are determined. To compare the four materials as to find the best one to use from the results.*

Keywords- Cement. Coarse aggregate, Fine aggregate and Fly ash

I. INTRODUCTION

Cement is a classical construction material whose use cuts across all fields of civil engineering and building construction. The cement production rate is approximately 2.1 million tonnes per year, and is expected to grow exponentially to about 3.5 billion tonnes per year by 2015. The production of 1 ton of cement contributes to about 1 ton of co_2 into the atmosphere; approximately 7% world's co_2 emission is accountable for production of ordinary Portland cement. The utilization of supplementary cementing material like flyash in concrete production is one of the solutions to reduce the cement content as well as co_2. The uses of fly ash in concrete also reduce the green gas emission. The pollution associated with cement production, has necessitated a search for an alternative binder which can be used in partial replacement of cement in concrete production. During recent decades, many researches have been conducted for using the different types of agro waste ashes such as rice husk ash, sugarcane bagasse ash, palm oil fuel ash, coconut coir pith ash. Research indicates that most materials that are rich in amorphous silica can be used in partial replacement of cement. Their utilization not only improves properties and durability of concrete, but also makes it cost effective and environment friendly.

RICE HUSK ASH

Rice husk ash is an agricultural waste which is produced in millions of tons. Approximately, 20kg of rice husk are obtained for 100kg of rice. This material is actually a super-pozzolan since it is rich in silica and has about 85% to 90% silica content. Presence of silica in this pozzolanic material makes possible the use of rice husk ash to replace part of cement. Pozzolanic definition by ASTM C618(1978) is a siliceous or siliceous and aluminous material which, in itself, possesses little or no cementitious value but which will, in finely divided for in the presence of moisture, react chemically with calcium hydroxide at ordinary temperature to form compounds possessing cementitious properties.

PALM OIL FUEL ASH

Palm oil fuel ash is one of the agro-waste produced from palm oil mills. Palm oil fuel ash is the ashes produced from husk fibre and shell of palm oil burning by generation plant boiler which generate energy to be used in palm oil mill in order to extract palm oil. Its chemical composition contains a large amountof silica and that has high potential to be used as a cement replacement. The palm oil fuel ash is spherical in shape and its fineness is almost similar to Portland cement fineness to ease the silica containing in flyash able to react.

SUGARCANE BAGASSE ASH

Sugarcane bagasse ash is a by-product of the sugarcane industry. Sugarcane bagasse ash can be used as partial replacement of cement in concrete because it presents proper chemical composition for application as a pozzolanic, mainly in regard to its high content in silica. Several studies have been conducted to investigate the chemical effect or pozzolanic activity of sugarcane baggasse ash and concluded that sugarcane bagasse ash is a pozzolan, which improves the performance when mixed to cement. In addition Ganesan et al. showed that sugarcane bagasse ash used as partial replacement

for Portland cement could increase the mechanical and durability.

COCONUT COIR PITH ASH

Coconut coir pith is one of the wastes, produced from coir industries. In the extraction of coir fiber from the coconut husk and in the production of finished materials from the extracted fiber, a large amount of coir dust is produced. The coir dust is about 70% of the weight of the coconut husk. It is described as that brown, spongy particle of low weight which falls out when the fiber is shredded from the husk. Coconut coir pith ash is a highly reactive pozzolanic material suitable for use in Portland cement replacement.

II. LITERATURE REVIEW

Large number of researchers **(Mehta, 1983; Malhotra et al., 1992; Massazza, 1993 and Nagtaki, 1994)** conducted since last century has provided a wealth of information on composition and characteristics of pozzolans and their effects on properties of concrete. The objective of this thesis is to present a durability of high strength concrete in particular, from the viewpoint on providing scientific explanations for some of the phenomenological observations. This is needed to encourage the proper use of new cement substitutes in cement and concrete industry.

Naik T et al., reported that 2000, the worldwide cement clinker production was approximately 1.6 million tons. Mixed with water and aggregates, the resulting concrete is second only to water as the most consumed substance on earth. The consumption of cement correlates to the economic development of a country as a base for new building, factories and infrastructures which are the root of development. As a result of this cement manufacturing has increased sharply in those developing countries.

Mehta, (1983) states that the relatively most soluble and alkaline then the other hydration product, it is easily subjected to attack by water or acidic solutions, thus reducing durability of Portland cement systems to such environments.

Abdullah and Hussin, (2006) states that the ash produced sometimes varies in tone of colour from whitish grey to darker shade based on the carbon content in it. In other words, the physical characteristic of POFA is very much influenced by the operating system in palm oil factory. In practise, POFA produced in Malaysian palm oil mill is dumped as waste without any profitable return.

Neville, (2005) states that the pozzolanicity of any material is closely related to the ability of silica to react with calcium hydroxide to produce calcium silicate hydrate. For an assessment of pozzolanic activity with cement, the method of pozzolanic activity index which determines the total activity of pozzolana.

III. COMPRESSIVE STRENGTH OF FLY ASH CONCRETE CUBES

Compressive strength after 7 days curing

Table.1 Compressive strength of different fly ash concrete at 7 days

Sample designation	Sample of fly ash	Percentage of fly ash	Compressive strength (N/mm2)
S1	Sugarcane ash	10	18.52
S2	Sugarcane ash	20	15.60
P1	Palm oil ash	10	18.10
P2	Palm oil ash	20	14.09
R1	Rice husk ash	10	17.34
R2	Rice husk ash	20	13.86
C1	Coir pith ash	10	17.60
C2	Coir pith ash	20	15.85

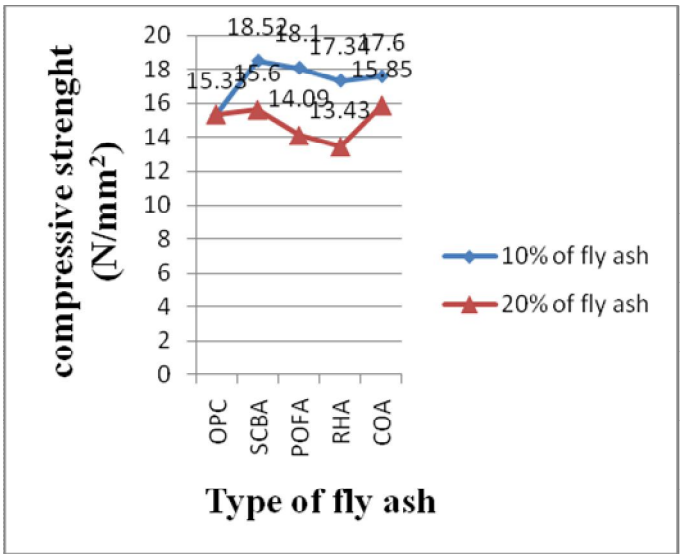

Fig. 1 Compressive strength of different fly ash concrete at 7 days

COMPRESSIVE STRENGTH AFTER 21 DAYS CURING

Table .2 Compressive strength of different fly ash concrete at 21 days

Sample designation	Sample of fly ash	Percentage of fly ash	Compressive strength (N/mm²)
S3	Sugarcane ash	10	28.30
S4	Sugarcane ash	20	22.90
P3	Palm oil ash	10	27.99
P4	Palm oil ash	20	23.04
R3	Rice husk ash	10	27.34
R4	Rice husk ash	20	20.64
C3	Coir pith ash	10	26.27
C4	Coir pith ash	20	22.26

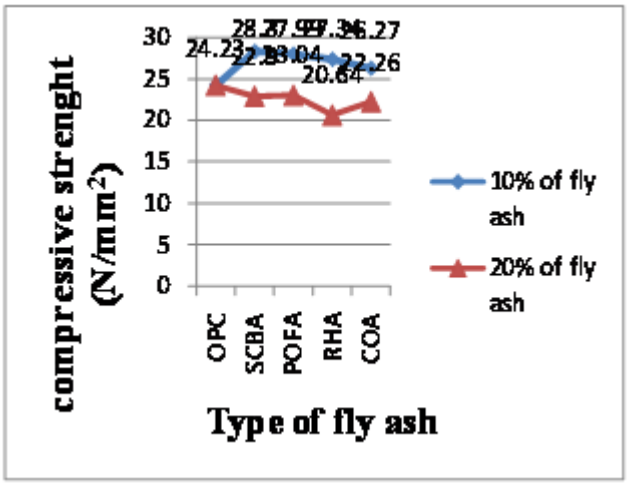

Fig.2 Compressive strength of different fly ash concrete at 21 days

COMPRESSIVE STRENGTH AFTER 28 DAYS CURING

Table 3 Compressive strength of different fly ash concrete at 28 days

Sample designation	Sample of fly ash	Percentage of fly ash	Compressive strength (N/mm²)
S5	Sugarcane ash	10	29.24
S6	Sugarcane ash	20	23.65
P5	Palm oil ash	10	28.47
P6	Palm oil ash	20	24.28
R5	Rice husk ash	10	28.34
R6	Rice husk ash	20	21.28
C5	Coir pith ash	10	27.13
C6	Coir pith ash	20	22.95

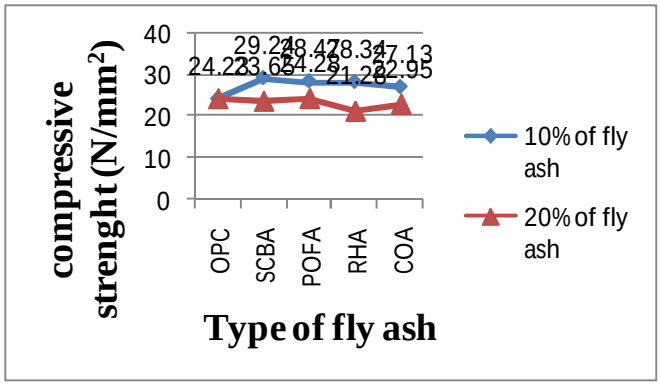

Fig. 3 Compressive strength of different fly ash concrete at 28 days

The compressive strength of different fly ash concrete is calculated the table 27, 28, 29 at the age of 7, 21, 28 days. The compressive strength of concrete in all fly ash can achieve 20 N/mm^2 for M20 grade of concrete. The 10% of fly ash is more compressive strength to compare the OPC. The higher strength is obtained by sugarcane bagasse ash to compare other fly ash. The strength is reduced at 20% of fly ash in concrete. The comparison shows that table 29 at 28 days compressive strength of fly ash concrete. Fig 7, 8, 9, the graphical representation of strength variation in fly ash concrete.

IV. CONCLUSION

- The consistency test results gives RHA is nearer to the OPC.The compressive strength of M_{20} concrete is 24.23KN.
- The compressive strength of POFA and SCBA are 28.47KN and 29.24KN.SCBA compressive strength is (29.24KN) highly to M_{20} concrete of 10% replacement.
- The setting time of cement with fly ash is best for RHA & POFA.From the study conducted it was clearly shown that POFA is a pozzolanic material that has the potential to be used as partial replacement material.

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