Study on Cement Mortars Made with Coir Pith Particles

A.Oorkalan
Department of Structural Engineering
Government College of Technology
Coimbatore, India

Dr. S.Chithra
Assistant Professor
Department of Structural Engineering
Government College of Technology
Coimbatore, India

***Abstract*- In general, industrial wastes are used as replacement of sand in mortar. The commonly used materials are slag, foundry sand, and quarry dust etc. In the present study, coir pith is partially replaced for sand in mortar. The coir pith is a byproduct of the coconut based industry and it consists of the coir fiber pith or coir dust. From the results, it is seen that cement mortar with replacement of sand by 5% coir pith mixed with fly ash mortar has comparable compressive strength with conventional mortar.**

Keywords- Coconut coir pith, compressive strength, fly ash, lime water

I. INTRODUCTION

Mortar is a workable paste used to bind building blocks such as stones, bricks and concrete masonry units together, fill and seal the irregular gaps between them, and sometimes add decorative colors or patterns in masonry walls. Mortar is a mixture of sand, binder such as cement or lime with water and is applied as a paste which then sets hard. It is prepared by adding required amount of water to a mixture of binding materials (also called matrix) and fine aggregate (also called adulterant). This plastic paste is useful to hold building materials such as stone or brick together. There are different types of mortar used in the construction based on the following factors

- Nature of application
- Binding materials
- Bulk density
- Special purpose

There are two types of mortars based on the nature of application: brick or stone laying mortar and finishing mortar. Based on binding material used, the quality, durability and strength of the mortar will mainly depend on the quantity and quality of binding material used like cement mortar, lime mortar, gypsum mortar, gauged mortar, surkhi mortar, and aerated cement mortar. Based on the bulk density of mortar in dry state, mortars are classified into two types: heavy mortar and lightweight mortar. Other than the above described types, there are some mortars with special purposes. They are fire resistant, packing, sound absorbing, X-ray shielding, chemical resistant mortar etc.

Many studies have been done using industrial wastes are used as replacement of sand in mortar and concrete. The commonly used materials are slag (1), foundry sand (2), crusher dust (3) and quarry dust (4) etc. Study on the use of coir pith as an aggregate in cementitious composites was evaluated. Some composites were produced exclusively with coir pith particles and other composites with coir pith partially substituting the natural sand (5). Chemical reaction of the cement with water was analyzed and the formation of C-S-H gel was studied (6). For the production of cement and concrete, very high amount of energy is needed. Around 7% of CO2 released to atmosphere is during cement production. Harmful effects of concrete on environmental can be reduced by producing good and durable concrete by using industrial byproducts (7). Pozzolanic activities on concrete were studied by incorporating the fly ash in concrete (8). Mechanical properties of the concrete were studied for the rice husk ash concrete incorporating quarry dust as a partial substitute for sand (9). Workability and strength behavior of concrete with cold bonded fly ash aggregate was studied (10). In the present study, sand is partially replaced by coir pith in mortar and analyzed. The effect of coir pith with fly ash and lime solution is also studied.

A. Coconut coir pith

The coir pith is byproduct of the coconut based industry. Coco peat is also known as coir pith. Coir fiber pith, coir dust, or simply coir, is made from coconut husks, which are byproducts of other industries that use coconuts. Coco peat primarily consists of the coir fiber pith or coir dust which is obtained by processing coconut husk and removing the long fibers. The coco peat can hold large quantities of water, just like a sponge. It is a special type of material used for mortar, lightweight materials, sound, thermal insulating, good air porosity and reduction in construction cost.

B. Fly ash

Low calcium fly ash and high calcium fly ash are two types of fly ashes. Low calcium fly ash (ASTM-class F) is basically by product of burning anthracite or bituminous coal has low calcium (CaO) less than 10% and has major oxides (SiO2+Al2O3+Fe2O3) more than 70%. These fly ashes in themselves, possess little or no cementitious value but will be finely derived form and in the presence of moisture chemically react with calcium hydroxide at ordinary temperature to form compounds possessing cementitious properties. High calcium fly ash (ASTM-class C) is the by-product of burning lignite or sub bituminous coal has calcium (CaO) content more than 20% and major oxide less than 70%. It has cementitious properties in addition to pozzolanic.

II. MATERIAL AND EXPERIMENTAL PROCEDURE

OPC 53 grade of cement is used for making the mortar, locally available sand was used as fine aggregate. Potable water available in the institution campus was used. Coir pith

was obtained from the nearby coconut based industry. Sieve analysis chart for coir pith and sand are presented Fig.1. Class F Fly ash was used in the present study of the materials are given below in the Table.1

Table.1 Physical properties of the materials

S. No.	Properties	cement	Fly ash (class F)
1	Specific gravity	3.15	2.45
2	Fineness	4%	12%
3	Consistency	35%	-
4	Initial setting time	35min	-
5	Final setting time	8 hrs	

In this study, sand is partially replaced by the agricultural waste (coconut coir pith) with various mix proportions. The details of mix for preparing mortar cubes are presented in Table.2. The conventional mix comprises of 100% river sand as fine aggregate. M5CP, M5CP5FA and M5CP10FA denotes mortar mix with constant 5% coir pith mixed with fly ash content of 0, 5% and 10% respectively and used as partial replacement for river sand.M5CP0.2NL mortar mix is made by soaking 5% coir pith in 0.2N lime water for 2hrs and using it for preparing the cement mortars.

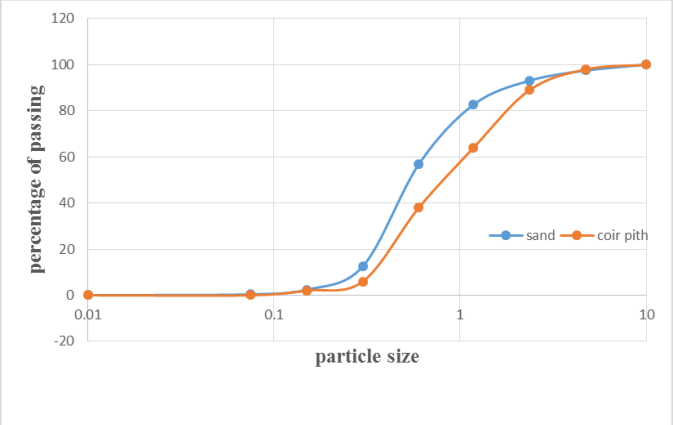

Fig.1. Sieve analysis of sand and coir pith

Table 2. Details of mortar mix

Mix	Cement (%)	Sand (%)	Coir pith (%)	Fly ash (class F) (%)	Lime water
M0	100	100	0	0	0
M5CP	100	95	5	0	0
M5CP5FA	100	90	5	5	0
M5CP10FA	100	85	5	10	0
M5CP0.2NL	100	95	5	0	0.2N

This experimental program involves casting and testing of mortar cube specimens at the age of 7 and 28 days. Fig.2 shows the image of coir pith, coir pith mixed with fly ash and finished mortar cubes. The cubes were casted using standard mould of 70.6 X 70.6 X 70.6mm size. Curing was done by the conventional moist curing for the mortar cubes.

Fig. 2 Coir pith particle mixed with fly ash and mortar cubes

A. *Compressive strength (IS 516-1959)*

The cube specimens were tested for compressive strength at the age of 7 and 28 days. The surface water and grit were wiped of the specimen and any projecting finds were removed. The dimensions of the specimens and their weight were recorded before testing. The bearing surfaces of the testing machine was wiped clean and again the surface of the specimen was cleaned from sand and other materials which may come in contact with the loading plates. While placing the specimen in the machine, care was taken such that the load was applied to opposite sides of the specimen as cast and not to the top and bottom faces. The axis of the specimen was carefully aligned with the center of thrust of the spherically seated plate. The load is applied gradually on the side faces of mortar. The maximum load applied to the specimen was recorded and any unusual appearance in the type of failure was noted.

III. RESULTS AND DISCUSSION

Density of mortar cubes are compared with different mixes. Density of 5% replacement of sand by coir pith mortar is decreased by 33.33% when compared with conventional mortar cube. Compressive test was carried out on the cube specimens after 7 and 28 days curing for various trial mixes. The Compressive test result is represented in Fig. No. 3.

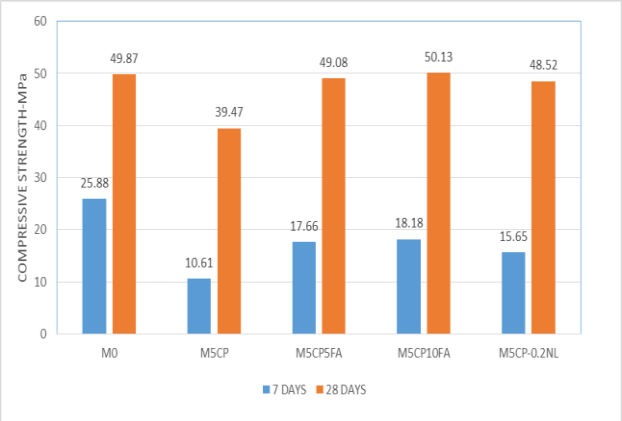

Fig.no.3 compressive strength of mortar cubes

It is noted that the compressive strength of mortar cube with 5 % replacement of sand with coir pith was decreased 20.85%, due to more amount water absorption capacity of coir pith. Compressive strength of mortar at 7 days coir pith mixed with 5% and 10% fly ash were increased by 66.35% and 71.35% when compared to 5% replacement of sand with coir pith. Compressive strength of mortar at 28 days coir pith mixed with 5% and 10% fly ash were increased by 24.34% and 27% when compared to 5% replacement of sand with coir pith, but decreased when compared to conventional mortar cube. Similarly the mix M5CP0.2NL showed an increased in strength of 22.92% when compared with mix M5CP.

IV. CONCLUSIONS

The strength of mortar specimens incorporating coconut coir pith as a fine aggregate for different mix proportions are determined. The following conclusions are drawn:

- Coir pith can be used as a partial replacement of sand in mortars.
- Coir pith mixed with fly ash shows better performance at later ages.
- Early age strength of coir pith mortars are less than conventional mix with or without addition of fly ash. Similar behavior was noted for mortar made with lime water soaked coir pith.
- Using this mortar for flooring, making pavement blocks and street road pavements etc. Reducing the usage of non-renewable resource of sand, so that cost of construction also reduced.

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