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Control of Land Pollution by the Partial Replacement of Effluent Sludge in Manufacturing of Fly ash Bricks

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ABSTRACT

This study involves the experimental investigation of effect of fly ash and dry sludge on the properties of fly ash bricks. On seeing the present day demand for bricks, an attempt is made to study the behavior of bricks manufactured using, different waste materials like dry sludge and fly ash. The main aim of this work was to compare the compressive strength of the bricks. The disposal of sludge has always been by dumping in the soil, this has hazardous effect on the air and environment at large. They can be recycled for use in construction industry without producing any harm to human and environment. Research has shown that they can be used in manufacturing of cement. Sludge and fly ash mixed with Quarry dust and cement in various percentage keeping the Quarry dust and cement with constant percentage of 30% and 20% respectively, while fly ash is replaced with sludge from 0% to 100% consequently with 20% replacement. The result shows that fly ash and sludge together can be used in the alternative bricks, the compressive strength and water absorption is good and weight of the brick is reduced up to10% from the nominal bricks.

Keywords: Fly ash, Quarry dust, Cement, Sludge, Compressive Strength, Water absorption.

1. INTRODUCTION

Since the large demand has been placed on building material industry especially in the last decade owing to the increasing population which causes more shortage of building materials, the civil engineers have been challenged to convert the industrial wastes to useful building and construction materials.

This experimental study which investigates the potential use of waste sludge for producing a low-cost and light weight composite brick as a building material. The alternative bricks were made with sludge and fly ash.

1.1 OBJECTIVES

- To achieve alternative improvements using sludge materials during manufacturing process.
- To reduce the land pollution by utilizing the sludge waste in fly ash brick manufacturing.
- To reduce the cost of fly ash brick with replacement of sludge waste.
- To improve the compressive strength and durability of fly ash brick.

2. MATERIALS

- **Ordinary Portland cement:** OPC of grade 43 was used in this study which was bought from a local dealer. Specific gravity-3.15
- **Quarry dust:** Fine aggregate used for this work is crushed sand from local stone crusher plant. It should be clean, strong, hard and free from organic impurities.
- Specific gravity of crushed sand is 2.3.
- It confirming to uniform grading passing from IS sieve 4.75 mm and retained on IS sieve 2.36 mm.
- **Water:** Water is an important ingredient of sludge brick as it actively participates in the chemical reaction with cement. It should be free from organic matter and the pH value should be between 6 to 7.
- **Fly ash:** Fly ash used in the present study was collected from Thermal power plant, Mettur. Specific gravity-2.288
- **Sludge:** Sludge is the major waste product in various treatment plants. Here we used effluent treatment plant sludge. This sludge mainly composed of various chemicals. This sludge is a very fine particle and can be used as fine aggregates in various construction materials like concrete and paver blocks.
  Specific Gravity- 1.66

3. Material Proportioning &Preparation

Table 3.1 Different Trial Mix Proportion in %

Brick sample	Quarry dust	Cement	Sludge	Fly Ash
	%	%	%	%
CF	30	20	0	50
M_1	30	20	10	40
M_2	30	20	20	30
M_3	30	20	30	20
M_4	30	20	40	10
M_5	30	20	50	0

Table 3.2 Quantity of materials

Brick sample	**Quarry dust**	**Cement**	**Sludge**	**Fly Ash**
	(g)	**(g)**	**(g)**	**(g)**
CF	900	600	0	1500
M_1	900	600	300	1200
M_2	900	600	600	900
M_3	900	600	900	600
M_4	900	600	1200	300
M_5	900	600	1500	0

After selection of proper proportion for brick the dry homogenous mixture is done. With adding the appropriate water, wet homogenous mixture is done and finally the mortar is allowed to making brick sample.

4. Test results

a) Compressive Strength Test

Table 4.1 Compressive strength @ 7 days

Brick sample	% of sludge used	Compressive strength (N/mm^2)
CF	0	2.25
M_1	10	2.246
M_2	**20**	**2.247**
M_3	30	1.813
M_4	40	1.486
M_5	50	1.126

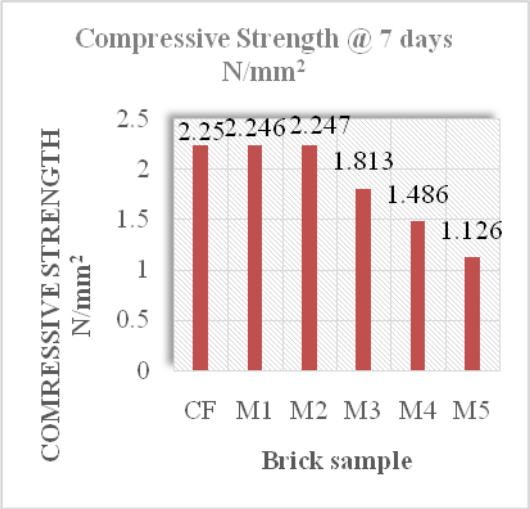

Fig.4.1 Variation of compressive strength\ @ 7 days

Table 4.2 Compressive strength @ 14 days

Brick sample	% of sludge used	Compressive Strength (N/mm^2)
CF	0	2.386
M_1	10	2.356
M_2	**20**	**2.334**
M_3	30	2.104
M_4	40	1.660
M_5	50	1.260

Mixture-M_2 got high compression value and high percentage of sludge Mixture-M_5 specimens have lower compressive strength than the other mixes.

b) Water Absorption Test

Sludge percentage is lower means (CF, M_1) the water absorption is slightly higher than the M_2. The mixture M_2 having low percentage of water absorption than the other mixes.
However the water absorption should be less than 20% by weight.
The water absorption of brick with 20 % sludge is 10.2 %.

c) Size and shape Test

Homogeneous, compact and free from defects.

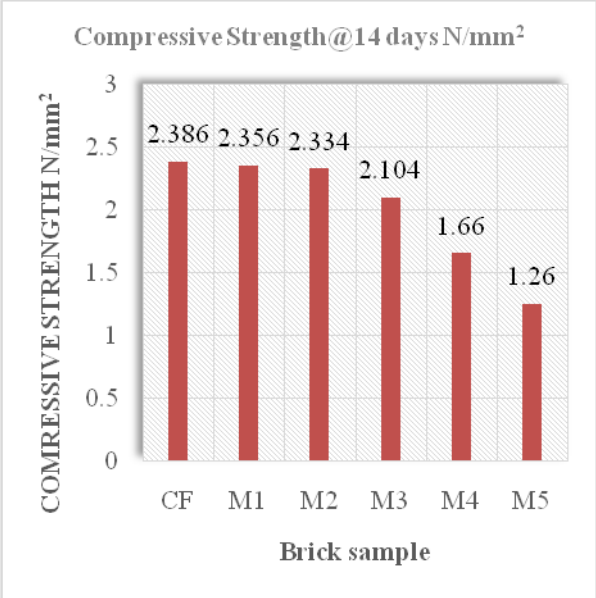

Fig.4.2 Variation of compressive strength @ 14 days

Table 4.3 Compressive strength @ 28days

Brick sample	% of sludge used	Compressive Strength (N/mm^2)
CF	0	2.565
M_1	10	2.556
M_2	**20**	**2.543**
M_3	30	2.182
M_4	40	1.947
M_5	50	1.313

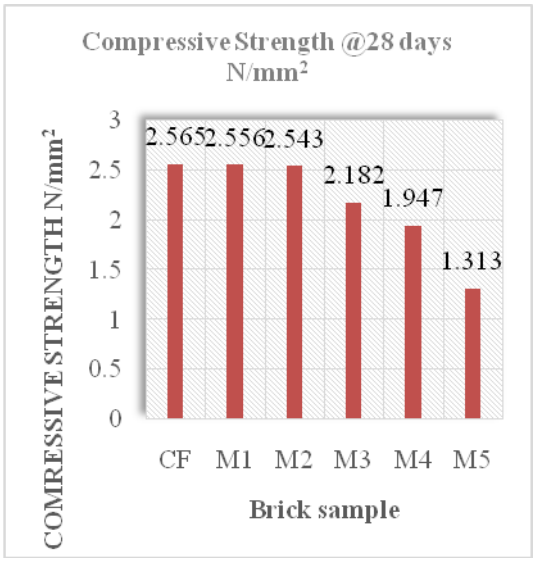

Fig.4.3 Variation of compressive strength @ 28 days

Sample bricks	% of sludge	Weight before Test (Kg)	Weight after Test (kg)	% of Water Absorption
CF	0	2.74	3.12	13.9
M_1	10	2.76	3.09	12
M_2	**20**	**2.85**	**3.14**	**10.2**
M_3	30	2.52	3.38	16.1
M_4	40	2.51	3.07	13.3
M_5	50	2.73	3.12	14.3

d) Soundness Test

The bricks not broken and clear ringing sound is produced.

e) Efflorescence Test:

There is no perceptible deposit of efflorescence, therefore liability to efflorescence as nil.

5. CONCLUSION

The conclusions reached in this study were based on the experimental program executed in this work,

- The compressive strength of the brick up to 20% usage of sludge waste is same value as compared to the 30%, 40% and 50% of sludge waste.
- The percentage of water absorption is 10.2% with 20% usage of sludge replacement.
- Homogeneous, compact and free from defects.
- The bricks not broken and clear ringing sound is produced.
- The bricks with sludge did not have any effect of efflorescence.
- Finally, we concluded that the mixture M_2 replacement with 20% of sludge waste is alternative for the 100% of fly ash bricks.
- Hence this waste replacement instead of fly ash is cost wise effective and also reduces the environment.

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Conflict of Interest

None of the authors have any conflicts of interest to declare.