Application of fly ash and plastic waste in brick construction

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***Abstract*—In this study focus has been given in the construction of bricks with utilization fly ash and waste plastic. An effort has been made towards the use of these waste materials to be utilized as construction materials. Clay bricks are common in use and these days fly ash bricks are also being introduced in large scale. So, in this research work an experimental study has been conducted to construct a fly ash and plastic waste based brick. Fly ash, cement, sand and plastic waste were used to prepare the material of brick construction. Three different combinations have been adopted, fly ash used in 50%, 45% and 40% ranges and plastic waste was 5% in all three combinations. Compressive strength test was performed and found that strength of waste material based bricks were good enough to construct a brick.**

Keywords: Brick, Fly ash, Plastic waste

I. INTRODUCTION

Fly ash and waste plastic materials both are generated in huge amount thermal power plants and plastic industries. Plastic waste not only generated in factories or industries but also in domestic levels. Disposal of these materials always been a challenge to clean environment. Since they are directly and indirectly come into the contact of humans and increasing chances of health issues. They are not only affected the human health but polluting the environment also. There are so many uses of fly ash as construction material, it is used in cement production in large amount, highway construction as dumping material, brick construction, use of fly ash as construction material also reduces the cost.

Owing to the idea of green construction, researchers are applying and searching for all opportunities to use of waste materials in construction to develop a green material. Use of waste plastic material in construction has become a decorative idea also. Since the plastic shows good characteristics like lightness, hardness and water resistance. There are few disadvantages of plastic also, once its life is over, it will be called waste, disposal is a problem, recycling of the material is big task. Based on the several studies, on the use of fly ash and plastic waste in construction, in this study combination of both the waste material is emphasized. Thirugnanasambantham et al.2017 By use of plastic sand bricks, the water absorption presence of alkalies was highly reduced. Owing to numerous advantages further research would improve quality and durability of plastic sand bricks. Prasanth et al. 2018 have partially relaced fly ash and plastic with quarry dust to construct brick and found that constructed brick can be easily used in building construction. Kognole et al. 2019 reported that the plastic sand bricks are useful for the construction and shows good strength in compressive strength test.

II. MATERIALS AND METHODOLOGY

The aim of this research is to utilize waste materials like fly ash and plastic waste in brick construction. To prepare a mix for brick manufacturing, combination of fly ash, plastic waste, cement, sand and water have been used. All these materials are taken from locally available market.

For the experimental setup, study has been conducted in five steps-

i. Batching
ii. Mixing
iii. Moulding
iv. Curing
v. Testing

Three different combinations have been utilized-

1. In first case 50% fly ash, 30% sand, 15% cement and 5% plastic waste with 0.55 water binder ratio used.

2. In second case 45% fly ash, 35% sand, 15% cement and 5% plastic waste with 0.60 water binder ratio used.
3. In third case 40% fly ash, 40% sand, 15% cement and 5% plastic waste with 0.55 water binder ratio used.

To manufacture the fly ash, plastic waste based brick, a total 81 no. of bricks were casted and the size was 100mm x 100mm x 10mm. The weight of manufactured brick varies from 3.0 to 3.6 kg. For preparation of mix IS 12894: 1990 is used. For testing compressive strength was done.

III.RESULTS AND DISCUSSION

The compressive strength of manufactured brick in combination of fly ash, plastic waste, cement and sand at 7, 28 and 56 days are given in Table 1,2 &3. It is evident from results that compressive strength was increased in second combination than the first and third. In first case average 7 days compressive strength is 6.6 kN/m2, 14 days average compressive strength is 8.17 kN/m2 and 28 days compressive strength is 10.9 kN/m2. In second case average 7 days compressive strength is 6.2 kN/m2, 14 days average compressive strength is 8.02 kN/m2 and 28 days compressive strength is 11.11 kN/m2. In Third case average 7 days compressive strength is 4.9 kN/m2, 14 days average compressive strength is 7.3 kN/m2 and 28 days compressive strength is 10.4 kN/m2.

In all three case percentages of cement and plastic waste are constant but percentage amount of fly ash and sand is varying. Also, there is requirement of more water seen when amount of fly ash is increasing. That is why variation in water binder ratio is incorporated, first case water binder ratio is 0.55, second case 0.60 and third case 0.65. In all three cases similar pattern has been found in compressive strength results, for the manufacturing of waste material based bricks, this combination can be utilized without compromising. All results are seen in tabulated form given below-

Table 1

S.No.	Fly ash (%)	Sand (%)	Cement(%)	Plastics (%)	W/B	Compressive Load (KN)					
						7 days	Wt. (Kg)	14 days	Wt. (Kg)	28 days	Wt.(Kg)
1.						58	3.6	74	3.2	94	3.2
	50	30	15	05	0.55	60	3.1	74	3.1	98	3.2
						62	3.1	76	3.2	100	2.9
						66	3.0	76	3.3	100	3.5
						68	3.2	80	3.3	104	3.5
						68	3.2	80	3.4	114	3.5
						68	3.5	90	3.0	116	3.3
						72	3.3	92	3.2	126	3.4
						72	3.4	94	3.2	132	3.6
Average strength in N/mm^2						6.6		8.17		10.93	

Table 2

S.No.	Fly ash (%)	Sand (%)	Cement (%)	Plastics (%)	W/B	Compressive Load (KN)					
						7 days	Wt. (Kg)	14 days	Wt. (Kg)	28 days	Wt. (Kg)
2.	45	35	15	05	0.60	58	3.1	72	3.2	92	3.4
						58	3.2	74	3.0	100	3.2
						58	3.3	76	3.2	104	3.0
						58	3.0	78	3.2	106	3.1
						62	2.9	80	3.1	112	3.2
						62	2.8	86	3.4	114	3.1
						64	3.1	86	3.4	118	3.1
						68	3.1	86	3.1	124	3.2
						70	3.5	88		130	3.1
Average strength in N/mm^2						6.2		8.06		11.11	

Table 3

S.No.	Fly ash (%)	Sand (%)	Cement (%)	Plastics (%)	W/B	Compressive Load (KN)					
						7 days	Wt. (Kg)	14 days	Wt. (Kg)	28 days	Wt.(Kg)
3.	40	40	15	05	0.65	38	3.5	60	3.5	92	3.2
						40	3.4	68	3.4	98	3.3
						46	3.3	70	3.0	98	3.2
						48	3.3	72	3.3	100	3.3
						50	3.2	72	3.1	102	3.2
						54	3.5	74	3.3	110	3.3
						54	3.4	74	3.3	110	3.3
						56	3.3	78	3.3	114	3.3
						58	3.4	90	3.2	118	3.4
Average strength in N/mm^2						4.933		7.311		10.466	

IV.CONCLUSION

From the above study following conclusions are drawn

1. In all three categories of combination results are similar and well enough to manufacturing of bricks
2. In second category compressive strength is m more than other two categories.
3. In 28 days compressive strength test first case, compressive10.3 N/mm^2, second case 11.11 N/mm^2 and third case 10.4 N/mm^2.
4. It is also found that variation is water binder ratio required when the combination has changed.

5. All these categories are showing good strength and can be utilized to manufacture a brick with waste materials.

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