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Performance Study on Fly Ash Bricks by Using Municipal Solid Waste as a Filler Material

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Abstract - Growing urbanization and industrialization is the cause for generation of enormous amount of municipal solid waste. Disposal of this municipal solid waste affects the environment and treatment process is quite uneconomical. Hence it needs attention to utilize this waste in any process. Attempt has been made for replacing crusher sand by Municipal Solid Waste(MSW) in fly ash bricks. MSW is partially replaced within the magnitude relation of 0%, 5%, 10%, 15%, 20%, 25% and 30% by weight of crusher sand. Bricks of size 230 x 110 x 70 mm are manufactured and tested for its compressive strength and durability properties and is compared with the conventional one. 20% replacement of MSW is found to be optimum and it performs well both interms of strength and durability.
Keywords – Flyash, Municipal Solid Waste, Compressive strength, Waste, Water absorption

I. INTRODUCTION

Traditionally burnt bricks constitute the brick masonry unit for the construction of houses and it is well known that manufacturing requires significant quantities of energy to produce burnt bricks while utilizing the top soil. Also, continual removal of top soil for production of conventional bricks creates environmental hazards. Hence, there is a strong need to adopt cost effective and sustainable technologies using waste materials to produce alternatives for burnt clay bricks. Attempt has been made for replacing crusher sand by municipal solid waste (MSW) in fly ash bricks.

V.Karthikeyan et.al prepared flyash bricks in four different proportions and tested for its compressive strength. Author concluded that flyash bricks possess more compressive strength than conventional bricks. Flyash bricks found to be more economical than conventional bricks and its cost ranges from Rs. 1.55 to Rs.1.90 per brick. (Class II)

Apurva Kulkarni et.al manufactured flyash bricks using bagasse ash and quarry dust. Flyash were replaced with bagasse ash in following proportions (10%, 20%, 30%, 40%, 50% and 60%).10 % replacement of bagasse ash is arrived as optimum and on further increasing, strength decreases. Waste disposal problem can be solved by utilising waste in construction materials.

Ravi Kumar et.al investigated three types of flyash bricks(by varying cement proportions 0%,3% and 5%) with lime and gypsum. Strength test and durability test were performed and author concluded that flyash brick containing cement with 5% strength yields higher compressive strength values than other proportions. Performance interms of water absorption and efflorescence were also recorded better results in case of 5% replacement.

II. EXPERIMENTAL PROGRAM

2.1 Materials –

Flyash, M-sand, MSW, Lime and Gypsum were the materials used in manufacturing brick.

MSW consists of both dry and wet waste which is generated from most of the cities. Screening process is carried out to segregate particles greater than 10 mm and less than 10 mm. Grains greater than 10 mm can be recycled and grains less than 2.36 mm can be used for brick making. Study was carried out using screened MSW obtained from dumping ground (Kumarapalyam, Namakkal District) which is shown in Figure 1.

Figure 1. Municipal solid waste

The size of Manufactured Sand (M-Sand) used is less than 4.75 mm. The fly ash used in this study were collected from Mettur Thermal Power Plant. Locally available water was used in the present work. Gypsum is used in fly ash brick to increase the setting time.

2.2. Mix Proportion –
MSW blocks are produced by replacing M-sand by MSW in various proportions (0%, 5%, 10%, 15%, 20%, 25%, 30%) and the mix percentage is given in Table 1.

Table 1 Mix proportion

Specimen	Percentage of Materials used			
	Gypsum	Lime	Fly ash	M-Sand
Brick	3%	20%	50%	27%

2.3. Preparation of Brick Specimen–
M-sand is partially replaced with municipal solid waste. The municipal solid waste, m-sand, lime, gypsum and fly ash are mixed dry till it attains uniformity. Then water is added and mixed for about 3- 4 minutes till the mix becomes cohesive. The brick mould of size 230x110x70 mm is taken and these are moulded and brushed with machine oil for easy removal. After filling up the mould, materials are pressed hardly by giving some load to attain the strength. The MSW blocks are de-moulded by rising from the mould after compression and are air-dried for two days and are water cured for about 7 days.

2.4 .Testing of Brick Specimen–
Compression test- After 7 days of water curing municipal solid waste blocks are tested to know its compressive strength by using the compression testing machine which is given in Figure 2. The maximum load at which the failure in brick occurs is noted down. The load at failure is considered as the maximum load which the specimen fails to produce any further increase in the indicator reading on the testing machine.

Figure.2 Compression test on bricks

2.4 Water absorption test-
This test is carried out by immersing specimen in water for a duration of one day with room temperature. After one day, specimen is taken out from water and traces are removed and then weighing is done. This weighing is done three minutes after wiping out the water.

2.5 Efflorescence test-
Distilled water is used in this test. Brick specimen is placed inside the shallow flat bottom dish such that ends of bricks are immersed in distilled water for a depth of 25 mm. Arrangement is placed in a warm and well-ventilated environment so that all the water evaporates. Experiment is repeated with similar quantity of water and efflorescence pattern is studied

III. RESULTS

7 days compressive strength test for Municipal solid waste blocks of mix proportion of 0%, 5%, 10%, 15%, 20%, 25%, 30% was given in Table 2. Water absorption test for different mix proportions of MSW blocks were also carried out as per IS code 3495:1992 and are tabulated in Table 2. The municipal solid waste bricks are subjected to efflorescence test and it showed that it has nil or no amount of salts present in the brick surface.

Table 2 Compressive strength test values

S. No	% of replacement	7 days -Average compressive strength (N\mm2)	Average Water absorption (%)
1.	0	11.13	11.85
2.	5	10.81	12.24
3.	10	11.43	15.10
4.	15	11.86	16.03
5.	20	12.34	17.66
6.	25	11.84	18.04
7.	30	10.02	18.61

IV.CONCLUSION

Maximum Compression strength value for 7 days of 12.34 MPa was obtained for 20% and it can be taken as optimum for real time execution.

Water absorption in MSW blocks increase with increase in addition of municipal solid waste in mix proportions. However it is less than 20% as per codal provisions.

Utilizing municipal solid waste for manufacturing of MSW masonry blocks is one of the efficient manners to minimize the disposal problems of municipal solid waste.

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