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A Pilot Scale Study on Use of Municipal Solid Waste in Making of Bricks

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ABSTRACT: *Generally bricks are made using top soil from Agricultural fields or Quarries; approximately half an acre land (about 2000 m²) top soil is required for the making of about 1 lac bricks. Top soil is developed over a period of millions of years of geological fines. This soil is very fertile. The process of making bricks is responsible for the degradation of the environment at large. MSW is a complex mixture of dry and wet wastes generated by city dwellers. MSW screened to separate grains less than & greater than 10 mm has shown presence of partially decomposed organic and inorganic substances in it. Grains greater than 10mm (glass, metal, plastic, paper, wood, cloth, debris) etc. can be recycled and grains less than 2.36mm can be used for brick making. Study was carried for making construction bricks using screened MSW obtained from dumping ground (Ichalkaranji, Dist.-Kolhapur Maharashtra) with addition of brick making natural soil and / or fly ash. MSW generated in the urban area is disposed off on the land. At this moment there is tremendous scarcity of land for disposal of the MSW. So this study serves as an alternative for both degradation of fertile soil & MSW.*

Keywords - *Municipal solid waste, characteristics of MSW, Brick manufacturing process, making of bricks using MSW.*

1. INTRODUCTION

India, the world's second highest populated country with population exceeding a billion and one of the fastest urbanizing countries, is a land of physical, climatic, geographic, ecological, social, cultural and linguistic diversity. The annual rate of growth of urban population in India is 3.09%. The proportion of population living in urban areas has increased from 17.35% in 1951 to 26.15% in 1991(CPCB, 1999). The number of Class I cities with population exceeding 1, 00,000 has increased from 212 to 300 during 1981 to 1991 (CPHEEO,2000).It is interesting to note that as much as 65.2% of the urban population is living in these Class I cities. Management of Municipal Solid Wastes (MSW) continues to remain one of the most neglected areas of urban development in India. The 23 metro cities in India generates about 30,000 tonnes of such wastes per day while about 50,000 tonnes are generated daily from the Class I cities. It is estimated that solid waste generated in small, medium and large cities and towns in India is about 0.1 kg, 0.3 – 0.4 kg and 0.5 kg per capita per day respectively. Studies carried out by National Environmental Engineering Research Institute (NEERI) indicated that the per capita generation rate increases with the size of the city and varies between 0.3 to 0.6 kg/d. In the metropolitan areas, values up to 0.5 kg / capita / day have been recorded. The estimated annual increase in per capita waste quantity is about 1.33% per year. Final disposal in most of the urban area is usually a matter of transporting the collected waste to the nearest available open space and discharging them. Results in the degradation of valuable land resources and the creation of environmental and human health problems.

Generally bricks are made using top soil from Agricultural fields or Quarries; approximately half an acre land (about 2000 m²) top soil is required for the making of about 1 lac bricks. Top soil is developed over a period of millions of years of geological fines. This soil is very fertile. The process of making bricks is responsible for the degradation of the environment at large. A study was carried for making construction bricks using screened MSW obtained from dumping ground with addition of brick making natural soil and / or fly ash.

2. STUDY OF CONVENTIONAL BRICKS

2.1 Material used

Clay, Flyash, Baggas, water.

From the survey of nearby sites of brick manufacturing material proportions used for 10 bricks are as follows:-

Table 1"Material proportions"

Sr.No.	Material	Proportion
01	Soil	43.5 Kg
02	Flyash	1.312 Kg
03	Baggas	1.032 Kg
04	Water	Approx.

2.2 Manufacturing Process:-

Although the basic principles of manufacture are fairly uniform, individual manufacturing plants tailor their production to fit their particular raw materials and operation. Essentially, brick are produced by mixing ground clay with water, forming the clay into the desired shape, and drying and firing. In ancient times, all molding was performed by hand.

2.3 Phases of Manufacturing:-

The manufacturing process has six general phases:

Mining and storage of raw materials, Preparing raw materials, Forming the brick, Drying, Firing and cooling, De-hacking and storing finished products

2.4 Test Results Of Conventional Bricks:-

The bricks are carried from different place nearby the area and are tested for different properties (Physical Analysis).

Site Details are as follows:-

Notation	**Site**	**Brick Size (cm)**
A	CHINCHAWAD	23X10X7
B	UDAGAON	22X10X7
C	ANKALI	22.5X9.5X7
D	KOTHALI	23X10X7

1. Compressive Strength:-

Sr.No.	**Site**	**Comp. Stg.(Kg/cm^2)**	**Avg.Comp Stg.(Kg/cm^2)**
1	A	18.70	
2		18.04	
3	B	18.18	
4		20.90	18.76
5	C	37.43	
6		25.73	
7	D	13.04	
8		13.04	

2. Water Absorption:-

Sr. No.	**Site**	**Water Absorption *(%)***	**Avg.Water Absorption *(%)***
1	A	18.45	
2		22.53	
3	B	24.53	
4		24.19	22.78
5	C	22.79	
6		21.93	
7	D	30.00	
8		17.79	

2.5 Study of Municipal Solid Waste:-

Physical Characteristics

Sr. No.	Material Categories	Mean	Lower	Upper
01	Paper	34.3%	32.4%	36.5%
02	Plastic	11.4%	10.6%	12.3%
03	Metals	5.1%	4.6%	5.8%
04	Glass	2.8%	2.5%	3.2%
05	Organic Materials	25.7%	24.1%	27.8%
06	Problem Materials	1.9%	1.5%	2.4%
07	HHW / HW	0.6%	0.5%	0.8%
08	Other Waste	18.3%	16.8%	20.2%
09	Total	100.0%		

2.5.2:-Chemical Characteristics

Chemical Analysis

Material	ph	Fe	Mn	Zn	Cu
Soil	7.0	1.67	2.73	0.25	0.54
Inorganic waste	6.5	4.73	2.20	0.41	6.76
Organic waste	6.5	6.83	8.31	0.46	7.29

2.5.3Other properties

Other properties

Sr. No.	Type of soil	Fe	Mn	Zn	Cu
1	Soil	24.52	26.36	3.46	2.66
2	Mix	46.64	32.74	3.22	9.86
3	Waste	54.84	39.90	3.64	18.03

2.5.4 MSW material used in brick manufacturing:-

Sr. No.	% of soil used	Wt of soil replaced (Kg)
1	5	2.25
2	10	4.35
3	15	6.5
4	20	8.7
5	25	10.8

3. MANUFACTURING PROCESS FOR BRICKS

3.1 Weighing and Dry Mixing of Material:-

First all the materials which are required for the brick manufacturing are taken as per there proportion by weigh batching. Then these materials are mixed thoroughly in a dry state as shown in fig.1.

3.2 Addition of water:-

Water is added to the dry mixture with suitable proportion. The compaction of mixture is done by the conventional method like compaction by hand and rods. This is required to remove the air bubbles from the mixture. After all the mixing and compaction, it is kept for unique mixing for 24hrs. fig.2.

3.3 Moulding:-

In this stage of brick manufacturing, the prepared mix is filled in the mould. Molding gives a definite shape to the mixture. The internal dimension of the mould is 23X10X7 cm. fig.3a & 3b.

3.4 Air Drying:-

After the casting of the bricks, these bricks are kept for air drying for 5 to 6 days. fig.4.

3.5.Burning of bricks:-

After air drying, the bricks are the put in to kilns. These bricks are kept for burning. fig.5a & 5b

3.6 Test results of manufactured bricks:-

The prepared bricks are tested for engineering properties. Following are test results for the bricks MSW.

3.6.1 Compressive strength:-

1. For 5% replacement of soil

Sr. No.	Notation	Comp. Strength (Kg/cm2)	Avg.Comp. Strength (Kg/cm2)
1	A	17.62	15.97
2		17.62	
3		13.21	
4		15.41	

2. For 10% replacement of soil

Sr. No.	Notation	Comp. Strength (Kg/cm2)	Avg.Comp. Strength (Kg/cm2)
1	B	13.21	14.31
2		15.41	
3		15.41	
4		13.21	

3. For 15% replacement of soil

Sr. No.	Notation	Comp. Strength (Kg/cm2)	Avg.Comp. Strength (Kg/cm2)
1	C	8.8	10.46
2		11.01	
3		13.21	
4		8.8	

4. For 20% replacement of soil

Sr. No.	Notation	Comp. Strength (Kg/cm2)	Avg.Comp. Strength (Kg/cm2)
1	D	4.4	9.56
2		13.21	
3		11.01	
4		8.8	

3.6.2 Water absorption:-

1. For 5 % replacement of soil :-

Sr. No.	Notation	% water absorption	Avg. water absorption
1	A	29.00	28.695
2		28.39	

2. For 10% replacement of soil :-

Sr. No.	Notation	% water absorption	Avg. water absorption
1	B	26.38	28.695
2		27.39	

3. For 15 % replacement of soil :-

Sr. No.	Notation	% water absorption	Avg. water absorption
1	C	29.97	29.985
2		30.00	

4. For 20 % replacement of soil :-

Sr. No.	Notation	% water absorption	Avg. water absorption
1	D	30.61	30.27
2		29.93	

3.6.3 Comparison of conventional and MSW bricks:-

Description	Comp. Stg. Kg/cm^2	Water absorption %	Remark
Conventional Bricks	13.76	22.78	Replace soil up to 15%
Bricks by using MSW			
5%	15.97	28.695	
10%	14.31	26.885	
15%	10.46	29.985	
20%	9.56	30.27	

3.6.4 Amount of material can be used by the nearby sites:-

Sr. No.	Site	No of brick (per day)	Quantity of Soil required (T)	Quantity of soil replaced (T)	Remark
1	CHINCHAWAD	35000	150	23.1	Save the soil @89.76 (T) per day
2	UDAGAON	34000	146.2	22.44	
3	ANKALI	35000	150	23.1	
4	KOTHALI	32000	137.6	21.12	
	TOTAL	136000	583.8	89.76	

4. COST ANALYSIS

For conventional bricks:-
For 1000 bricks = Rs.2000/-
Soil cost=Rs. 500/- for 1000 bricks
4.35Kg of soil required for making 1 brick. Therefore
For 1Kg=Rs. 0.116/- Cost of MSW material:- For 1000Kg= Rs. 100/-
(Including all the processing charges)
Therefore
For 1Kg=Rs. 0.10/- Therefore
Cost of 1 brick using soil= Rs. 2.00/- (Including other material)
Cost of 1 brick using MSW= Rs. 1.80/- (Including soil and other material) For 1000 bricks= Rs. 1800/-
Hence economy can be achieved.

5. CONCLUSION

As the percentage of MSW soil as replaced up to 15 to 20% by the weight natural soil, strength of bricks can be achieved. Even though the bricks made by using more % of MSW material does not take much load(i.e. 20% replacement of soil) than the lower % of soil replaced bricks. The main purpose of this study to save the environment rather than in achieving economy. This can be achieved by using land filling soil along with economy in making bricks. This also saves the fertile soil which can be used for agricultural purpose. This helps in economical growth of our country. As we use landfilling waste for brick manufacturing the land filled area get emptied so it can be useful for further deposition of solid waste. These bricks are also environmentally accepted and do not have any adverse effect on environment.

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fig.1.

fig.2.

fig.3a.

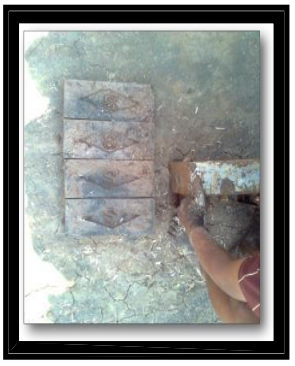

fig.3b

fig.4.

fig.5a.

fig.5b.