RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 12 | Issue 1 | April, 2019 | 149-152
ISSN–0974–2662 ■ Visit us : *www.researchjournal.co.in* ■ **DOI: 10.15740/HAS/IJAE/12.1/149-152**

Partial replacement of clay in bricks with municipal solid waste

■ **Abhishek Chanchal and Ritesh Jain**

Received : 16.01.2019; **Revised :** 01.03.2019; **Accepted :** 18.03.2019

See end of the Paper for authors' affiliation

Correspondence to :

Abhishek Chanchal
Department of Agricultural Engineering, Punjab Agricultural University, **Ludhiana (Punjab) India**
Email : Chanchalabhishek 1997@gmail.com

■ **ABSTRACT :** Since ages, bricks have been made from clay. To save excessive usage of clay, one might use various types of waste products in the production of bricks with partial replacement of clay in the manufacturing process. Waste products might include plastic, glass, rubber, fly ash, construction material, sewage sludge and MSW. From past studies, it was found that wastes of various types such as municipal MSW incineration fly ash, paper sludge, agricultural waste, industrial waste (sewage, sludge and bagasse), sawdust wastes and limestone dust wastes and coconut shell powder have been used for the production of bricks by replacing clay partially. Bricks made from these wastes give satisfactory results. To examine the effect of MSW (powder form) in bricks we used MSW from waste treatment plant in this present study in different combinations as a partial replacement of clay. It's found upto 24 per cent MSW we may attain bricks of good quality reasonably.

■ **KEY WORDS :** Bricks, Clay, Compressive strength, MSW, Waste

■ **HOW TO CITE THIS PAPER :** Chanchal, Abhishek and Jain, Ritesh (2019). Partial replacement of clay in bricks with municipal solid waste. *Internat. J. Agric. Engg.*, **12**(1) : 149-152, **DOI: 10.15740/HAS/IJAE/12.1/149-152.**

In the present century, as technology is updated very rapidly, the usage of natural materials like clay for the construction in bricks is also increased very fast. Since ages, bricks have been made from clay. These are used for building and pavement all throughout the world. As per the statistics of world bankon solid waste (SW) assessment for disposal, the major cities in the world is presently producing approximately 1.3 billion tones of SW per annum. Further the same is forecasted to rise to the tune of 2.2 billion tones by the year 2025 Also, this type of solid waste production may get double over the next twenty years in under developed or the developing countries. To recover the problem of pollution and disposal of municipal solid waste (MSW) is the main problem. Dumping of MSW is very difficult due to lack of land available. New buildings, roadways, bridges, etc is constructed over the land available. Due to this land is not available to use for the purpose of dumping of MSW especially in urban areas. So for the solution of this problem, MSW treatment plants are organized. MSWs from nearer areas or from urban areas are collected. In these plants MSW can be divided into different parts according to different raw materials, which can be further processed into valuable products by related machines. In a world, the plant can not only remove waste pollution and improve the environment, but also create great profits and drive the economy. These treated MSWs in powder form can be used as an ingredient in bricks. Waste products are getting recycled using modern techniques. After recycling these products are used in bricks.

■ METHODOLOGY

Following methodology was planned:

– To study the literature review related to this work and analysis them.

– Collection of all materials to be used in investigation

– Lab testing of materials.

– Preparation of mix by addition of MSW as 0 per cent, 8 per cent, 16 per cent, 24 per cent, 30 per cent and 38 per cent by weight of bricks.

– 4 specimens of each type of mixing of MSW will be prepared.

– Mixing, drying and burning of bricks.

– Analysis and discussion on properties of bricks. *i.e*. soundness, colour, weight, efflorescence, water absorption, compressive strength.

From past studies, it was found that wastes of various types such as municipal MSW incineration fly ash, paper sludge, agricultural waste, industrial waste (sewage, sludge, bagasse), sawdust wastes and limestone dust wastes and coconut shell powder have been used for the production of bricks by replacing clay partially. Bricks made from these wastes give satisfactory results. To examine the effect of MSW (powder form) in bricks we used MSW from waste treatment plant in this present study.

Mix design:

Built up technique:

This might include five processes in the production of bricks, namely: Batching, mixing, moulding, drying and burning. Weight batching is most preferable and most accurate method to mix the material in required proportion. We preferred hand moulding; firstly the material mixed with clay is placed in the brick developing mould so thatno space or voids are left as far as possible. Surplus material if any has to be detachedusing strike preferably by making use of frame having attached wire. The raw brick is once removed from this developing aid and is left on ground. After molding drying of bricks are done which might approximately a weak depending on weather conditions. After sundry of molded bricks, all the samples were subjected to the burning in kiln at 1000°C to 1100°C. Bricks might attain its strength during this process.

Test to be performed on bricks:

Weight of bricks:

In this test, weights of the different bricks were checked immediately after the manufacturing of bricks.

It is observed that the weight of the brick is getting decrease with the increase in the quantity of the dry MSW in to the brick. Bricks having 0 per cent MSW have 2999 g average weight. There is decrease in weight with 2980.7 g, 2955.2 g, 2916.7 g, 2886.8 g and 2855.5g with addition of 8 per cent MSW, 16 per cent MSW, 24 per cent MSW, 30 per cent MSW and 38 per cent MSW, respectively. Hence, the bricks made up of MSW are light in weight as compared to the conventional bricks.

Compressive strength test:

Compressive strength test on bricks will assess its load bearing strength when subjected to compression and is done under compression testing machine. Cement

Table A : Mix design for bricks

Different percentage of MSW	Clay	Water (in liter)
8%	92%	1/3
16%	84%	1/3
24%	76%	1/3
30%	70%	1/3
38%	62%	1/3

Table B : The weight of the bricks are shown as

Sample number	1 (in g)	2 (in g)	3 (in g)	4 (in g)	Average (in g)
0% MSW bricks	2990	2995	3001	3010	2999
8% MSW bricks	2993	2972	2983	2975	2980.7
16% MSW bricks	2968	2955	2954	2944	2955.2
24% MSW bricks	2900	2915	2927	2925	2916.7
30% MSW bricks	2885	2890	2894	2878	2886.8
38% MSW bricks	2857	2863	2854	2848	2855.5

mortar (1cement, 1clean sand having size of 3 mm and below) paste is applied to all the faces of bricks to cover and fill the voids present over the bricks. It will be kept under the damp jute bags for another 24 h. Then this is placed in pure water for another 72 hours. The sample so prepared is put with flat faces in a horizontal position and mortar is packed to the top face keeping it to up wards sandwiched by two ply plywood sheets each of 3 mm thickness up and below centered carefully under the jaws in the machine. Gradually the load is applied axially at a uniform rate until the sample is failed fully. The reading of this load at when the failure has occurred is noted down. This load is taken as the maximum load when the indicator reading on the testing machine gets stable.

$$\text{Compressive strength} = \frac{\text{Maximum load at failure (N)}}{\text{Average area of bed face (mm}^2\text{)}}$$

RESULTS AND DISCUSSION

Similar procedure was followed for the other combination of mixes of MSW was used. The graphical representation of all the tests is presented in the Fig.1.

After the testing of all the bricks samples for the compressive strength its inferred that compressive strength decreases with augmentation of MSW. Compressive Strength with 0 per cent MSW has 10.45 N/mm^2. Diminishing of this strength occurs with addition of MSW to the values of 10.1 N/mm^2, 7.9 N/mm^2, 7.28 N/mm^2, 6.4 N/mm^2 and 5.7 N/mm^2 on addition of varied MSW, respectively. Bricks made up of MSW upto 8 per cent can be used for the construction for the construction work as it has the satisfactory results in the form of hardness. Brick with 8 per cent MSW is also acceptable as first class brick. Brick with 16 per cent and 24 per cent MSW comes under the classification of second class work. On the other hand brick with 30 per cent and 38 per cent MSW have strength nearest to third class brick. Similar work related to the present investigation was also carried out by Datar and Shinde (2017); Ismail (2006); Kae (2006); Paki and Algin (2007); Safiuddin *et al.* (2010) and Weng (2003).

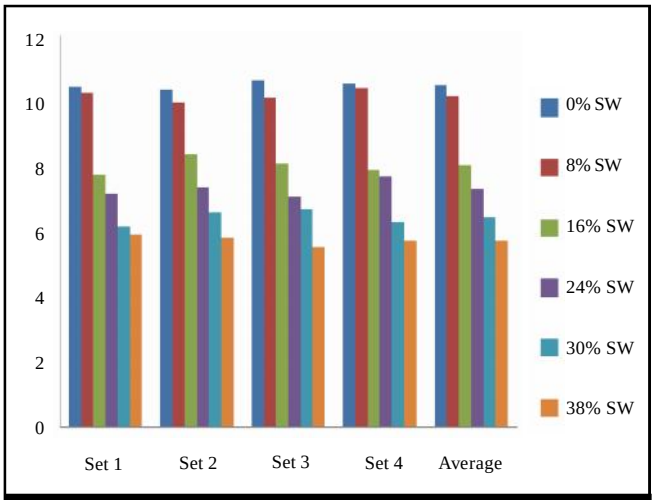

Fig. 1 : Compressive strength of bricks (kN/m^2)

Conclusion:

This study was conducted with the purpose of discovering MSW as a superior material for replacement of clay. Based on study and various experimental results, it's found that from all different types of mixes, mix with 8 per cent replacement of clay with MSW gives the optimum results in all tests. It can be used for construction work as it has

Table 1 : Compressive strength for bricks when 0% MSW in used

Sr. No.	Size of bricks (in mm)	Cross-sectional area of bricks	Load applied (in N)	Compressive strength (N/mm^2)
1.	230 x110 x70	230 x 110	263700	10.4
2.	230 x 110 x 70	230 x 110	260800	10.3
3.	230 x 110 x 70	230 x 110	269500	10.6
4.	230 x 110 x 70	230 x 110	265900	10.5

satisfactory results in the form of hardness. Brick with 8 per cent MSW is also acceptable as first class brick. Brick with upto 24 per cent MSW comes under the classification of second class work. On the other hand brick with higher per cent MSW have properties nearest same as third class brick.

Authors' affiliations:

Ritesh Jain, Department of Civil Engineerng, Punjab Agricultural University, **Ludhiana (Punjab) India (**Email : Ritesh5@pau.edu**)**

REFERENCES

Datar, Pranav and Shinde, Vikas (2017). Solid waste management by using coconut shell powder as an aggregate material in construction bricks. *Internat. J. Scient. & Engg. Res.*, **8** (4) : 341-345.

Indian Standard: IS 1077:(1992). *Common burnt clay building bricks specifications* .IS : 3495 (Part I to IV) 1992 Methods of Tests on Burnt clay Building Bricks.

Ismail, Demir (2006). An investigation on the production of construction brick with processed waste tea. *Building & Environ.*, **41** : 1274–1278.

IS: 2117(1991). Guide for manufacture of hand-made common burnt-clay building bricks.

Kae, Long Lin (2006). Feasibility study of using brick made from municipal solid waste incinerator fly ash slag. *J. Hazardous Materials*, **137** : 1810-1816.

Paki, Turgut and Algin, Halil Murat (2007). Limestone dust and wood sawdust as brick material, *Building & Environ.*, **42** (9) : 3399-3403.

Safiuddin, M., Jumaat, Zamin, Salam, M.A. and Islam, M.S. (2010). Utilization of solid wastes in construction materials, *Internat. J. Physical Sci.*, **5** (13): 1952-1963.

Weng, Chin-Huang (2003). Demonstrated suitable conditions for using dried sludge as a clay substitute to produce engineering quality of brick for using in building bricks manufacturing. *J. Waste Mgmt.*, **22** : 887-889.