International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 06 | June - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

A EXPERIMENTAL STUDY ON USE OF PLASTIC WASTE FOR MANUFACTURING OF CLAY BRICKS

Prof. Pawar S.S., Mr. Kumbhar Raviraj Sunil, Mr. Shinde Abhinav Anil, Mr. More Akshay Dattatray, Mr. Tate Sameer Appa, Mr. Maske Mayur Balaso, Mr. Jadhav Rohit Anandrao.

B.Tech. Student, Civil Depertment,
Project Guide
Shree Santkrupa Institute of Engineering & Tecnology, Ghogaon

---

Abstract –

This paper investigates the utilization of municipal plastic waste (MPW) in construction industries.Plastic is a non-bio-degradable substance which takes thousands of years to decompose that creates land as well as water pollution to the environment. The quantity of plastic waste in Municipal Solid Waste (MSW) is expanding rapidly. It is estimated that the rate of usage is double for every 10 years. The Plastic usage is large in consumption and one of the largest plastic wastes is polyethylene (PE). The utilization of earth-based clay material resulted in resource depletion and environmental degradation

One such effort is the efficient use of waste plastic and laterite quarry waste with a small quantity of bitumen, to develop an alternative building material such as bricks with negligiblewater absorption and satisfactory strength in comparison with Laterite stone to satisfy the increasing demand of conventional building materials.

Utilizing MPW as construction materials especially in production of bricks is one of a promising step towards a sustainable resources and waste management. Plastic waste can substitute either partially or completely one or more of the materials in brick production. Further research based on recent research and a better understanding in utilization of plastic waste in brick is needed to produce a high durability and quality of bricks as well as to achievethe optimum balance in all aspects especially in terms of cost and functionality.

1.INTRODUCTION

Plastics are made up of synthetic organic polymers which are widely used in different applications ranging from water bottles, clothing, food packaging, medical supplies, electronic goods, construction materials, etc. In the last six decades, plastics became an indispensable and versatile product with a wide range of properties, chemical composition and applications. Although, plastic was initially assumed to be harmless and inert, however, many years of plastic disposal into the environment has led to diverse associated problems. Environmental pollution by plastic wastes is now recognized widely to be a major environmental burden, especially in the aquatic environment where there is prolong biophysical breakdown of plastics, detrimental negative effects on wildlife, and limited plastic removal options.

In many instances, sheeting and packaging plastics are disposed of after usage, however, because of their durability, such plastics are located everywhere and persistent in the environment. Research on the monitoring and impacts of plastic wastes is still at the infancy stage, but thus far, the reports are worrisome. In human occupational and residential environment, plastics made of petrol-based polymer are present in high quantity. At the end- of-life of these plastics, they are usually land-filled together with municipal solid waste. Plastics have several toxic constituents among which are phthalates, poly-fluorinated chemicals, bisphenol A (BPA), brominated flame retardants and antimony trioxide which can leach out to have adverse effects on environmental and public health. Plastics in electronic waste (e-waste) have become a serious global environmental and public health concern due to its large production volume and the presence of inadequate management policies in several countries. Reports from China, Nigeria, and India indicated that plastic hazardous substances from e-wastes can migrate beyond the processing sites and into the environment.

2. LITERATURE REVIEW

1 “Fabrication and testing of Plastic sand bricks” by S S Chauhan, Bhusan Kumar, Prem Shankar Singh, Abuzaid Khan, Hrithik Goyal, Shivank Goyal (2019). They mixed the river sand and the PET plastic (molten form) in the ratio of 1:2, 1:3, 1:4 for mould size of (230*100*75) mm for which they found maximum compressive strength on the ratio of 1:2 mixture for the same size of the bricks. The water absorption of these bricks was observed less than 5% that is less than conventional clay bricks i.e. 15-20%. However, they failed in maintaining fire resistance property of these bricks.

2 “Utilization of plastic waste in manufacturing of plastic sand bricks.” By Arvind Singhal, Dr. Om Prakash Netula (2018). They used the mixture of plastic and stone dust in the molten form in the ratio of 3:7 in standard brick mould for which stone dust was sieved through 4.75 mm using sieve analysis and conducted test on water absorption to

be found as 0%. Compressive strength of plastic sand bricks is 5.6 N/mm2 at the compressive load of 96 KN.

3."Plastic in Brick Application." By Siti Nabilah Amir & Nur Zulaikha Yusof (2018). The studies showed the possibility of using plastic as binder with the aid of catalyst through depolymerisation of PET to replace sand. It was observed that a significant decrease in compressive strength is observed for more than 50% replasand of binder with PET waste. With increased amount of PET, the softening point of the bricks produced was also increased. They used the different size of moulds like (150*150*150) mm, (200*100*100) mm etc.

4."Study of plastic dust brick made from waste plastic" by Ronak Shah, Himanshu Garg, Parth Gandhi, Rashmi Patil, Anand Daftardar (2017). They used plastic dust as the main component of waste product which is the by – product of many industrial products such as PVC pipes and they have heated plastic dust at 220℃. The final product from plastic dust was tested for the compressive strength and it was observed as 6.66 N/mm2 which is higher than conventional bricks (3-5 N/mm^2).

5. Muyen Z, Barna TN, Hoque MN (2016) Strength properties of plastic bottle bricks and their suitability as construction materials in Bangladesh. Progressive Agriculture 27(3): 362-368.

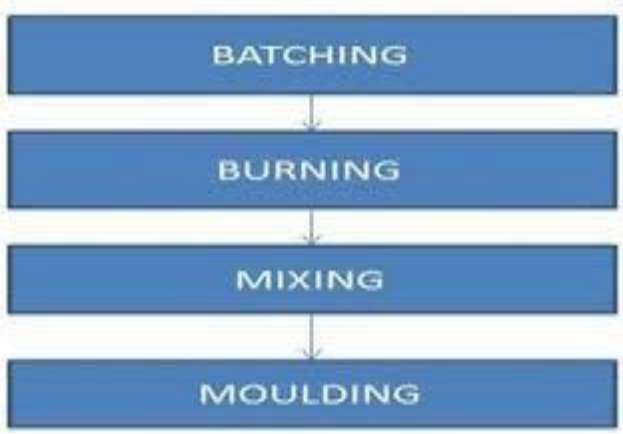
6. Hiremath PM, Shetty S (2014) Utilization of waste plastic in manufacturing of plastic-soil bricks. International Journal of Technology Enhansand and Emerging Engineering Research 2(4): 2347-4289

3 METHODOLOGY

Process of Casting Plastic Sand Brick

- First, we need to collect the plastic waste and separate it from other wastes.
- Second, we should dry the plastic waste if it is wet and has a content of moisture. We have to use dry plastic waste.
- Then, we crush the plastic waste in small particles by crushing machine.
- Then, the small particles crush into fine size particles.
- The ratio of plastic and stone dust which we use is 3:7.
- The stone dust which we use in manufacturing of bricks/tiles is sieved for a size less than 4.75mm using sieve analysis.
- Then, we heated the stone dust on a furnace (Bhatti).
- The fine particles of plastic waste also heated on a furnace (Bhatti) till it is in a liquid form.
- Then, we add the stone dust into melt plastic.
- Then, we can mix it properly and make a mix.
- Then, we poured the mix into moulds.
- Then keep it the mould for dry and demould it on a next day.
- The weight of the brick is 2.5Kg

MIX DESIGN



In order to find the plastic soil bricks that they possess high compressive strength with various mix proportions are made and they are tested using compressive testing machine [CTM]. The mix proportions were in the ratio of (1:3, 1:4, and 1:5). These are the ratio which represents the plastic, M-sand respectively.

- Mix Design Calculations

a) Ratio (1:2)

Size of brick = 19 X 9 X 9 cm

= 0.19 X 0.09 X 0.09 m

Volume of brick = 0.00153 m3 Sum of proportion= 1+2 = 3
Amount of plastic = (0.00153/2) x 1 = (5.1 x 10-4) x 1390 …… (1390 PET density)
Amount of plastic = 0.7089 kg of plastic. Amount of sand=0.00153 x 2
2
= (1.02 x 10-3) x 1620 …. (1620 Sand density)
Amount of sand=1.65kg of sand.
b) Ratio (1:3)
Size of brick = 19 X 9 X 9 cm = 0.19 X 0.09 X 0.09 m
Volume of brick = 0.00153 m3
Sum of proportion= 1+3=4
Amount of plastic =0.00153 x 1
2
= (3.825 x 10-4) x 1390… (1390 PET density)
Amount of plastic = 0.53 kg of plastic.
Amount of sand= 0.00153x 3 = (1.14 x 10-3) x 1620 …. (1620 Sand density)
4
Amount of sand = 1.85 kg of sand

TESTS ON BRICKS

Compression Strength test (BS 5628: Part 1: 1992)

In this test, the cubical brick specimen is placed in the compression strength testing machine. After placing it we will apply the load on the brick without any shock. The load will be increased at a rate of 140kg/cm2 min continuously till the specimen's resistance to increasing load breaks down and it cannot withstand any greater load further. Recording the maximum load applied to the brick specimen and the appearance and type of failure is also noted along with any unusual features.

COMPRESIVE STRENGTH= MAXIMUM LOAD APPLIED SPECIMEN AREA
COMPRESSIVE STRENGTH = F/A
Where,
F - Maximum load applied (KN) A – Specimen Area (mm2)

Table: Compressive strength for 1:05 sand to plastic ratio, Plastic Sand Brick

Plastic Sand Brick (1:05 Ratio) Maximum Load (N/mm2) Average load (N/mm2)

Specimen 1	7.59 N/mm2	
Specimen 2	7.92 N/mm2	7.53 N/mm2
Specimen 3	7.10 N/mm2	

Table: Compressive strength for 1:1 sand to plastic ratio, Plastic Sand Brick

Plastic Sand Brick (1:1Ratio) Maximum Load (N/mm2) Average load (N/mm2)

Specimen 1	8.28 N/mm2	
Specimen 2	6.93 N/mm2	7.87 (N/mm2)
Specimen 3	8.40 N/mm2	

Table: Compressive strength for 1:1.5 sand to plastic ratio, Plastic Sand Brick

Plastic Sand Brick (1:1.5Ratio) Maximum Load (N/mm2) Average load (N/mm2)

Specimen 1	5.33 N/mm2	
Specimen 2	6.01 N/mm2	5.91 N/mm2
Specimen 3	6.40 N/mm2	

CONCLUSION

The proposed project presented above intends to resolve in reducing the plastic waste disposal problem as it utilizes the waste even in its finest form and converts that useless material into a useful construction material. Extruder machine plays a prominent role in the conversion of waste plastic into its melted form. Also, extruder does not possess any threats to the environment and hence can be used without any restriction. It also helps in reducing the usage of natural resources which are utilized during the manufacturing of burnt bricks, also it reduces the pollution which is generated from kiln during brick manufacturing. The final end product can be used as brick, which is having a higher strength than conventional brick. Also, the water absorption capacity is higher in comparison to conventional brick with a lower weight. Its uses are not restricted as only brick; it can even be utilized as a building block by increasing the dimension of the mould. Also, it reduces the use of wire used for fencing.

Floor tiles, sleepers, etc. can also be produced from it. This brick also turns out to be economical than conventional brick, by reducing the cost of incinerators for burning purpose and landfills.

REFERENCES

11. S S Chauhan, Bhusan Kumar, Prem Shankar Singh, Abuzaid Khan, Hrithik Goyal, Shivank Goyal, "Fabrication and testing of Plastic Sand Bricks" on ICCEMME 2019.
2. Rajarapu Bhushaiah, Shaik Mohammad, D. Srinivasa Rao, "An Overview of Study of Plastic Bricks Made From Waste Plastic" International Research Journal of Engineering and Technology (IRJET) (April 2019)
3. V. Velumurugan , R. Gokul Raj , A.Harinisree, "An Overview of Rebuilding of Plastic Waste to Pavement Bricks" International Journal for Research in Applied science & Engineering and Technology (April 2019)
4. Arvind Singhal, Dr. Om Prakash Netula, "Utilization of plastic waste in manufacturing of plastic sand bricks" on 17th June 2018 at 3rd International conference on New Frontiers of Engineering, Science, Management and Humanities. ISBN: 978-93-87433-29-8.
5. Siti Nabilah Amir & Nur Zulaikha Yusof, "Plastic in Brick Application" on 4th September 2018 by LUPINE PUBLISHERS. ISSN: 2637-4668. DOI: 10.32474/TCEIA.2018.03.000152.
6. Aiswaria K, Khansa Abdulla, E B Akhil, Haritha Lakshmi V G, Jerin Jimmy "Manufacturing and Experimental Investigation of Bricks with Plastic And M-Sand" International Journal of Innovative Research in Science, Engineering and Technology Vol. 7, Issue 6, June 2018
7. Ronak Shah, Himanshu Garg, Parth Gandhi, Rashmi Patil, Anand Daftardar. "Study of plastic dust brick made from waste plastic." on International journal of mechanical and production engineering. ISSN: 2320-2092, volume-5, issue-10, OCT - 2017.
8. A.S. Manjrekar, Ravi, D. Gulpatil, Vivek P. Patil, Ranjit S. Nikam, Chetali M. Jeur (2017). "Utilization of Plastic Waste in Foundry Sand Bricks", International Journal for Research in Applied Science & Engineering Technology (IJRASET).
9. Loukham Gerion Singh, Pongsumbam Boss Singh, Suresh Thokchom (2017). "Manufacturing Bricks from Sand and Waste Plastics", National Conference on Innovations in Science and Technology (NCIST-17).
10. Dinesh.S, Dinesh.A, Kirubakaran.K, "UTILISATION OF WASTE PLASTIC IN MANUFACTURING OF BRICKS AND PAVER BLOCKS'' International Journal of Applied Engineering Research, ISSN 0973-4562, Volume 1, 2016.
11. Gopu Mohan C, Jikku Mathew, JithinX Ninan Kurian, John Thomas Moolayil, "FABRICATION OF PLASTIC BRICK OMANUFACTURING MACHINE AND BRICK LANALYSIS" International Journal of Innovative Research in Science and Technology, ISSN (online) 2349-6010, Volume 2, Issue 11th April 2016
12. Sina Safinia, Amani Alkalbani. "Use of Recycled Plastic Water Bottles in Concrete Blocks" Middle East College, KOM, Rusayl, Muscat PC 124, Oman 2016.
13. Dibya Jivan Pati, Riken Homma, Kazuhisaikt, "PLASTIC BOTTLES MASONRY AS ALTERNATE SOLUTION TO HOUSING PROBLEMS IN URBAN AREA OF INDIA" International Journal of Architecture Planning and Building Engineering, ISSN 2455-5045, Volume 2, Issued 2nd April 2015.
14. Maneeth. P.D, Pramod. K, Kishore Kumar, Shanmukha Shetty, "UTILISATION OF WASTE PLASTIC IN MANUFACTURING OF PLASTIC-SOIL BRICKS'' International Journal of Engineering Research and Technology (IJERT), Volume 3, ISSN 2278-0181, Issued 8th August 2014.
15. Amit Gawande, G. Zamare., V.C Range., Saurabh Taye, G. Barnacle. "an overview on waste plastic utilization in asphalting of roads", Journal of Engineering Research and Studies (JERS), Vol. III, Issue II, April June 2012, pp 01-05.
16. Bharath Raj, Varshith A, Rashmitha Kotian, N.G. Ashwath. "Study on Laterite-Sand bricks" Project report, K.V.G College of Engineering, Sullia.DK. 2011-2012.
17. Hiremath PM, Shetty S (2014) Utilization of waste plastic in manufacturing of plastic-soil bricks. International Journal of Technology Enhansand and Emerging Engineering Research 2(4): 2347-4289
18. Gopu Mohan. C, Jikku Mathew, Jithin Ninan Kurian, John Thomas Moolayil, "FABRICATION OF PLASTIC BRICK MANUFACTURING MACHINE AND BRICK ANALYSIS" International Journal of Innovative Research in Science and Technology, ISSN (online) 2349-6010, Volume 2, Issue 11th April 2016.
19. Dibya Jivan Pati, Riken Homma, Kazuhisaikt, "PLASTIC BOTTLES MASONRY AS ALTERNATE SOLUTION TO HOUSING PROBLEMS IN URBAN AREA OF INDIA" International Journal of Architecture Planning and Building Engineering, ISSN 2455-5045, Volume 2,Issued 2nd April 2015.
20. Dr.M. Mageswari, J.S. Chiranjeevi, K. Magesh, , "An Overview of Plastics Bricks" International Research Journal in Advance Engineering And Technology (10- 04-2018