World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(RESEARCH ARTICLE)

Check for updates

An experimental study of plastic bricks made from waste plastics

Sangita Nayak [1,*], Prabhudatta Senapati [1], Suvashree Mohanty [1], and Shidhi Swarupa Nayak [2]

[1] *Department of civil Engineering, Spintronic Technology and Advance Research, Bhubaneswar, 752050, Odisha India.*
[2] *Sanghavi College of Engineering, Nashik, 422202, Maharashtra, India.*

World Journal of Advanced Engineering Technology and Sciences, 2025, 15(01), 973-978

Publication history: Received on 03 March 2025; revised on 08 April 2025; accepted on 12 April 2025

Article DOI: https://doi.org/10.30574/wjaets.2025.15.1.0265

Abstract

The Plastic waste is the hazardous problem in today's world. This is most dangerous problem in front of humanity. The most hazardous type of wastes are HDPE and PTE and the plastic below 50 micron is also causing a serious problem. These plastic mixed in the soil, is directly effects on fertility of soil. Nowadays, the large amount of plastic is deposited into sea. This plastic waste gives hazardous effect on the life and quality of sea water also polluted by this plastic. So, we try to finding an efficient way to solve this problem of plastic wastes. So, we added these plastic wastes into the bricks and create the bricks by using plastic wastes. It is most economical solution present in the construction industry and it is also economical and environment friendly solution of the plastic wastes. This study summaries the work done by authors to use plastic as construction material in bricks. Various authors performed comparative study with brick made up of other materials by using various testing method such as Scratch test, apparent porosity, water absorption, apparent porosity test, soundness test, efflorescence test and analyzed that the further research on this field can enrich the strength, quality and durability of the masonry bricks. These bricks absorb very less water as compared to conventional bricks that is also very significant with the view of environmental sustainability. The different types of plastic percentages we used in this experiment were 30%, 35%,40%,45% and 50% respectively with the river sand. The tests that were performed on these bricks were Compression test and Hardness Test and Other tests that were performed on normal bricks. These bricks are light in weight and economical in budget as we are using plastic waste. This paper reviews the reduction of plastic disposal and the results are clearly shows that some part of plastics can be definitely used in the production of bricks.

Keywords: Plastic Waste; Compressive Strength; Hardness and Toughness Test

1. Introduction

Plastic is the very hazardous material and very difficult to decompose it is main problem in the world. Use of plastic is high in our daily life such as polythene bags, disposals, furniture's, packing food packets and other accessories. Plastic is varied in large and various types according to their chemical composition. So, to separation of plastic wastes and mainly big problem in front of us. Nowadays, In the world plastic deposited by burning procedure. They emit large amount of hazardous and toxic gases. These gases effect on the human health and also living animals. Human suffers by the toxic gases such as cancer, high blood pressure, Asthma.etc We are not completely able to stop the use of plastic but we are able to recycle and reuse it by many ways and minimum effect on environment. We use such recycle plastic in the various industries such as construction, transportation, manufacturing. In construction industry, larger cost of project is including in materials up to 60% to 70% of the total cost of the project. So, construction industry large number of bricks are used and they available in various forms such as clay bricks, concrete bricks, fly ash bricks and foam bricks. In this project, we try to use wastes plastic to manufacture the bricks and increase the strength and achieve economy so the people can easily afford this type of bricks. In the construction industry Polyethylene (PET) and Polypropylene (PP) plastics are frequently employed. PET plastic brick in composition with foundry sand (Aneke and Shabangu, 2021)

* Corresponding author: Sangita Nayak.

and recycled glass granules (Frank Ikechukwu and Shabangu, 2021) respectively had 2.5 and 3 times higher compressive strength, and the temperature required to manufacture those bricks was approximately 5 times lower than burnt clay brick. The bricks with a higher percentage of PET i.e., 5% gave many effective results when compared with conventional fire clay bricks, but beyond 5% replacement of PET in fire clay bricks, a reduction in compressive strength was observed (Akinyele et al., 2020a, b). Many experimental studies have been undertaken on a brick masonry wall and masonry prisms of varied constituent materials, bonds, dimensions, and height to thickness (h/t) ratio. The physical and mechanical characteristics of brick masonry units, as well as their masonry with lime mortar joints, are determined (Drougkas et al., 2016; Bompa and Elghazouli, 2020). Nassif Nazeer Thaickavil et al. (Thaickavil and Thomas, 2018) proposed a masonry model with two different types of bricks: cement stabilized pressed earth brick (B1) and local burnt clay brick (B2). Cement mortar ratios of different proportions were used to make masonry prisms. They assessed the compressive strength of the masonry prism and recorded the cracking pattern by performing a laboratory test on 192 masonry prism specimens. The model proposed by Thaickavil et al. (Thaickavil and Thomas, 2018) accommodates a wide range of mortar (0.3–52.6 MPa) and masonry unit strength (3.5–127 MPa) in his study. Kumavat et al. (Kumavat, 2016) conducted experimental research on the mechanical properties and compressive strength of clay brick masonry prisms using mortar composed of fine aggregate with clay brick waste (in percentage proposition) as a replacement for sand. In that, the cement mortar of 1:4 and a 20% replacement of clay brick waste gave higher results in compressive strength. They found that due to this replacement compressive strength of the masonry prism was found to be more as compared to standard masonry prism. The compressive strength of brick and mortar is the primary factor influencing the compressive strength of masonry prism, since the strength of masonry increases as the strength of brick-and-mortar increases (Nauman Azhar and Ali Qureshi, 2020; Francis et al., 2017; Singh and Munjal, 2017). Gumaste et al. (2007) conducts experimental research on strength, elastic properties, and failure pattern of brick masonry prism and Wallette under axial compression. The masonry prism is constructed with varying mortar ratios and designed following IS 1905:1987 specifications. Ajith Thamboo and Dhanasekar (2019) compared the behavior of a prism to a cube and found that the prism provides more strength than a cube. Aside from constructing brick and analyzing its mechanical properties, numerical simulation and computerized modeling of brick masonry are also done using a finite element (FE) program (Srinivas and Sasmal, 2016; Furtmüller and Adam, 2011). Bricks made by recycling soft plastic waste had high pressure withstand capacity and were very lightweight compared to conventional bricks. (Kognole, Shipkule and Survase, 2019) Plastic replaced the clay as a binder, which was much cheaper than ordinary brick, and water absorption capacity was zero percent when crushed waste (0.75 kg) and red soil (2 kg) were mixed. (Kumar, Biswas and Nath, 2020) Bricks made from plastic waste have minimal water absorption compared to conventional bricks (Prasanth, Gopalakrishnan, Thanigainathan, and Kathiravan, 2018). The water absorption capacity of fly ash bricks decreases from 12.714% to 1.8% when plastic waste significantly increases to the fly ash (Belay Wendimu, NeguseFurgasa, & Mohammed Hajji, 2021). The bricks made of plastic met the standard referred by the ASTM and Ethiopian, but it was not recommended on using in the places like kitchens, chimneys and walling purposes because of its low melting capacity. (Manas, 2022) reveals that water absorption and compression strength are more than ordinary bricks (Kadhone, Rajput, Deshmukh, Narkhede & Dhivare, 2022). Plastic bottles had beneficial use on optimization in energy by reducing the degradation of the environment with sustainable waste management.

2. Literature review

Om Prakash Netula et.al [1] “Utilization of plastic waste in manufacturing of plastic sand bricks.” 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.

Nur Zulaikha Yusof [2] “Plastic in Brick Application.” The studies showed the possibility of using plastic as binder with the aid of catalyst through depolymerisation of PET to replace cement. It was observed that a significant decrease in compressive strength is observed for more than 50% replacement 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.

Ananda Daftardar et.al [3] “Study of plastic dust brick made from waste plastic” 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).

S S Chauhan et.al [4] “Fabrication and testing of Plastic sand bricks” 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.

Arvind Singhal et.al [5] "Utilization of plastic waste in manufacturing of plastic sand bricks." 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.

Rajarapu bhushaiah et.al [6] study of plastic bricks made from waste plastic this study investigates the use of waste plastic to create bricks for building construction. the author conclude that the plastic sand bricks are useful for the construction industry when they compare with fly ash bricks and 3rd class clay bricks.

P. Jayaprakash et al. [7] "Plastic waste converted into bricks" This study investigates the use of plastic waste to create bricks for building construction. The authors find that the use of plastic waste can reduce the amount of waste going to landfills and can result in cost savings in the construction industry. They also note that the mechanical properties of the plastic bricks are comparable to traditional bricks.

Mr. Aman Kumar et al [8] Present a report on Manufacturing Bricks from Sand and Waste Plastics, this report concludes that, making bricks from sand and waste plastics can be an alternative to the available traditional clay bricks. Sand plastic bricks have lower water absorption (1.5%), bulk density(1.497Kg/L), and apparent porosity when compared with those of normal clay bricks. Sand plastic bricks have near same compressive strength(5MPA) than normal clay bricks (4.3 to 6.9) Plastic brick have low weight compression to normal brick. Waste plastics which is available everywhere may be put to an efficient use in brick making. Sand plastic bricks can help reduce the environmental pollution thereby making the environment clean and healthy

Mr. C. Selvamani et al [9] Present a report on preparation of brick using sand and plastic bottles, this report concludes that. Waste plastic, which is available everywhere, may be put to an effective use in brick making. Plastic sand bricks can help reduce the environmental pollution, thereby making the environment clean and healthy. Plastic sand bricks reduce the usage of clay in making of bricks. Plastic sand bricks give an alternative option of bricks to the customers on affordable rates. Water absorption of plastic sand brick is zero percent. Compressive strength of plastic sand brick (8.6N/mm2) is more than compression to the normal red brick (5.58N/mm2) they perform the test at different - different ratio (1:3) is very good for high compressive strength ratio.

Prof. A. S. Moon et al [10] Present Ecological brick by use of west plastic & sand, this report concludes Waste plastic, which is available everywhere, may be put to an effective use in brick. Plastic bricks can help reduce the environmental pollution, thereby making the environment clean and healthy. Plastic sand bricks reduce the usage of clay in making of bricks. Plastic sand bricks give an alternative option of bricks to the customers on affordable rates. it reduces the weight of brick compression to normal brick. Water absorption of plastic sand brick is zero percent.

R. S. Kognole et al [11] Present a report on Utilization of Plastic waste for Making Plastic Bricks, this report concludes that. Waste plastic, effective use in brick making. Plastic sand bricks can help reduce the environmental pollution, thereby making the environment clean and healthy. Plastic sand bricks reduce the usage of clay in making of bricks. Plastic sand bricks give an alternative option of bricks to the customers on affordable rates. Water absorption of plastic sand brick is zero percent. We conclude that the plastic sand bricks are useful for the construction industry when we compare with Fly Ash bricks and 3rd class clay bricks.

Objectives

- To compare the strength of plastic bricks with normal clay bricks.
- To vary the percentage of plastic in bricks to determine the strength performance.
- Cost comparison in between plastic bricks and normal clay bricks.

4. Methodology

- 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. The small particles crush into fine size particles.

- Fine particles of plastic waste also heated on a furnace till it is in a liquid form. we add the stone dust into melt plastic. We can mix it properly and make a mix. We poured the mix into moulds. Keep it the mould for dry.
- The test specimens after moulding were allowed to dry for a period of 5 hours. The specimens were kept in curing tank and allowed to cure for a period of 3 hours.

Figure 1 Collection of plastics

Figure 2 Moulding

5. Materials used for plastic brick

- Polythene
- High density polymer
- Plastic bottles (PET)
- River Sand (4.75 MM)

5.1 Testing of specimens

5.1.1 Compressive Strength Test

This test is done to know the compressive strength of brick. It is also called crushing strength of brick.3 Specimens of bricks are taken to laboratory for the testing and tested one by one. In this test a brick specimen is put on compressive strength testing machine and applied pressure at a constant till it breaks. All three brick specimens are tested one by one and average result is taken as bricks compressive strength.

5.1.2 Hardness & Toughness Test

Hardness test is done to check hardness of brick. This is tested by using a sharp tool and scratching against the brick surface. If there is no impression of the scratch on the brick surface, the brick is sufficiently hard and fit for use.

6. Calculation

Compressive Strength of Bricks= Maximum load at Failure(P)/ Area of brick(mm^2)

Sample No 01= 91KN=91000N

Sample No 02= 103KN=103000

Sample No 03= 115KN=115000

Area of Brick= Length (200) × Width (100) =20000

Table 1 Compressive Strength of Plastic Brick

Sample 1	Sample 2	Sample 3	Average Comp Strength (N/mm^2)
4.55	5.15	5.75	5.15

7. Result

Average compressive strength of Plastic bricks= 5.15 N/mm^2

Table 2 Comparison between Clay Brick & Plastic Brick

Sl.No.	Properties	Clay Brick	Plastic Brick
1	Material	Soil	Plastic
2	Compressive Strength	6.10 N/mm^2	5.15 N/mm^2
3	Hardness	Low	High
4	Toughness	Low	High
5.	Cost of Manufacturing	5-6rs/Brick	2-3rs/Brick

8. Conclusion

- Plastic Brick Can be a good alternative of traditional earthen Bricks.
- Plastic bricks can be used for partition wall and exterior walls. However, they must not be used in load bearing walls.
- Plastic bricks are water resistant, hence can be used in under water structures.
- Re using plastic will reduce environmental pollution.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

9. References

[1] Manish, G, N, (2021). Constructing structures using eco-bricks International Journal of Recent Trends in Engineering & Research, Vol.2 (4), pp,159-164.

[2] D, P, Maneet., K, Promod., K, Kishor., & Setty, S (2020). Utilization of Waste Plastic in Manufacturing of Plastic Soil Brick International Journal of Engineering Research and Technology, Vol3 (8), pp, 529-536.

[3] H, M, Puttaraj ., S, Shanmukha., R, Navaneeth., & B, T, Pratima,.9(2016). Utilization of Waste Plastic in Manufacturing of Plastic Soil Brick International Journal of Technology Enhancement and Emerging Engineering Research Vol 2(4), pp, 102- 107.

[4] S, P,. (2022) . Experimental Investigation on Making of plastic Brick Volume- 5, Issue- 01,

[5] Kumar, A,. (2022). A Study of Manufacturing Brick Using Plastic Waste Volume 7, Issue-08 (2020). [3] Mr. Anubhav Verma, Preparation of plastic brick using sand & west plastic bottle Volume issue 06.

[6] Moon, S, A,. (2022). Ecological brick by use of west plastic and sand volume 10 issue- 4.

[7] K, S, R. (2009). Utilization of plastic waste for making plastic brick volume 4, issue 4.

[8] O, A, Dawood, H, Kharzai,& S, R, Falih,. (2021) . Physical and mechanical properties of concrete con - training PET wastes as a partial replacement for fine aggregates. Case Studies in Construction Materials.

[9] Osman, G, Gökhan. (2013) . Porous clay bricks manufactured with rice husks, Construction and Building Materials, 40, 390- 396.

[10] Syed, M ,. S, K, Safeer, A., Muhammad, J,M,. & Anwar, K. (2016). Exploratory study on the effect of waste rice husk and sugarcane bagasse ashes in burnt clay bricks, Journal of Building Engineering, Volume 7, Pages 372-378, ISSN 2352-7102.

[11] Shakir, A,. Naganathan, S,. & Mustapha, K,. (2013). Properties of bricks made using fly ash, quarry dust and billet scale, Constr. Build. Mater. 41 131-138.

[12] Syed, M, S ,K,. Safeer, A, Muhammad, .& J, M, Anwar, K,. (2016). Exploratory study on the effect of waste rice husk and sugarcane bagasse ashes in burnt clay bricks, Journal of Building Engineering, Volume 7, Pages 372-378, ISSN 2352-7102.