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A Review of Plastic Bricks as a Construction Material

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ABSTRACT

plastic brick is a building material made from a blend of non-recyclable waste plastic and other components (such as sand, aggregate, cement, water, stone dust, fly ash, etc.). This study aims to investigate research findings on transforming waste plastic into bricks that can replace traditional bricks. Various journal articles were reviewed, titled 'Conversion of Waste Plastic into Bricks to Replace Conventional Clay Bricks.' Several open-access journal articles were examined to align with the focus of this study. The results indicate that concrete blocks incorporating plastic bottles exhibit a 57% higher compressive strength, as cited by other researchers (n = 79) in 'Use of Recycled Plastic Water Bottles in Concrete Blocks.' The findings suggest that compressive strength and other properties can be significantly enhanced when plastic is used as a coating with sand. However, when used as filler, it yields comparable strength to conventional bricks and can be employed without restrictions or reservations. The primary reflection of this review is to conduct extensive research on a large scale to discover an innovative method to transform waste plastic into environmentally friendly bricks. The implications of this study would be beneficial to students, future researchers, and the Building Department of the Oxford College of Engineering and Management, Gaindakot 2 in Nawalparasi district, and young.

KEYWORDS: *Plastic waste, Bricks, waste recycling, Binders, Plastic bricks*

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1. INTRODUCTION

Plastic bricks are the sorts of bricks that are made utilizing plastic squander. These bricks are not as it were cost-effective and eco-friendly but moreover have moo water assimilation esteem and tall compressive quality and will not have issues like efflorescence in future. Plastic squander is expanding due to an increment in contamination, organization, and advancement. Since the rate of plastic generation is anticipated to twofold the esteem each ten a long time, a more maintainable and more secure way is required to be taken (Prasanth, Gopalakrishnan, G Thanigainathan & Kathiravan, 2018, Kulkarni, Ravekar, Rama Rao, Waigokar & Hingankar, 2022. Plastic brick gives superior temperature resistance than ordinary brick indeed after 30 minutes of warming in the corners and the middle of the modular brick (Shrimali and Shikhar, 2017).

Bricks made by reusing delicate plastic squander had tall weight withstand capacity and were exceptionally lightweight compared to customary bricks. (Kognole, Shipkule and Survase, 2019) Plastic supplanted the clay as a folio, which was much cheaper than standard brick, and water retention capacity was zero percent when pulverized squander (0.75 kg) and ruddy soil (2 kg) were blended. (Kumar, Biswas and Nath, 2020) Bricks made from plastic squander have negligible water retention compared to customary bricks (Prasanth, Gopalakrishnan, Thanigainathan, and Kathiravan, 2018). The water assimilation capacity of fly fiery debris bricks diminishes from 12.714% to 1.8% when plastic squander altogether increments to the fly fiery debris (Belay Wendimu, NeguseFurgasa, & Mohammed Hajji, 2021). The bricks made of plastic met the standard alluded by the ASTM and Ethiopian, but it was not prescribed on

utilizing in the places like kitchens, chimneys and walling purposes since of its moo softening capacity. (Manas, 2022) uncovers that water retention and compression quality are more than standard bricks (Kadhone, Rajput, Deshmukh, Narkhede & Dhivare, 2022). Plastic bottles had advantageous utilize on optimization in vitality by diminishing the debasement of the environment with maintainable squander administration. The essential objective of this think about was to analyze an effective way to successfully utilize squander plastic which is a more critical danger to the sustainment of environmental adjust, donate the information of supplanting the conventional development brocks and compare the properties of the bricks with other development fabric.

2. LITERATURE REVIEW

Table 1. Literature review of waste plastic transformation into bricks

Authors & Publication Years	Topics of the articles	Objective	Types of journals	Citations counts	Methods	Findings	Future Research
Chauhan, Kumar, Shankar Singh, Khan, Goyal, & Goyal (2019), UMundhe& Dhawale (2018). Al-Sinan &Bubshait (2022)	1. Fabrication and Testing of Plastic Sand Bricks 2. Use of Waste Plastic as a Construction Material Utilization of Plastic waste for Making Bricks	To create masonry units to replace conventional bricks by recycling plastic. To solve plastic waste by creating bricks made from plastic.	International Journal of Engineering and Applied Sciences International Research Journal of Engineering and Technology	8 23	Experimental method Experimental method.	The compressive strength of brick is more than conventional clay brick. Plastic sand bricks are useful for construction and reduce environmental pollution.	Further research is required for the fire resistance of bricks and to improve the quality durability. Future research could focus on the cost-effective model of transformation of waste plastic into bricks
Lamba, Kaur, Raj &Sorout (2021) Ogundairo, Olukann, Akinwunmi & Adegoke (2021)	1. Recycling/ reuse of plastic waste as construction material For sustainable development: a review 2. A review of plastic waste as a sustainable resource in civil engineering applications	To use plastic waste as a constituent of construction material To produce high-durability and quality bricks as well as to achieve optimum balance in all aspects, especially in terms of cost and functionality	1. Environmental Science and Pollution Research 2. I.O.P. Conference Series: Materials Science and Engineering	17	Literature Review Method	Plastic waste may produce construction bricks, concrete blocks, road construction materials, and tiles.	Further research is required to determine the optimum proportion of plastic waste as a constituent of construction materials.
Al-Sinan & Bubshait (2022)	Using Plastic Sand as a Construction Material	To look at the recent studies regarding the development	Reviewed article	4	Literature review method	The compressive strength of the brick increased	Required further investigation on the types of plastic used

	toward a Circular Economy: A Review	of plastic sand bricks and the different percentages of plastic and sand used in the bricks.				by increasing the ratio of plastic to sand.	and the flammability used in resistance to fire, also, their ick of standard code ta o the definite proportion of sand and plastic use in construct use of the rick.
Kumar Biswas & Nath (2020)	A Study of Manufacturing Bricks Using Plastic Wastes Plastic in Bricks Application	To study the properties of the brick manufactured using plastic waste.	. International Journal of Trend in Scientific Research and Development	24	Experimental study	The bricks produced are lightweight, have a smooth surface and fine edges, do not have cracks, and have high crushing strength.	Future research has to focus on finding cost-effective methods to transform the waste plastic into bricks
Yusof (2018)	Plastic in Brick Application	To outline the utilization of municipal plastic waste in construction industries	Trends in Civil Engineering and its Architecture	2	Literature review method	Plastic waste can be substituted either partially or completely in brick production.	Require further investigation on increasing the durability and quality of bricks
Al-Sinan and Bubshait, (2022)	Using Plastic Sand as a Construction Material toward a Circular Economy: A Review	To look at the recent studies regarding the development of plastic sand bricks and the different percentages of plastic and sand used in the bricks.	Journal of substantiality and development	4	Literature Review Method	Plastic brick can be used as an alternative to ordinary brick, which shows competitive results in terms of physical properties (e.g., compressive strength)	More research is required on the physical issue (fire resistance, commercial aspects of plastic brick)
Safinia & Alkalbani (2016)	Use of recycled plastic water bottles in concrete blocks	To research the use of plastic water bottles in concrete blocks.	Procedia Engineering	80	Experimental Method	The results show, Concrete blocks made with plastic bottles have 57% higher compressive strength.	Further research is required for concrete mix design and the feasibility of production in the industry to reduce cost.

Velmurugan (2019)	Rebuilding of Plastic Waste to Pavement Bricks	To recycle rich plastic for the concrete block.	International Research Journal of Engineering and Technology	6	Experimental Method	The result shows that the best ratio to construct the plastic brick is 30% plastic and 70% sand.	Future research could examine the cost-effective methods of transforming waste plastic into bricks
Sahani et al., (2022)	Mechanical Properties of Plastic Sand Brick Containing Plastic Waste	To utilize unused plastic to prepare plastic sand bricks.	Advances in Civil Engineering	35	Experimental Method	The results show that the best ratio to prepare plastic sand brick is 1:4, which has the maximum compressive strength and split tensile strength.	The future researcher may be interested in finding cost-effective methods of transforming waste plastic into bricks
User (2019)	Utilization of Waste Plastic in the Manufacturing of Paver Blocks	To the properties of plastic-made brick.	International Research Journal of Engineering and Technology	24	Experimental methods	Plastic sand bricks provide more advantages compared to continental brick in terms of cost efficiency, ultimately removing plastic waste.	On further research, the manufacturing cost could be reduced by replacing river sand with fly ash, quarry dust, or other waste products.

Our survey think about can make a stage for researchers who might be interested in plastic squander administration. The survey exposition almost bricks is critical since it can possibly increment readers' or students' understanding. It gives data on the different forms utilized in different nations to change over plastic squander into bricks. Among other things, it gives a concept for bringing down or controlling the natural contamination caused by plastics. The fundamental thing that pulled in us to this theme was the current setting that the whole world is confronting with respect to plastic squander administration. With a restricted understanding of squander administration, we realized that the squander plastic might be turned into numerous other development materials without making natural deterioration.

Objective

- To analyze the profoundly cited articles on the related subjects of bricks
- To discover key models of the change of squander plastic into bricks.
- To analyze the review's fundamental discoveries, which are based on the writing in Table one.
- To discover the investigate holes in the models utilized in changing over the squander plastic into bricks
- To compare the properties of bricks with other development materials.

Scope of the study

- To provide unused information, supplant the official fabric of conventional brick with plastic.
- To upgrade the information of how to minimize the taken a toll of bricks compared to conventional bricks.
- To discover effective ways of overseeing the non-degradable plastic waste
- To compare the properties of bricks with other development materials.

Research questions

- What are the profoundly cited articles on the related subjects of bricks?
- What are the key models of the change of squander plastic into bricks?

- What are the primary discoveries of the survey based on Table one?
- What inquire about crevices exist in the models utilized to change over squander plastic into bricks?
- What are the distinctive strategies of comparing the properties of bricks with other construction materials?

3. METHODS AND MATERIALS

Distinctive articles on converting waste plastic into bricks were considered by reviewing the abstracts of the papers. After that, several sections of each article provided a comprehensive introduction to their respective issue areas. Then, we proceeded to the final section before the heading "Methodology," which typically marks the first major section in a research article (Galvan, 1987). This section conventionally allows researchers to state their hypotheses, research questions, or study aims. Next, we reviewed the remainder of the article, focusing on all headings and subheadings to survey the content in each subsection. Our aim at this stage was to gain an overview.

It should be noted that following this guideline, we engaged in prereading, a method frequently recommended by reading experts as the initial step in analyzing a technical paper. Prereading provided an overview of the document's purpose and content, helping us focus on the big picture as we delved into the specifics of each research report from start to finish. As suggested in the following guideline, the information gathered through prereading also assisted us in categorizing the articles (Galvan, 1987). We accessed various journals from different sources on Google. Our review primarily relied on published materials that examine recent or current literature covering a wide range of aspects related to bricks made from waste plastic. This literature encompasses research findings on converting waste plastic into bricks. Our review has primarily focused on authors and publication years, the purpose of the reviewed articles, objectives, citation counts, methodologies employed in the articles, findings, and future research recommendations on this theme within the scope of this review.

4. RESULTS

After reviewing various papers, articles, reviews, and conference papers, we found that waste plastic products can be transformed into various construction materials used as additives and fillers for solid and interlocking bricks and tiles. The results highlighted that the compressive strength of the brick exceeds that of conventional clay bricks (Chauhan et al., 2019). This finding is supported by Murthi et al. (2020), who similarly observed higher compressive strength in plastic bricks.

Research question 1: What are the highly cited articles on related subjects of plastic bricks?

The results indicate that concrete blocks made with plastic bottles exhibit a 57% higher compressive strength and have been cited 79 times. Additionally, the optimal ratio for designing plastic sand bricks is 1:4, which offers the highest compressive and flexural strength and has been cited 35 times. Moreover, the review concludes that plastic sand bricks offer more advantages than conventional bricks in terms of cost-effectiveness, eliminating plastic waste, and has been cited 24 times. The results also highlight that melted recycled plastic mixed with stone dust to form bricks has been cited 23 times (see Table 1).

Research question 2: What are the key models of converting waste plastic into bricks?

The results highlight that key models of converting waste plastic into bricks involve using plastic as a partial filler or a covering material. In the process of plastic filler, a small percentage by weight of plastic is mixed with sand or aggregate in cement, while in the case of using plastic as a covering, a maximum proportion of sand may be used with sand in brick production (see Table 1).

Research question 3: What are the main findings of the review based on Table one?

The review of various journals reveals that compressive strength and other properties can be significantly increased when plastic is used as a binder with sand. When used as a filler, it achieves comparable strength to standard bricks and can be used without restrictions or hesitation. The results emphasize that plastic sand bricks have higher compressive strength than conventional clay bricks and are beneficial for construction and reducing environmental pollution. Furthermore, the results indicate that plastic waste can produce construction bricks, concrete blocks, road construction materials, and tiles, and also demonstrate that increasing the proportion of plastic to sand increases the compressive strength of the bricks.

It was found that the bricks produced are lightweight, have a smooth surface and fine edges without cracks, and have high crushing strength. Plastic waste can partially or completely substitute conventional brick production. It was found that plastic bricks can be used as an alternative to conventional bricks, showing competitive results in terms of physical properties (e.g., compressive strength). The results show that concrete blocks made with plastic bottles have a 57%

higher compressive strength. Finally, the findings indicate that the optimal ratio for developing plastic bricks is 30% plastic and 70% sand, and also indicate that the optimal ratio for designing plastic sand bricks is 1:4, which offers maximum compressive and flexural strength (see Table 1).

Research question 4: What research gaps exist in the models used to convert waste plastic into bricks?

The results highlight a research gap in examining the fire resistance of bricks to improve strength and may focus on the cost-effective model of converting waste plastic into bricks. There is also a research gap in determining the optimal proportion of plastic waste as a constituent of construction materials. There is also a research gap on what types of plastic appear to be used and the combustibility used in fire resistance, and the use of the brick of standard code to the explicit proportion of sand and plastic in the use of the brick. There is a research gap in finding cost-effective methods to convert waste plastic into bricks, and increasing the durability and strength of bricks has to be conducted. The results show that a research gap was to conduct more research on the physical issue (fire resistance, commercial perspectives of plastic brick). It is also expected to do further research on concrete mix design and the feasibility of production in the industry to reduce costs. There is a research gap in examining how the manufacturing cost could be reduced by replacing river sand with fly ash, quarry dust, or other waste products (see Table 1).

Research question 5: What are the different methods of comparing the properties of bricks with other construction materials?

The results highlighted that plastic usage in our daily life had increased significantly due to urbanization as it is a beneficial and popular material. The only downside is non-biodegradability. This study summarizes the work done by authors to use plastic as a construction material in bricks. The recyclable properties of plastic waste can be used to recycle this waste and produce a new product having a lesser negative impact on the environment. One of the options to recycle plastic waste is to form bricks of plastic by mixing plastics with sand which can be used to replace traditional bricks.

The results show that different authors performed a similar study with brick made up of other materials by using different testing methods. For example, scratch test, compressive test, clear porosity, water absorption, clear porosity test, stability test, and efflorescence test and compared that further research in this field can improve the quality, strength, and durability of these brick work bricks. These bricks absorb less water compared to ordinary bricks, which is also incredibly significant in the view of environmental sustainability. The results highlighted that using waste materials in construction materials had shown immense potential. Although some properties may decrease when the waste fibers are included, the slightly lower properties compared to the cost and energy saved may be a viable and environmentally beneficial compromise. In some cases, the processing cost for recycling and using the waste materials may be higher than the usual cost of virgin materials, which limits their offer for use (see Table 1).

5. DISCUSSION AND CONCLUSION

When pulverized waste plastic (0.750 kg) was melted and mixed with river sand (2 kg), a brick's compressive strength and water absorption capacity were 97.5 kN/m² and 3%, respectively. However, when red soil (2 kg) was mixed with crushed and melted waste plastic (0.750 kg), the compressive strength and water absorption capacity of the resulting brick were 26 kN/m² and 0%, respectively (Kognole, Shipkule & Survase, 2019). The average compressive strength and flexural strength of plastic sand bricks in ratios 1:3, 1:4, and 1:5 are 9.72 N/mm² and 737.486 MPa, 12.28 N/mm² and 804.53 MPa, 3.39 N/mm² and 654.25 MPa, respectively. The compressive and flexural strength increase with a reduction in the percentage of plastic from 25% to 20% (Sahani et al., 2022).

Our survey found that the conversion of waste plastic into bricks primarily focused on environmentally friendly solutions, ultimately reducing production costs and managing our community's plastic waste. Future research is expected to further examine this study's objective to better understand the various methods of converting conventional bricks into plastic bricks. We anticipate future essential research based on a cost-effective experimental model for converting waste plastic into bricks.

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