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Overview of Performance of Polysand Bricks in Construction Industry

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Abstract: The rising threat of plastic pollution and the urgent demand for sustainable construction materials have prompted researchers and industries alike to seek innovative solutions. One such approach is the transformation of waste plastics into construction bricks, known as plastic sand bricks or eco-bricks. This paper presents a comprehensive review of the existing literature and experimental studies that explore the feasibility, process, benefits, and challenges of using plastic waste in brick production. Drawing on multiple peer-reviewed articles and case studies, the review synthesizes findings on the mechanical performance, environmental implications, and economic viability of plastic bricks. The reviewed studies reveal that plastic bricks exhibit competitive compressive strength, reduced water absorption, improved durability, and cost-effectiveness compared to conventional clay bricks. They also highlight the environmental advantages of diverting plastic waste from landfills and incineration. However, limitations such as low fire resistance and structural constraints are also noted. This review affirms that plastic bricks hold substantial promise in sustainable construction, especially for non-load-bearing structures, and encourages further innovation and policy support to integrate them into mainstream building practices.
Keywords: construction bricks, plastic bricks, sustainable construction

I. INTRODUCTION

The widespread use of plastic in modern life, though incredibly convenient, has led to one of the most pressing environmental problems of the 21st century: plastic waste pollution. Every year, millions of tons of plastic are discarded, with only a small percentage being recycled effectively. Due to its non-biodegradable nature, plastic persists in the environment for hundreds of years, causing soil, water, and air pollution, and posing a severe threat to wildlife and human health alike. The traditional disposal methods of incineration and landfilling contribute to greenhouse gas emissions and the degradation of ecosystems, pushing researchers and industries to explore innovative solutions to this growing problem. Parallel to this crisis, the construction industry—one of the largest consumers of natural resources—is undergoing a transformation, seeking alternatives that are environmentally sustainable and economically viable. Traditional building materials such as clay bricks and concrete blocks require intensive energy and natural resources to produce, leading to land degradation, deforestation, and carbon emissions. Against this backdrop, the concept of integrating plastic waste into construction materials has emerged as a powerful strategy to address both plastic pollution and resource depletion.

Among various innovations, plastic bricks or plastic sand bricks have garnered significant attention. These bricks are made by combining shredded plastic waste with materials like sand, laterite soil, fly ash, or even rubber powder, and moulding them into durable blocks suitable for construction. Researchers such as Suriya et al., Deepak Shiri et al., and Goyal & Manisha have demonstrated that plastic bricks can outperform traditional bricks in compressive strength, water resistance, and durability, while also offering the environmental benefit of waste reduction.

This paper aims to synthesize the existing body of research on plastic bricks, exploring their physical properties, production methods, environmental implications, economic viability, and real-world applications. By evaluating insights from numerous studies, this review presents a comprehensive understanding of plastic bricks and their role as a sustainable building material in the circular economy.

II. LITERATURE REVIEW

The concept of manufacturing bricks from plastic waste has been explored in a wide range of academic studies, highlighting its potential to address two critical challenges: plastic pollution and the rising demand for sustainable building materials. This literature review examines notable works that contribute to our understanding of plastic brick production, properties, and environmental benefits.

Kumar et al. (2020) explored the application of plastic bricks in remote regions where garbage disposal is inadequate. They emphasized the low cost, water resistance, and environmental benefits of plastic bricks, particularly for partition walls and non-load-bearing structures. Similarly, Suriya et al. (n.d.) conducted an experimental study on the compressive strength of plastic bricks at various plastic-to-sand ratios (1:2, 1:3, 1:4). Their findings showed that the 1:2 ratio yielded the highest strength (9.17 N/mm²), significantly outperforming conventional clay bricks.

Manish Kumar Sahu and Lokesh Singh (2017) provided a critical review of plastic sand bricks and highlighted the use of PET and PP waste in construction. Their work supported the environmental feasibility of plastic bricks, particularly in reducing greenhouse gas emissions and reliance on clay resources. They coined the term "eco-bricks" to represent these sustainable alternatives.

A novel approach was demonstrated by Deepak Shiri et al. (2015), who used a plastic extruder and compression testing to study bricks made from polypropylene and rubber composites. These bricks withstood over 17 tons of load—nearly double the capacity of standard clay bricks—while offering enhanced durability and shock resistance.

Bhushaiah et al. (2019) added a thermodynamic dimension by baking plastic bricks at low temperatures (90–110°C) instead of using high-energy incineration. Their bricks exhibited lightweight properties, low thermal conductivity, and promising compressive strength, along with a reduced environmental footprint.

Collectively, these studies affirm that plastic bricks are not only structurally viable but also environmentally and economically beneficial. However, limitations such as fire resistance and restricted use in load-bearing applications remain consistent across the literature, pointing toward areas for future research and development.

III.METHODOLOGY

A. Materials And Methodologies In Reviewed Studies

Several types of plastics have been utilized across different studies, including PET (polyethylene terephthalate), HDPE (high-density polyethylene), LDPE (low-density polyethylene), and PP (polypropylene). These plastics are either used in shredded or granulated form and combined with materials such as sand, laterite soil, fly ash, or rubber powder.

The reviewed research generally follows a common methodology:

Collection and Sorting of plastic waste

Cleaning and Drying the plastic

Shredding or Granulating the material

Mixing with sand or additives in specific ratios (e.g., 1:2, 1:3)

Melting or compressing the mixture into moulds

Cooling, curing, and testing for properties such as compressive strength, water absorption, and efflorescence

For instance, Deepak Shiri and others (2015) used an extruder and tested various plastic-rubber composites, while Bhushaiah and others (2019) used non-recyclable thermoplastics and evaluated the bricks under heat curing and mechanical stress.

B. Mechanical And Structural Performance

1) Compressive Strength

The most commonly tested parameter is compressive strength. Suriya and others reported that plastic bricks with a 1:2 plastic-to-sand ratio reached a strength of 9.17 N/mm², which surpasses that of conventional red bricks (1.27 N/mm²). Similarly, Deepak Shiri and others (2015) found that polypropylene/rubber composite bricks withstood up to 17.05 tons of load.

2) Water Absorption and Alkali Resistance

Water resistance is another key advantage. Suriya and others and Kumar and others (2020) demonstrated that plastic bricks absorb significantly less water than traditional bricks, and the absence of alkali further improves durability in moist environments.

3) Thermal Insulation and Density

Bhushiah and others (2019) observed that plastic bricks have low thermal conductivity and are lightweight, making them suitable for insulation and easy transport. However, their load-bearing capacity is limited compared to reinforced concrete bricks.

C. *Environmental Benefits*

Plastic bricks contribute to waste reduction by diverting plastics from landfills and oceans. According to Naresh and others (2017), every plastic brick reuses up to 28 grams of waste, and a square meter of pavement using these bricks can prevent up to 3 kilograms of plastic waste from entering the environment. Additionally, studies such as those by Gopumohan and others. (2016) and Valinejad Shoubi & Barough (2013) support the claim that using plastic in construction reduces greenhouse gas emissions compared to burning or burying plastic. This approach promotes circularity in material use and aligns with sustainable development goals.

D. *Economic Feasibility*

The low cost of raw materials often sourced for free or minimal cost from municipal waste systems makes plastic bricks a highly cost-effective alternative. Tharun Kumar and others (2017) and Goyal & Manisha noted that production costs per unit are significantly lower than for clay or fly ash bricks. Manufacturing setups, although requiring initial investments in shredders, mixers, and moulding equipment, are scalable and can operate with semi-skilled labour. Kamble & Dnyandevkarad (2017) proposed micro-enterprises in rural and urban settings that utilize locally available plastic waste, thereby generating employment and reducing material transport costs.

IV. CONCLUSION

The reviewed literature strongly supports the feasibility and sustainability of plastic bricks as an alternative construction material. These bricks are cost-efficient, environmentally beneficial, and suitable for various applications, particularly in non-structural infrastructure. While challenges like fire safety and long-term durability under extreme weather remain, the overall benefits of using plastic waste in construction are substantial. By converting a pollutant into a building resource, plastic bricks offer a practical solution to some of the world's most pressing environmental and infrastructure issues. With policy support, public awareness, and continued innovation, they have the potential to revolutionize the construction industry.

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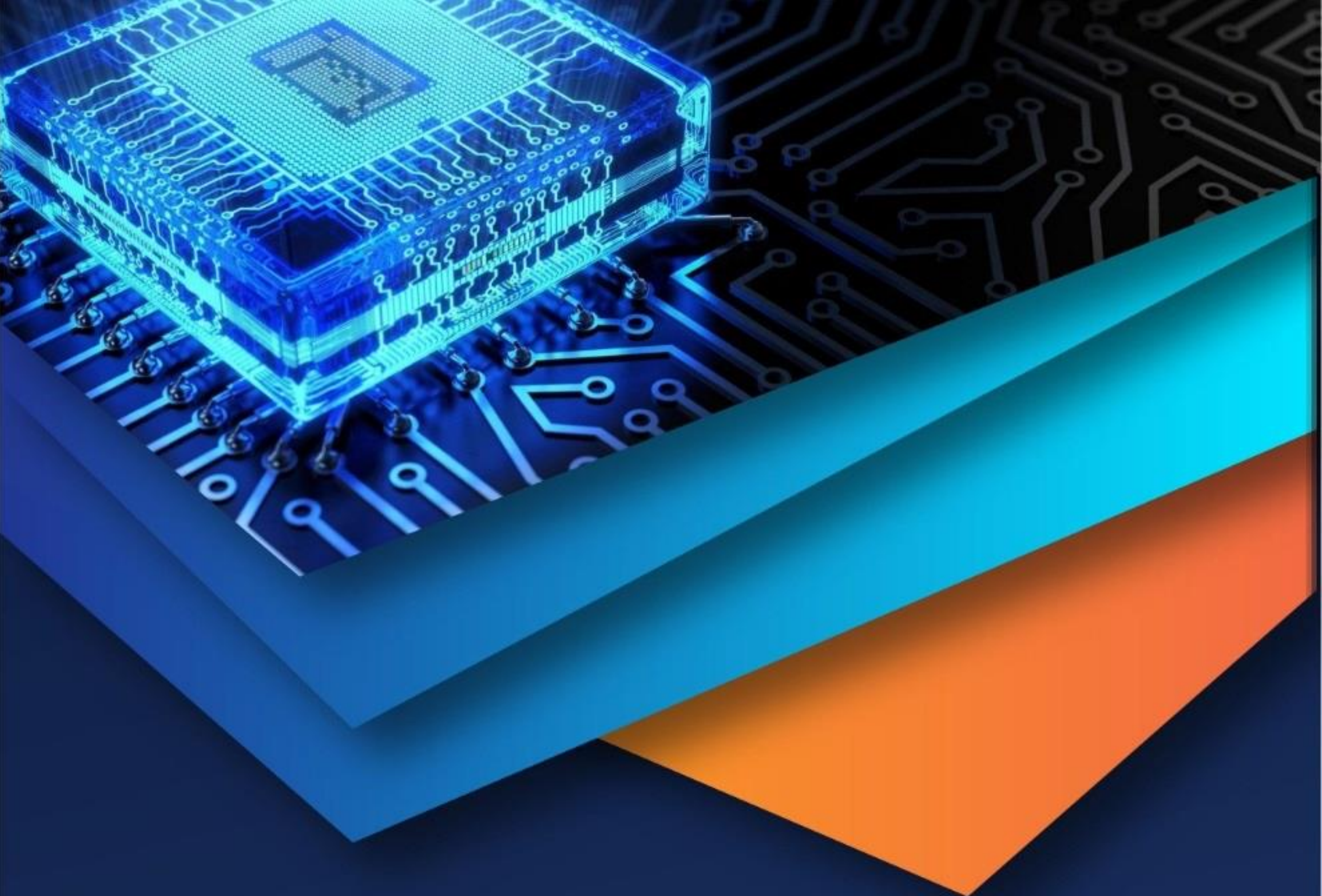

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