iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** II **Month of publication:** February 2026

DOI: https://doi.org/10.22214/ijraset.2026.77744

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue II Feb 2026- Available at www.ijraset.com

Sustainable Brick Using by Recycled Plastic Waste, Foundry Sand, and Crusher Waste Dust

Prof. I. J. Korabu[1], Mr. Haval Om Manoj[2], Mr. Raje Ghadage Sairaj Yashwantrao[3], Mr. Kavade Suraj Nana[4], Mr. Mahasawade Dadasaheb Jalinder[5]

Abstract: The increasing generation of plastic waste and industrial by-products such as foundry sand and crusher waste has created serious environmental concerns. Simultaneously, conventional brick manufacturing consumes natural resources and requires high energy for kiln firing. This study focuses on the development of sustainable bricks using recycled plastic waste as a binding material along with foundry sand and crusher waste as filler materials.

The bricks were manufactured using a non-burning process with a material proportion of 30% recycled plastic, 35% foundry sand, and 35% crusher waste. Laboratory tests including compressive strength and water absorption were conducted to evaluate the performance of the developed bricks. The results indicated an average compressive strength of approximately 14 MPa and low water absorption values below 1.2%, demonstrating good durability.

The developed bricks are suitable for non-load bearing applications such as partition walls, paving blocks, and landscaping works.

I. INTRODUCTION

The construction industry is one of the major consumers of natural resources and contributes significantly to environmental degradation. Conventional burnt clay bricks require large quantities of clay and high-temperature kiln firing, which results in depletion of fertile soil and increased carbon emissions.

Plastic waste generation has increased rapidly due to urbanization and industrialization. Plastic is non-biodegradable and causes environmental pollution when disposed improperly. Similarly, industrial wastes such as foundry sand and crusher waste are disposed in landfills, creating environmental hazards.

Sustainable construction practices encourage the utilization of waste materials to develop eco-friendly building materials. Plastic waste possesses thermoplastic properties that allow it to melt and act as a binder. Foundry sand improves workability, while crusher waste contributes to strength due to its angular particle shape.

Therefore, this research aims to develop sustainable bricks using recycled plastic waste, foundry sand, and crusher waste

Several researchers have investigated the use of plastic waste in construction materials as an alternative to conventional binders. Studies indicate that plastic-based bricks exhibit low water absorption, improved durability, and resistance to chemical attack compared to traditional clay bricks. The thermoplastic behavior of plastic allows it to act as a strong binding material when melted and mixed with aggregates. This approach also eliminates the need for kiln firing, thereby reducing energy consumption and carbon emissions associated with conventional brick manufacturing.

Similarly, industrial by-products such as foundry sand and crusher waste have been explored for their potential in sustainable construction. Foundry sand, due to its fine particle size and high silica content, improves density and surface finish, while crusher waste contributes to mechanical strength because of its angular particle shape. The combined use of plastic waste with these industrial materials has shown promising results in achieving adequate compressive strength and durability, making such bricks suitable for non-load bearing construction applications and eco-friendly infrastructure development.

II. LITERATURE REVIEW

The increasing generation of plastic waste and industrial by-products has created serious environmental concerns. Researchers have explored the use of these waste materials in construction to promote sustainable development and reduce environmental pollution. Among these materials, plastic waste, foundry sand, and crusher waste have shown promising results in brick manufacturing.

Studies on plastic waste indicate that thermoplastics such as polyethylene (PE) and polypropylene (PP) can be used as binding materials in construction. When heated, plastic softens and binds with aggregates, and upon cooling, it hardens to form a solid mass. Research has shown that plastic-based bricks exhibit low water absorption, good durability, and resistance to moisture. These bricks also eliminate the need for water curing and kiln firing, thereby reducing energy consumption and carbon emissions.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue II Feb 2026- Available at www.ijraset.com

Foundry sand, content silica(**sio2**) Due to its fine and uniform particle size, it improves workability and surface finish in construction materials. Previous studies suggest that foundry sand can partially replace natural sand without significantly affecting strength when used in optimum proportions. Its utilization helps in reducing landfill disposal and environmental hazards.
Crusher waste or stone dust has also been widely studied as a substitute for river sand. The angular shape of crusher particles enhances internal interlocking and improves compressive strength. Researchers have reported that crusher waste contributes to better density and stability in bricks and concrete products.
Several experimental studies combining plastic waste with industrial by-products have demonstrated that sustainable bricks can achieve satisfactory compressive strength suitable for non-load bearing applications. These studies emphasize the importance of proper proportioning and controlled manufacturing processes.
Based on the reviewed literature, it is evident that the utilization of recycled plastic waste, foundry sand, and crusher waste in brick manufacturing is environmentally beneficial, technically feasible, and economically viable. Therefore, the present study focuses on developing sustainable bricks using these materials and evaluating their performance through standard laboratory tests.

III. OBJECTIVES

The main objectives of this study are:
1) To develop sustainable bricks using recycled plastic waste as a binding material.
2) To utilize industrial waste materials such as foundry sand and crusher waste effectively.
3) To reduce environmental pollution and conserve natural resources.
4) To determine compressive strength and water absorption of developed bricks.
5) To evaluate the suitability of bricks for construction applications.

IV. MATERIAL SELECTION

The materials for sustainable brick manufacturing were selected based on availability, engineering properties, environmental benefits, and cost-effectiveness. replace natural clay.

A. Recycled Plastic Waste (Binder)

Recycled plastic waste was selected as the binding material because of its thermoplastic property. Plastics such as Polyethylene (PE) and Polypropylene (PP) soften when heated and harden upon cooling, which helps in binding the sand particles together. Plastic is also water-resistant, lightweight, and easily available from municipal waste.
Plastic is also:
- Water-resistant ;- which reduces water absorption of bricks.
- Lightweight :-reducing the overall weight of bricks.
- Non-biodegradable :- so using it in bricks helps reduce environmental pollution.

Fig No .3.1. Recycled Plastic Waste

B. Foundry Sand

Foundry sand was selected because it contains a high percentage of **silica (SiO_2)**. Silica provides hardness, strength, and stability to construction materials.
- ➢ Important properties of foundry sand:
- Fine and uniform particle size, which improves workability.
- High silica content, increasing strength.
- Good thermal stability, meaning it can withstand heat during plastic melting.

Because of its silica content and fine texture, foundry sand improves surface finish and bonding inside the brick.

Fig No. 32. Foundry Sand.

C. Crusher Waste

Crusher waste (stone dust) was selected due to its **angular particle shape** and mineral composition.

- ➢ Important properties:
- Angular particles provide better interlocking.
- Contains minerals like silica and stone fragments that improve strength.
- Increases compressive strength of bricks.
- Adds density and stability to the structure.
- ✓ Thus, crusher waste was selected mainly for its **strength-giving and interlocking properties**

Fig No . 3. Crusher Waste

V. DETERMINATION OF MATERIAL PROPORTION

After selecting materials, different trial mixes were considered. Based on:

- Literature review
- Experimental trials
- Workability observation
- Strength performance

The final optimum proportion selected was:

Material	Proportion %
Plastic	30
Foundry Sand	35
Crusher Waste	35

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue II Feb 2026- Available at www.ijraset.com

VI. METHODOLOGY

Collection of Materials

(Plastic Waste, Foundry Sand, Crusher Waste)
↓
Cleaning & Drying of Materials
↓
Shredding of Plastic Waste
↓
Sieving of Foundry Sand & Crusher Sand
↓
Batching (30% Plastic : 35% Foundry Sand : 35% Crusher Waste)
↓
Melting of Plastic (160°C–200°C)
↓
Addition of Foundry Sand
(Gradually with Mixing)
↓
Addition of Crusher Sand
(Gradually with Mixing)
↓
Uniform Mixing of All Materials
↓
Pouring Mixture into Steel Mould
(190 mm × 90 mm × 90 mm)
↓
Hydraulic Compaction
↓
Setting at Room Temperature
(15–30 min)
↓
Demoulding.
↓
Water Cooling (10–20 min)
↓
Final Sustainable Brick Ready.

VII. MANUFACTURING PROCESS

A. Collection of Materials

Plastic waste was collected from municipal and household sources. Foundry sand was obtained from metal casting industries, and crusher sand waste was collected from stone crushing plants. All materials were stored in dry conditions.

B. Preparation of Plastic Waste

Collected plastic was washed to remove impurities and dried properly. It was then cut or shredded into small pieces to ensure uniform melting.

Fig No .7.2. Preparation of Plastic Waste.

C. Preparation of Foundry Sand

Foundry sand was washed to remove dust and clay particles. After drying in sunlight, it was sieved through a 4.75 mm sieve to obtain fine and uniform particles.

Fig No .7.3.Sive Foundry Sand By 4.75 mm Sive

.

D. Preparation of Crusher Sand Waste

Crusher sand waste was dried and sieved to remove oversized particles. Fine and uniformly graded material was used for mixing.

Fig No.7.4. Preparation of Crusher Sand Waste.

E. Batching

Materials were measured using the weight batching method. The adopted proportion was 30% plastic, 35% foundry sand, and 35% crusher sand waste to achieve optimum strength.

- Plastic (30%) = 3.0 kg.
- Foundry sand (35%) = 3.5 kg.
- Crusher sand waste (35%) = 3.5 kg.

Fig .7.5. Batching Of plastic as per 30% .

Fig.7.5.1. Batching Mix Of Foundry &Crusher Sands

F. Melting of Plastic

Shredded plastic was heated in a metal container using a gas stove at 160°C–200°C. The plastic was stirred continuously until a uniform molten mass was obtained.

Fig No.7.6. Melting Plastic.

G. Addition of Foundry Sand and Crusher Sand

After obtaining uniformly molten plastic, foundry sand was added gradually while stirring continuously to ensure uniform coating and proper bonding between the plastic and sand particles. Once the foundry sand was properly mixed, crusher sand waste was added slowly in stages to the mixture. Continuous mixing was maintained throughout the process to achieve uniform distribution and good interlocking of particles, resulting in a homogeneous and workable brick mixture.

Fig No .7.7. Addition Crusher Waste .

H. Mixing Process

All materials were mixed thoroughly until a homogeneous, lump-free mixture was formed. Proper mixing ensured uniform strength and reduced voids.

Fig No .7.8. Mixing Process .

I. Moulding Process

The hot mixture was poured into a steel mould of size 190 mm × 90 mm × 90 mm. The top surface was levelled to achieve uniform thickness.

Fig .No. 7.9. Filling Molten Mix In M.S. Mould

J. Compaction Process

The filled mould was placed under a manual hydraulic press. Pressure was applied to remove air voids and increase density and strength. The compaction process ensured proper bonding between particles,resulting in improved structural integrity and uniformity of the specimen.

Fig No . 7.10 . Apply Pressure by Using Hydraulic Jack .

K. *Setting Process*

After compaction, bricks were left undisturbed at room temperature for 15–30 minutes. Setting occurred due to cooling and solidification of plastic

L. *Demoulding*

After initial setting, the mould was carefully removed. Bricks were handled gently to avoid edge damage.

M. *Cooling in Water*

Demoulded bricks were immersed in water for 10–20 minutes. This helped in rapid cooling and final hardening of the bricks.

VIII. TESTING AND RESULTS

A. *Compressive Strength Test*

(As per Bureau of Indian Standards – *IS 3495 Part 1)*

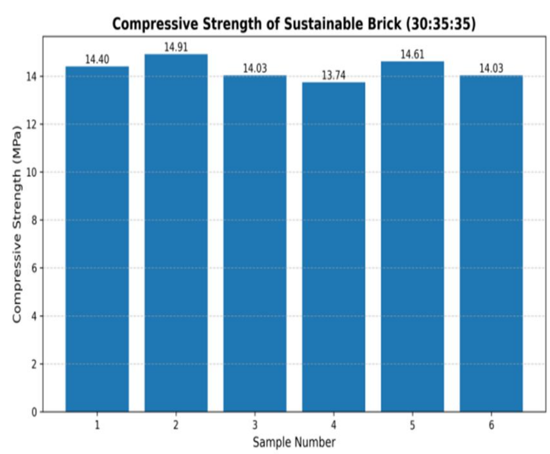
Procedure: The brick specimen was cleaned and dried.imensions of the brick were measured using a steel scale.The brick was placed between the plates of the Compression Testing Machine (CTM).Load was applied gradually and uniformly.The maximum load at failure was recorded.Compressive strength was calculated using:

➢ Compressive Strength Of Sustainable Brick.

Sample No	Maximum Load (KN)	Compressive Strength (N/mm^2) MPA	Average Compressive Strength (N/mm^2) MPA
1	245	14.4	14.28
2	255	14.91	
3	245	14.03	
4	235	13.74	
5	250	14.61	
6	240	14.03	

Table No .8.1.1. CTM Test Result .

✧ Result: Average compressive strength obtained = **14.28 MPa**Table No .6.1.



Graph 1 . Compressive Strength .

Fig . No. 8.1.2. Testing ON Brick By Using CTM .

B. *Water Absorption Test*

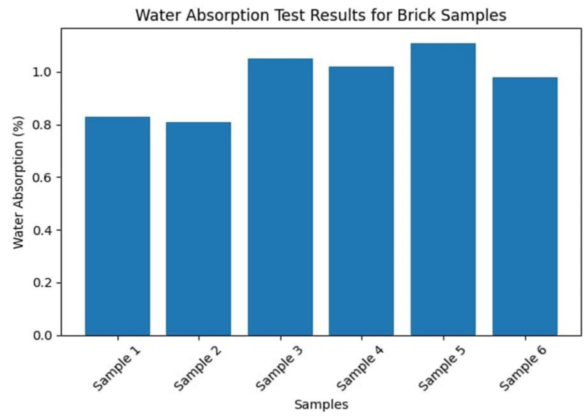
(As per Bureau of Indian Standards *– IS 3495 Part 2)*

Procedur :- The bricek was dried in an oven at 105–110°C for 24 hours.Dry weight (W1) was recorded.The brick was immersed in clean water for 24 hours.The brick was removed and wiped with a damp cloth.Wet weight (W2) was recorded.Water absorption was calculated using:

Table No . 8.1.2. Water Absobrtion Of Brick.

Sample No	Weight Of Oven Dry Brick (W1)	Weight Of(Wet Brick After 24 hours water Curing) W2	Water Absorbtion In% (W2-W1)/(W2)x 100	Average Water Absorbtion (W %)
Sample 1	2965	2990	0. 83	0.79
Sample 2	2948	2972	0.81	
Sample 3	2721	2750	1.05	
Sample 4	3025	3056	1.02	
Sample 5	2842	2874	1.11	
Sample 6	2723	2750	0.98	

- Result: Average water absorption =**0.79.**



Graph 2 . Water Absrobtion Test Graph .

C. Fir Resistance Test

A fire resistance test was conducted to evaluate the performance of the sustainable brick under high temperature conditions. The brick specimen was exposed to direct flame at approximately 300–400°C for 15–20 minutes. During heating, slight surface softening was observed due to the presence of plastic binder; however, no major cracks or structural failure occurred. After natural cooling, the brick retained its shape and integrity. The results indicate that the sustainable brick has moderate fire resistance and is suitable for non-load bearing applications, but it is not recommended for high-temperature structural uses.

Table: Fire Resistance Test Results.

Sr. No.	Parameter Observed	Observation	Remark
1	Temperature Applied	300–400°C	Controlled heating
2	Duration of Exposure	15–20 minutes	Continuous flame exposure
3	Surface Condition During Heating	Slight softening observed	Due to plastic binder
4	Cracks Formation	No major cracks observed	Structurally stable
5	Shape Retention	Shape retained after cooling	No deformation
6	Structural Integrity	No breakage after cooling	Moderate fire resistance

Fig NO.8.3. Brick Sample Place In Oven for Fir Resestance Test.

D. Dimensional Accuracy Test

Procedure:

1. Length, width, and height of the brick were measured using a steel scale.
2. Measurements were compared with standard size (190 mm × 90 mm × 90 mm).
3. Deviations were noted.

Fig .No.6.4. Measurement of Diamenstion of Brick By using Scale

✧ Observation: Dimensions were within permissible limits.

E. Visual Inspection Test

Procedure:

1. The brick surface was examined visually.
2. Edges and corners were checked.
3. Presence of cracks, warping, or defects was observed

Fig .No. 6.5. visual Inspection of Brick

✧ Observation: No visible cracks or defects were found.

F. Hardness Test

Procedure:

1. A steel nail was scratched across the brick surface.
2. Surface resistance to scratching was observed.

✧ Observation: -No visible scratch marks were formed, indicating good hardness.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue II Feb 2026- Available at www.ijraset.com

Fig.No.8.6. Hardness Checking By Using Iron Nail .

G. Soundness Test

Procedure:

1. Two bricks were struck against each other.
2. Sound produced was observed.

Fig. No . 8.7. Brick Struck Against Each Other.

✧ Observation:-A clear ringing sound was heard, indicating good compactness.

H. Impact Resistance Test

Procedure:

1. The brick was dropped from a moderate height (about 1 meter).
2. The brick was examined for cracks or breakage.

Fig No . 8.8. Brick Drop From 1m For Impact Resistance Test

✧ Observation:-No cracks or breakage were observed.

I. Shape and Edge Test

Procedure:

0. Edges and corners were checked manually.
1. Brick shape was examined for uniformity.

Observation: Sharp edges and uniform shape were obtained.

IX. FINAL PRODUCT

Fig No. 9.1. Final Product .

X. CONCLUSION

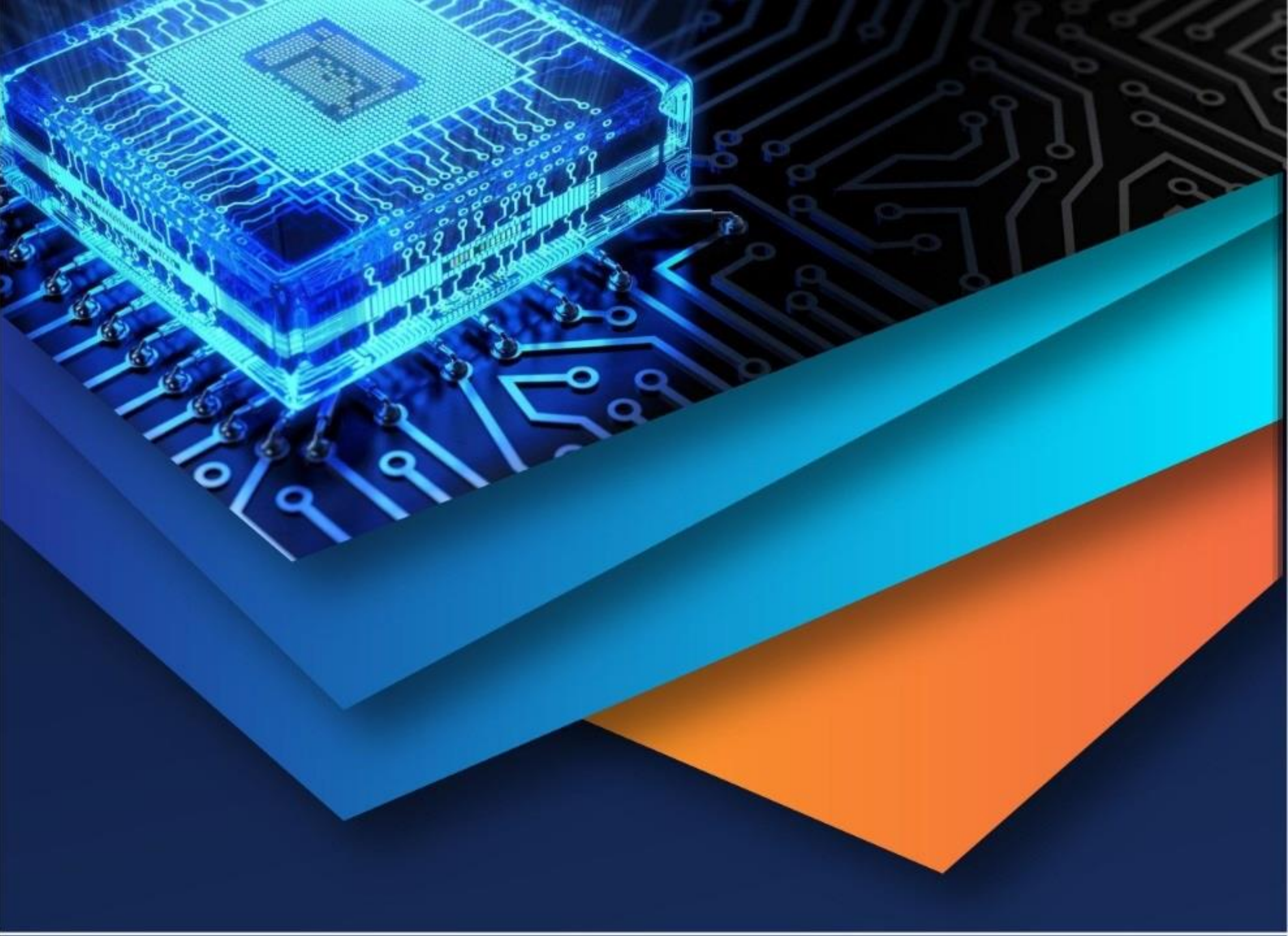
Based on the reviewed literature and comparative analysis, it can be concluded that bricks manufactured using waste plastic and sand provide a viable and sustainable alternative to conventional clay bricks. The findings indicate that plastic-sand bricks can achieve comparable or even higher compressive strength when produced with appropriate mix proportions. Additionally, these bricks exhibit very low or zero water absorption, which enhances their durability and resistance to moisture.

The utilization of waste plastic in brick manufacturing significantly contributes to reducing environmental pollution caused by non-biodegradable plastic disposal. It also helps conserve natural clay resources and minimizes the depletion of riverbeds and soil used in traditional brick production.

Furthermore, plastic-sand bricks are lightweight, cost-effective, and environmentally friendly, making them suitable for modern sustainable construction practices. Therefore, the adoption of plastic bricks can play an important role in promoting eco-friendly development and effective waste management in the construction industry.

REFERENCES

[1] Siddique, R., & Kaur, G. (2019). *Utilization of waste materials in concrete and construction.* Journal of Cleaner Production, 231, 1222–1239.
[2] Sharma, R. K., & Chandel, S. S. (2017). *Plastic waste incorporation in construction materials: A review.* Sustainable Materials and Technologies, 14, 15–23.
[3] Abdulkareem, M. Y., et al. (2015). *Recycling of waste foundry sand in concrete production: A review.* Construction and Building Materials, 78, 122–131.
[4] Gupta, T., & Kumar, P. (2018). *Use of crusher waste for sustainable brick manufacturing.* International Journal of Civil Engineering Research, 9(3), 321–328.
[5] Chowdhury, S., & Paul, S. K. (2021). *Environmental assessment of construction waste reuse.* Journal of Environmental Management, 278, 111444.
[6] Al-Jabri, K. S., et al. (2008). *Effect of temperature on properties of recycled plastic concrete.* Journal of Materials in Civil Engineering, 20(9), 569–577.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY