e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:07/July-2024 Impact Factor- 7.868 www.irjmets.com

DESIGN, MANUFACTURING AND ASSESSMENT OF TILES MADE FROM PLASTIC WASTE

Ratish Karnik[*1], Arfat Khan[*2], Prof. Satish Silaskar[*3], Prof. Sunil Kadam[*4]

[*1,2]New Horizon Institute Of Technology & Management, Thane, Maharashtra, India.

[*3,4]Prof, Department Mechanical Engineering New Horizon Institute Of Technology & Management, Thane, Maharashtra, India.

DOI: https://www.doi.org/10.56726/IRJMETS60016

ABSTRACT

Plastics pose serious environmental problems due to their non-renewable nature and large landfill space. They are increasingly used in industries like automobiles, packaging, and medical care due to their ease of manufacturing, handling, and reliability. However, hydraulically operated machines are expensive for small and medium-sized industries. This paper discusses the design and fabrication of pneumatically operated injection plastic molding machines, which are the most widely used and man-made materials due to their easy manufacturing, shaping, and biodegradability. The paper also addresses the issue of waste plastic incineration or landfills, highlighting the need for a partial solution environment that reduces costs and low density. It also addresses the imbalance between conventional building materials availability and demand. The disposal of plastic waste is a significant challenge, as repeated recycling poses potential environmental risks. The paper proposes using plastic waste to create tiles with sand in a 3:2 ratio, which have negligible water absorption and satisfactory compressive strength compared to normal tiles. This approach aims to address the environmental concerns associated with plastic waste and promote sustainable practices in various industries.

Keywords: Plastic Waste, Plastic Tiles, Environmental Problems, Recycle.

I. INTRODUCTION

The increasing plastic waste causes a lot of threat to the environment and even repeated recycling pose a potential danger. This waste plastic can be reused to make tiles that can be used in floorings for houses, terraces and bathroom. Polypropylene copolymer (PPCP) is a solid in granular form with no odors. It is non-reactive with environment. PPCP is widely used in Plastic Processing Industries to make a variety of products such as sheets, boxes, containers, home ware, brushes, combs, etc. PPCP is a non-hazardous material and its overexposure by short term or long term doesn't cause any harmful health effect. Recycling is a hot issue in today's society and one that has gradually gained momentum over the years as wastes and threats to the environment and human health have grown. As Technology develops the number of materials that can be reused or recycled also grows. Given current population trends and the number of wastes that will be produced recycling and reuse needs to take a front seat in our everyday lives. One particular material that interests me is plastic. Plastics are being used more and more these days throughout every facet of industry. Everywhere one may look, plastics are being used. Plastics are used in packaging, building Materials, consume goods, electronics, transportation and adhesives, just to name a few. Given the amount of goods we produce and consume each year and the fact that a good Percentage of these products are made from plastics, only intensifies the need for better reuse and plastic recycling practices. Within this research paper I'm going to try and answer some popular questions about the recycling industry in regards to plastics. I'll also shed some light on the uses of plastics, the chemical materials in plastics and some of the disposal methods used for plastics. In addition to these topics, I'd also like to talk about some of the ongoing controversies and differences over recycling plastics. Finally, I'll also provide some statistics on the plastic industry in relation to uses recycling and disposal. Plastic recycling is the process of recovering scrap or waste plastic and reprocessing the material into useful products. Since plastic is non-biodegradable, recycling is a part of global efforts to reduce plastic in the waste stream, especially the approximately eight million metric tons of waste plastic that enter the Earth's ocean every year.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:07/July-2024 Impact Factor- 7.868 www.irjmets.com

II. RESULTS

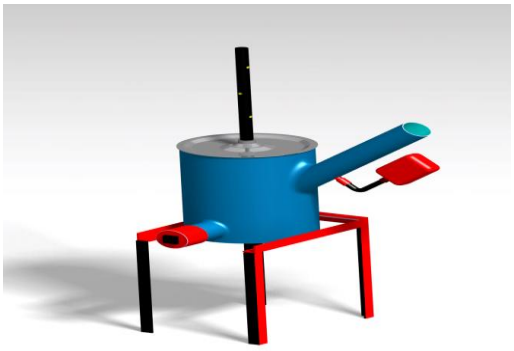


Fig. 1. 3D Model of Melting Machine

Fig. 2. 3D Model of Molding Machine

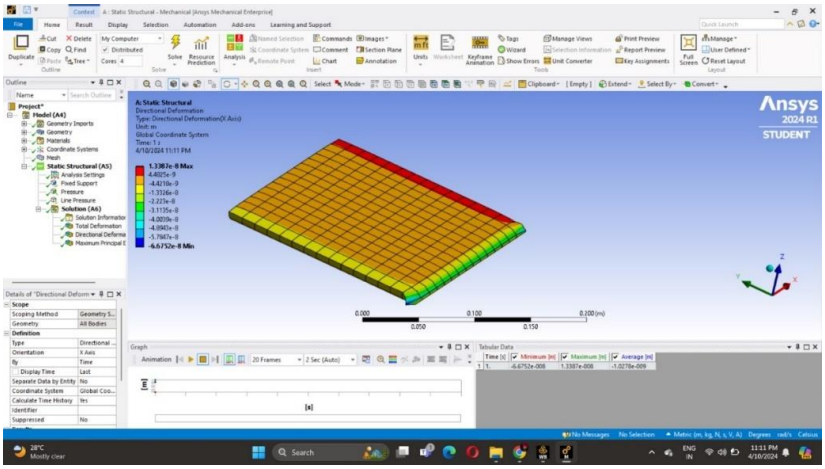


Fig. 3. Maximum Principal Elastic Strain

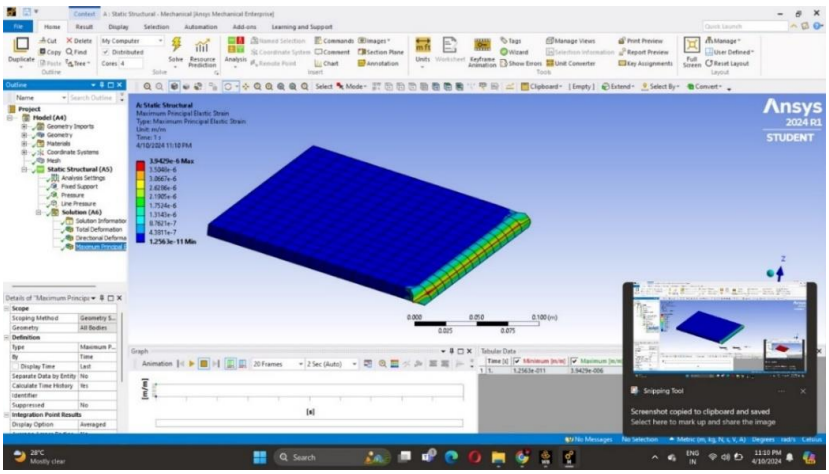


Fig. 4. Directional Deformation

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:07/July-2024 Impact Factor- 7.868 www.irjmets.com

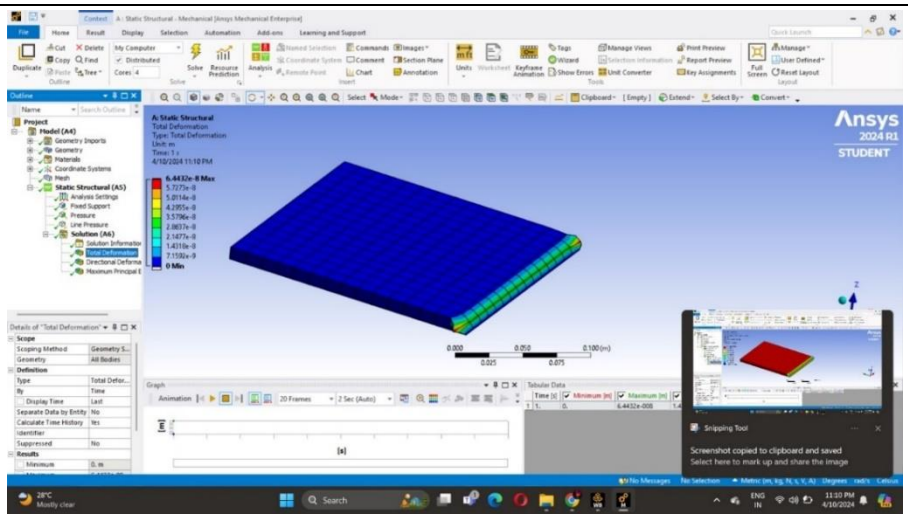


Fig. 5. Total Deformation

Structural	
Isotropic Elasticity	
Derive from	Young's Modulus and Poisson's Ratio
Young's Modulus	1.461e+09 Pa
Poisson's Ratio	0.4087
Bulk Modulus	2.667e+09 Pa
Shear Modulus	5.1856e+08 Pa
Isotropic Secant Coefficient of Thermal Expansion	9.909e-05 1/°C
Tensile Ultimate Strength	3.762e+07 Pa
Tensile Yield Strength	3.46e+07 Pa

Thermal	
Isotropic Thermal Conductivity	0.209 W/m·°C
Specific Heat Constant Pressure	1600 J/kg·°C

Fig. 6. Structural and Thermal Data of Polypropylene Plastic

Based on the analysis of the parameters, ceramic tiles demonstrate superior performance in terms of Modulus of Rupture and MOHS Hardness, indicating greater strength and durability. On the other hand, plastic tiles exhibit better performance in Breaking Strength, suggesting higher resistance to applied forces and impacts. Therefore, the choice between plastic and ceramic tiles depends on specific requirements such as strength, durability, and intended application. If strength and durability are primary concerns, ceramic tiles may be preferred. However, if impact resistance is crucial, plastic tiles may be a suitable option.

On compression testing machine, we have taken compression test on our tiles. Firstly, we on the compression testing machine then we touched the upper surface of compression testing machine to the surface of the tiles. After that, we loosen the valve to apply the compression force on the tiles. After 400KN the tiles deformation started. Which mean that the tiles can sustain 400KN of load.

Table. 1. Testing on Plastic Tiles

Sr. No.	Parameter (Material: Plastic Tiles)	Result	Test Method
1.	Modulus of Rupture (N/mm^2)	4.5	IS 13630 (Part-6):2019
2.	Breaking Strength (N)	384.6	IS 13630 (Part-6):2019
3.	MOHS Hardness	3	IS 13630 (Part-13):2019

Table. 2. Testing on Ceramic Tiles

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:07/July-2024 Impact Factor- 7.868 www.irjmets.com

Sr. No.	Parameter (Material: Ceramic Tiles)	Result	Test Method
1.	Modulus of Rupture (N/mm^2)	9.5	IS 13630 (Part-6):2019
2.	Breaking Strength (N)	165.3	IS 13630 (Part-6):2019
3.	MOHS Hardness	7	IS 13630 (Part-13):2019

Fig. 7. Tile- Length & Width

Fig. 8. Tile- Thickness

ELCA laboratories

Plot No.: Gen - 62, TTC Industrial Area, MIDC, Mahape, Navi Mumbai - 400710
Tel.: (022) 685 11 111 - E-mail: info@elcalabs.com
Web: www.elcalabs.com

TC-5743

TEST REPORT Page 1 of 1

Customer: **M/s. New Horizon Institute Of Technology** Plot No.253, Sec.1, Ghansoli, Navi Mumbai-400706	Report No.:	C-657-M
	Report Date:	27-04-2024
	Job. No.:	ELM-24-25-00879
	Sample Received Date:	25-04-2024
	Date Of Completion:	27-04-2024
	ULR No.:	TC574324000009855F

Customer Ref. No. & Date: NIL 24-04-2024
Samples not drawn by ELCA
Product Specification: --
Sample Description: Plastic Tile 1 to 3

MECHANICAL PROPERTIES OF TILES

Discipline Mechanical **Group** BUILDING MATERIALS
Tested At ELCA Laboratories Mahape **Tested on :** 27-04-2024

Parameter	Result	Test Method
1. Modulus of Rupture (N/mm²)	4.5	IS 13630(Part-6):2019
2. Breaking Strength (N)	384.6	IS 13630(Part-6):2019
3. MOHS Hardness	3	IS 13630 (Part-13):2019

******END OF REPORT******

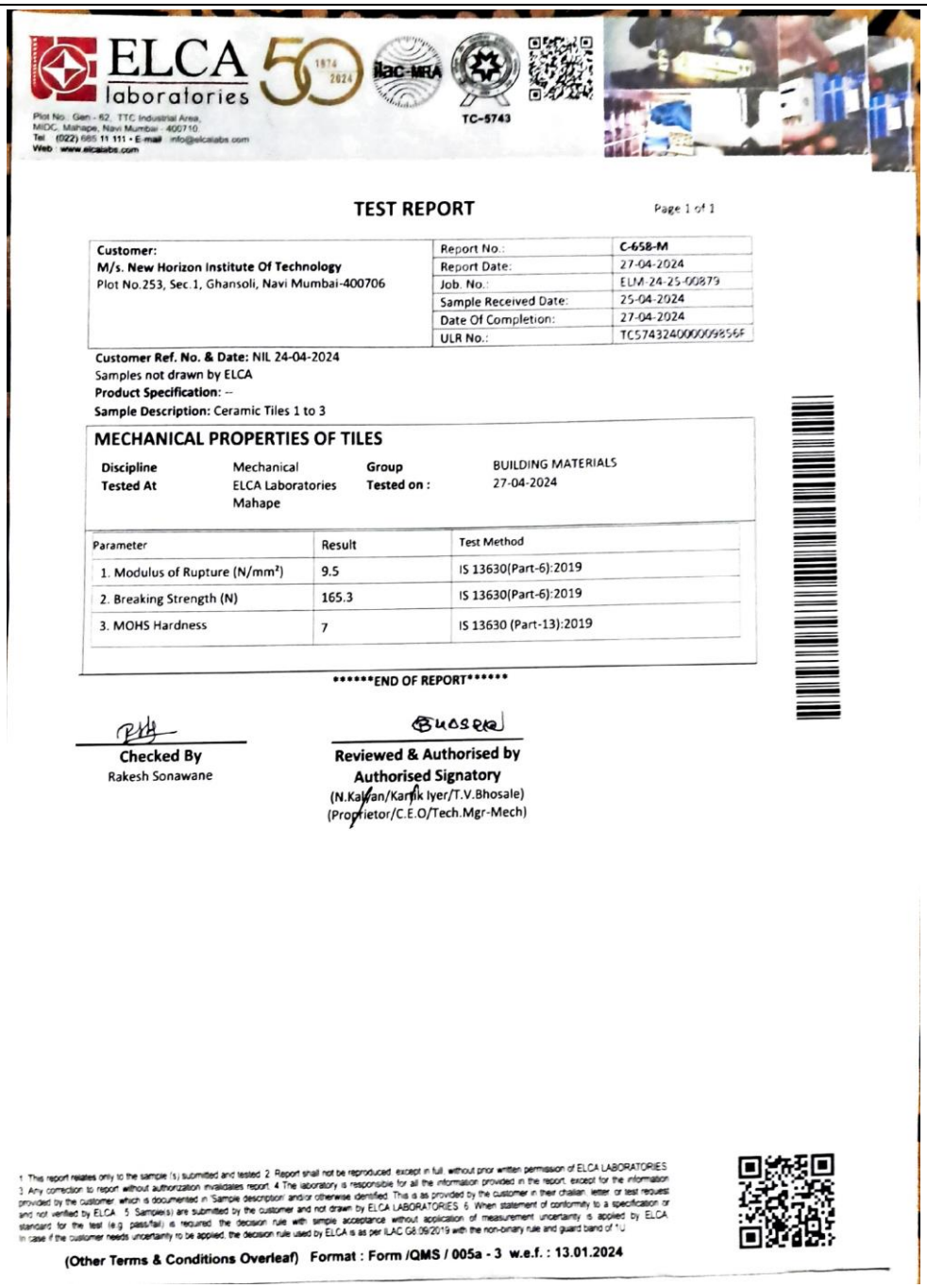
Checked By
Rakesh Sonawane

Reviewed & Authorised by
Authorised Signatory
(N.Kalyan/Kartik Iyer/T.V.Bhosale)
(Proprietor/C.E.O/Tech.Mgr-Mech)

1. This report relates only to the sample (s) submitted and tested. 2. Report shall not be reproduced, except in full, without prior written permission of ELCA LABORATORIES. 3. Any correction to report without authorization invalidates report. 4. The laboratory is responsible for all the information provided in the report, except for the information provided by the customer, which is documented in 'Sample description' and/or otherwise identified. This is as provided by the customer in their challan, letter, or test request and not verified by ELCA. 5. Sample(s) are submitted by the customer and not drawn by ELCA LABORATORIES. 6. When statement of conformity to a specification or standard for the test (e.g. pass/fail) is required, the decision rule with simple acceptance without application of measurement uncertainty is applied by ELCA. In case if the customer needs uncertainty to be applied, the decision rule used by ELCA is as per ILAC G8:09/2019 with the non-binary rule and guard band of 1U.

(Other Terms & Conditions Overleaf) Format : Form /QMS / 005a - 3 w.e.f. : 13.01.2024

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:07/July-2024 Impact Factor- 7.868 www.irjmets.com



ELCA laboratories

Plot No. Gen - 62, TTC Industrial Area, MIDC, Mahape, Navi Mumbai - 400710
Tel (022) 685 11 111 • E-mail info@elcalabs.com
Web www.elcalabs.com

TC-5743

TEST REPORT Page 1 of 1

Customer: **M/s. New Horizon Institute Of Technology** Plot No.253, Sec.1, Ghansoli, Navi Mumbai-400706	Report No.:	C-658-M
	Report Date:	27-04-2024
	Job. No.:	ELM-24-25-00879
	Sample Received Date:	25-04-2024
	Date Of Completion:	27-04-2024
	ULR No.:	TC574324000000985GF

Customer Ref. No. & Date: NIL 24-04-2024
Samples not drawn by ELCA
Product Specification: --
Sample Description: Ceramic Tiles 1 to 3

MECHANICAL PROPERTIES OF TILES

Discipline Mechanical **Group** BUILDING MATERIALS
Tested At ELCA Laboratories Mahape **Tested on :** 27-04-2024

Parameter	Result	Test Method
1. Modulus of Rupture (N/mm²)	9.5	IS 13630(Part-6):2019
2. Breaking Strength (N)	165.3	IS 13630(Part-6):2019
3. MOHS Hardness	7	IS 13630 (Part-13):2019

******END OF REPORT******

Checked By
Rakesh Sonawane

Reviewed & Authorised by
Authorised Signatory
(N.Kalyan/Kartik Iyer/T.V.Bhosale)
(Proprietor/C.E.O/Tech.Mgr-Mech)

1. This report relates only to the sample (s) submitted and tested. 2. Report shall not be reproduced, except in full, without prior written permission of ELCA LABORATORIES. 3. Any correction to report without authorization invalidates report. 4. The laboratory is responsible for all the information provided in the report, except for the information provided by the customer, which is documented in 'Sample description' and/or otherwise identified. This is as provided by the customer in their challan, letter or test request and not verified by ELCA. 5. Sample(s) are submitted by the customer and not drawn by ELCA LABORATORIES. 6. When statement of conformity to a specification or standard for the test (e.g. pass/fail) is required, the decision rule with simple acceptance without application of measurement uncertainty is applied by ELCA. In case if the customer needs uncertainty to be applied, the decision rule used by ELCA is as per ILAC-G8:09/2019 with the non-binary rule and guard band of *U.

(Other Terms & Conditions Overleaf) Format : Form /QMS / 005a - 3 w.e.f. : 13.01.2024

III. CONCLUSION

In conclusion, the comparison between plastic and ceramic tiles reveals distinct advantages and considerations that are pivotal in determining the most suitable tile material for specific applications. Both materials have their unique strengths and weaknesses, which should be carefully weighed against the requirements of the intended use. Ceramic tiles showcase superior performance in terms of Modulus of Rupture and MOHS Hardness, indicating exceptional strength and durability. With a significantly higher Modulus of Rupture and MOHS Hardness value compared to plastic tiles, ceramic tiles offer robust resistance to bending, breaking, scratching, and surface abrasion. This makes them particularly well-suited for applications where longevity and resistance to wear and tear are paramount, such as high-traffic areas or outdoor environments subject to harsh weather conditions.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:07/July-2024 Impact Factor- 7.868 www.irjmets.com

IV. REFERENCES

[1] Vijayan, Dhanasingh & Vaidevi, C. & Jazeel, Muhammed & AmalMurali, M. & Razi, Muhammed. (2023). Applications of plastic tiles in construction industry-A review. AIP Conference Proceedings. 2523. 020170. 10.1063/5.0109829.

[2] Satya, S. & Sreekanth, P S. (2024). The Morphological and Thermal Characteristics of Hollow-Glass-Microsphere-Coated Phase Change Material–Cow Pie Embedded Recycled Plastic Tiles for Cool Roofs. Journal of Composites Science. 8. 148. 10.3390/jcs8040148.

[3] Butt, Faizan & Shangguan, Donghui & Butt, Asim Qayyum & Arshad, Muhammad & Raja, Babar & Khitab, Anwar & Ding, Yongjian & Li, Da & Mukhtar, Muhammad. (2023). An Experimental Study to Mitigate Environmental Impacts by Transforming Waste Plastic Bags into Paving Blocks and Roof Tiles. Sustainability. 15. 10.3390/su152215801.

[4] Alexander, Jock & Akpan, Messiah & Oluwadayo, Francis. (2022). Production and Characterization of Sand-Plastic Composite Floor Tiles. Hungarian Journal of Industry and Chemistry. 50. 29-32. 10.33927/hjic-2022-06.

[5] Taiwo, Omosebi & Abas, Noor & Taylor, George. (2022). Tiles from Recycled Plastic Bottle (Pet) Wastes and POFA: Strength Properties and Durability. Civil Engineering and Architecture. 10. 1253-1259. 10.13189/cea.2022.100402.

[6] Anyaogu, Lewechi & Okere, Chinenye & Martin, Nnanna. (2022). Model For Predicting Compressive Strength Of Interlocking Tiles Using Recycled Plastic Bottles.

[7] Parangi, Basavaraj & Gagan, & Hallur, Manjunath & Professor, Asst & Mh, Puttaraj. (2020). REUSE OF PLASTICS WASTE FOR THE PRODUCTION OF FLOOR TILES. Seybold Report. 15. 1633-1639.

[8] Momin, Asif & Kadiranaikar, Dr & Talavara, Siddarooda & K, Nagaraj. (2014). Plastic Floor Tiles.

[9] Balcom, Paige & Carey, Van. (2019). Exergy-Based Sustainability Analysis for Tile Production From Waste Plastics in Uganda. 10.1115/ES2019-3897.