

An Experimental Study on Manufacturing Process of WPC Bricks

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Abstract: *Plastic waste is accumulating rapidly due to various industrial activities, polluting the environment. It is non-biodegradable, leading to global deterioration. The study suggests using sustainable building materials, such as combining polyethylene terephthalate (PET) waste with wood fibers to make non-conventional bricks, which encourages efficient use of wood industry waste. In this research, we utilized a unique method of creating bricks by combining polyethylene terephthalate (PET) waste with wood fibers. four types of bricks were examined, one with 75% PET waste, second with 85%PET, third with 80% PET and forth with 70% PET content with using Constant proportion of chemical in each brick.*

It is important to note that this evaluation is based solely on mechanical and physical properties and does not take into account any other factors. The results showed that the brick containing 80% by weight of plastic waste was the best of the all trial of wood plastic composites (WPCs).

Keywords: *recycled polymer & wood waste, WPC bricks, effective modern construction material.*

1. INTRODUCTION

Millions of tonnes of polymer waste are produced every year, which end up in landfills or are burnt, creating an environmental problem by threatening the health of living organisms. New types of bio-based building materials made from renewable resources such as wood are becoming increasingly interesting. The main reason for this is global environmental challenges and the need for sustainable development in society. There is a long tradition of using thermoplastic materials such as polyethylene and polypropylene, and an even longer tradition of using wood-based materials such as chipboard and fibreboard.

A new material has emerged that is a combination of a thermoplastic component and a wood-based component, known as wood-plastic composites (WPCs). The term wood-plastic composites is historically a broad term that includes all wood containing composites in both thermoset and thermoplastic matrices.

WPCs are manufactured by mixing wood waste, such as sawdust, wood shavings or wood flour, with a thermoplastic polymer and melt processing (or thermoforming) it into its final shape, as a continuous profile formed by extrusion. Over the past few decades, WPCs has rapidly increased their market share as a construction material. The fact that WPCs are a competitive alternative to tropical hardwoods and that they are considered to require less maintenance than traditional wood products. It is also possible to produce more complex shapes with WPC.

2. METHODS AND MATERIALS

The passage you provided describes the brick preparation process for Wood-Plastic Composite (WPC) bricks made from recycled materials. Here's a breakdown of the key steps:

Materials:

1. PET Waste (Plastic Waste)

2. Wood flour

3. Additives to be added

1. **Maleic anhydride** (Coupling agent)

These chemicals promote adhesion between the hydrophilic wood fibers and hydrophobic plastic polymers, improving the overall strength and durability of - the WPC brick.

2. **Magnesium hydroxide** (flame retarder)

This agent is used to enhanced fire safety, flame retardants can be incorporated to improve the WPC brick's resistance to ignition and burning.

3. **Stearic acid**

It is Lubricant which reduce friction during the mixing and Extrusion and ensuring smooth processing.

Process:

1. PET Waste Preparation:

The collected PET bottles are thoroughly cleaned, dried, and then shredded into small pieces using scissors (Note: Industrial processes likely use specialized shredders for faster and more consistent results).

2. Mixing:

The chopped wood fibers and shredded PET granules are precisely weighed and blended in specific proportions (details in Table 1, not provided here). This creates four unique WPC brick prototypes (WPC 1, WPC 2, WPC3, and WPC4).

3. Preheating and Melting:

The combined plastic waste and wood fiber mixture undergoes preheating, followed by melting in a laboratory furnace at 220°C. This high temperature melts the plastic, allowing it to bind with the wood fibers.

4. Moulding and Curing:

The molten mixture is poured into a pre- prepared wooden mould lined with Greece (likely a typo, possibly referring to grease to prevent sticking).

The filled mould is left to cool at room temperature.

5. Demolding and Final Dimensions:

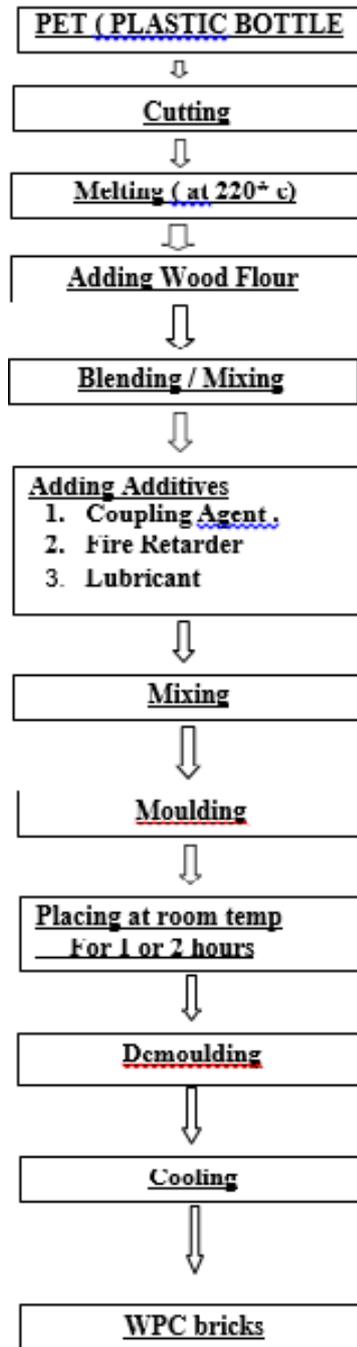
Once cooled, the WPC bricks are removed from the mould. The final product is a brick measuring 190 mm x 190 mm x 90 mm.

3. METHODOLOGY

Table no: 01

MixDesign

wood-plastic composition in brick.



Sr no.	Types of Bricks	Percentage by weight of Plastic Waste	Percentage by weight of wood Particle
1	WPC 1	75	25
2	WPC 2	85	15
3	WPC 3	80	20
4	WPC 4	75	25

As Pre Decided Mix Designs , 4 Brick Trial were made . In which as a result second & fourth brick were found to be best one. Among these two brick , Second brick i.e. WPC 2 were found to be best .which were made with proportion of 85% - 15% of plastic & wood Respectively.

Table no : 02

Sr no	Pvc Powder (in gm)	Plastic Waste (in gm)	Wood Flour (in gm)	Coupling agent (in gm)	Flame reatarder (in gm)	Lubricant (in gm)	Total weight
1.	100 g	650 g	220 g	10 g	10 g	10 g	1000 g
2.	100 g	920 g	150 g	10 g	10 g	10 g	1200 g
3.	100 g	1100 g	270 g	10 g	10 g	10 g	1500 g
4.	100 g	1300 g	570 g	10 g	10 g	10 g	2000 g

- i. Proportion of Platsic Waste And Flour Were Taken as Per Decided Percentage by Weight.
- ii. PVC Powder Were Kept Constant .ie. 100gm so to see how different proportion of wood-plastic response/ react .
- iii. Proportion of additive/ Agent Were Kept Constant for all Trials as used Agent Quantity i.e. 10 gm Were found to be upto the requirement
- iv. The Burn Plastic Wood Fuse Wood Fiber To Form Solid Brick



Fig. 01



Fig.02

Fig.03

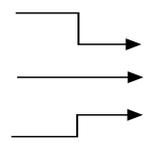


Fig.05



Fig.04



Fig.06



Fig.08



Fig.07



Fig.09



Fig.01: PET (Plastic Waste)

Fig 02: Collection waste plastic bottle from college campus

Fig 03: Cutting plastic bottles with scissors. Plastic bottles were cut into smaller pieces.

Fig 04: It shows wood flour collected from saw machine.

Fig 05: Collected wood flour were sieved by using sieve size 1.18 and 2.36 mm.

Fig 06: Wood flour passed through sieves were collected.

Fig 07: Melting

PET waste was heated at temperature of 220 degree Celsius, PET waste was melted and wood flour was added.

Fig 08: Once PET & proper mixed and melted additive were added.

Fig 09: The brick was formed.

Test For WPC Bricks

: Studies are underway to evaluate the mechanical properties (strength, bending resistance), thermal insulation, fire resistance, and moisture resistance of WPC bricks compared to traditional bricks.

IS CODE USED FOR TESTING IS 3495

(Parts 1 to 2) : 1992

PART 1 DETERMINATION OF COMPRESSIVE STRENGTH .

PART 2 DETERMINATION OF WATER ABSORPTION.



Fig : 1

Drv Weight



Fig : 2

Wet Weight

Water Absorption Test

Water absorption tests determine the durability properties of bricks, including degree of burning, quality, and weathering behavior. Bricks with a water absorption rate of less than 7% exhibit superior resistance to damage caused by freezing. The degree of compactness of bricks can be accurately measured through a water absorption test, as the pores in the bricks absorb water. It is important to note that an increase in the number of pores results in a higher water absorption rate for bricks.

Bricks with a water absorption rate of less than 3% are vitrified. The calculations for the test are given below:

Calculations :-

Dry weight of brick (W1) = 1107 gm

Weight after water absorption (W2) = 1110 gm

Water absorption = $\frac{W2 - W1}{W1} \times 100$

W1

= $\frac{1110 - 1107}{1107} \times 100$

1107

Water absorption = **0.271 %**

Shape, Size, and Colour Test

This test confirms that the brick meets the required specifications for shape, size, and colour, which are critical factors in determining its performance in real-world applications. Please refer to the accompanying images that demonstrate the ideal appearance of a WPC brick based on our extensive research:

Dimensions Obtained:

Shape: Rectangular, Distinct, and sharp edges.

Size: As standard: 190 mm x 90 mm x 90mm

Colour: Greenish colour.

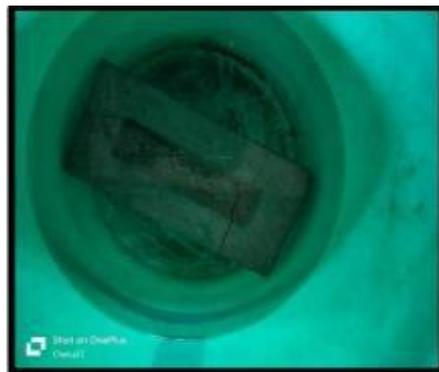


Fig no: 02

Hardness Test

A good brick should resist scratches against sharp things. So, for this test a sharp tool or fingernail is used to make scratch on brick. If there is no scratch impression on brick then it is said to be hard brick.



Fig no : 01



4. CONCLUSION

The project has made significant progress in developing a WPC brick. We are actively working to address the identified challenges such as Optimizing production efficiency to reduce costs and meet the target price point for WPC bricks and Optimizing WPC mix design - Achieving the perfect balance between wood content (for sustainability) and plastic content (for strength and durability) and to Achieve smooth and attractive surface. We are confident that WPC bricks have the potential to be a viable and sustainable alternative to traditional clay bricks.

We will evaluate key properties such as compressive strength, water absorption, and fire resistance through standardized testing procedures

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