

Utilization of Waste Plastic in Manufacturing of Bricks Along with Quarry Dust and M-Sand

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Abstract

There is considerable imbalance in the conventional building materials; there is a great demand in recent past years. In quarries while cutting out the lateritic stone with help of cutting machines which produces 15-20% of soil wastes which poses a problem of disposal and utilizing the quarry waste. The amount of plastic squander in metropolitan strong squander collection is growing quickly ,the rate of development is twofold for each 10 a long time .since it is non-biodegradable which stay on earth for 4500 years without degradation and it is a great challenge in disposing of waste plastics ,it is also danger in repeat recycling of plastic waste it poses a danger of being transformed to a carcinogenic materials and only a small amount of pet bottles are recycled, it has a many good characteristics such as versatility , hardness, resist to chemical ,water impacts. In recent years ,the natural sand is replaced by the m-sand .m-sand is also used in mixture of plastic and soil , in this work an attempt has been made to make of bricks by utilizing the mis-use plastic in expand of 60-80% by weight of lateritic quarry dust and m-sand mix. The bricks manufactured possess the properties such as neat and even-finishing with negligible water absorption and which satisfies the compressive strength to a certain extent.

Keywords: Waste Plastic, Bricks, Quarry Dust and M-Sand

I. INTRODUCTION

Plastic waste has become a significant environmental concern worldwide due to its non-biodegradable nature and improper disposal practices. The accumulation of plastic waste in landfills and oceans has led to severe ecological and health hazards. Finding effective ways to manage and recycle plastic waste has become a critical priority in sustainable development. Plastic waste has become a significant environmental concern worldwide due to its non-biodegradable nature and improper disposal practices. The accumulation of plastic waste in landfills and oceans has led to severe ecological and health hazards. Finding effective ways to manage and recycle plastic waste has become a critical priority in sustainable

development. Plastic is an exceptionally common fabric that is presently broadly utilized by everyone in the world. Plastic plays an overwhelming part in reusable in this age, as it is compact and light in weight. Common plastic things that are utilized are covers, bottles, and nourishment packages. The incredible issue with plastic is its deterioration. They are made of polymer chemicals and they are non-biodegradable. This implies that plastic will not break down when it is set in soil. Though plastic is an exceptionally valuable fabric that is adaptable, strong and unbending they ended up squander after their utilize and they contaminate the discuss and land. Reusing is handling utilize squander materials into modern items to avoid squander of possibly valuable materials. The increment in the notoriety of utilizing eco-friendly, moo fetched and lightweight development materials in building industry has brought approximately the require to explore how this can be achieved by profiting to the environment as well as keeping up the fabric necessities and their standards. From the inclinations of plastic reusing strategy is used. For the generation of plastic bricks is an ideal strategy for controlling the issue by decay of plastic squander and too it costs conservative for the generation of building materials. In the later past investigate, the substitution and expansion have been done with the coordinate consideration of polyethylene, polyethylene terephthalate (PET) bottles in destroyed shape, chemically treated polyethylene-fiber, PET in small particles shape by supplanting sand and quarry tidy. Most of substitutions have been done by volume calculation, and appeared the diminished in compressive quality as the expanded plastic squander. In this think about, reused plastic squanders have been presented in the frame of little pieces, and this test expanding the fire resistance by utilizing adequate percent of gypsum. The substitution of plastic squander fabric has been done by weight.

PLASTIC BRICKS:

Plastic bricks are plastic drinking bottles stuffed with non-biological squander to make a reusable building piece. A plastic brick is a plastic bottle stuffed strong with non-biological squander to make a reusable building piece. These bricks are utilized to make secluded furniture, cultivate spaces and full-scale buildings such as schools and houses. Plastic bricks are a collaboration fueled innovation that gives a zero-cost strong squander arrangement for people, family units, schools and communities.

APPLICATIONS OF PLASTIC BRICKS:

- High-quality plastic bricks, which have standard shape, sharp edges, smooth surfaces, tall solidness, and extraordinary quality, can be utilized for changeless basic development such as buildings, streets, stopping tiles, etc.
- Development of dividers of any measure (uncovered brick dividers, parapet dividers, partion dividers) floors, little curves, and cornices.
- Sun-dried or un-burnt bricks are utilized as it were for transitory structures and these bricks ought to be dodged where overwhelming moistness and visit rain is predominant.
- Low-quality bricks or ineffectively blended bricks are utilized as total for establishment concrete and street metal works.
- Bricks can be utilized for making casual walkway or way to entryways and strolling way through blossom plant.
- Holes in bricks can be utilized to make astonishing planter/candleholders.

ADVANTAGE OF PLASTIC SAND BRICKS:

- Plastic brick have more preferences which incorporates taken a toll proficiency, asset proficiency, lessening in emanation of nursery gasses, etc.
- Reduce the intensity of plastic on earth. So, it can be used effectively in construction.
- Plastic brick is also known as “Eco-Bricks” made of plastic waste which is otherwise harmful to all living organisms can be used for construction purposes.
- It increments the compressive quality when compared to ruddy burnt brick bricks.
- By utilize of plastic bricks, the water retention of the brick is less and nearness of alkalies was profoundly decreased.
- Owing to numerous advantages like weight, fire resistance etc., and further research would improve quality and durability of plastic bricks.

II. NEED FOR STUDY

The study of experimental investigation of plastic mixed brick is needed for several reasons:

Sustainable use of plastic waste

The expanding sum of plastic squander produced all inclusive has gotten to be a major natural concern. The use of plastic waste in brick mixtures can provide a sustainable solution to this problem.

Reduction of natural resources consumption

The use of plastic waste in brick mixtures can reduce the consumption of natural resources such as sand and gravel, which are becoming scarce in many regions.

Performance evaluation

The performance of plastic mixed brick under various conditions is not yet fully understood. This experimental investigation will provide valuable insights into the properties of plastic mixed brick, including compressive strength, split tensile strength, flexural strength, and durability.

Potential Benefits and Drawbacks

The use of plastic waste in brick mixtures has several potential benefits, including reducing the amount of plastic waste in landfills. However, there may also be drawbacks, such as a reduction in the compressive strength of the brick. This investigation will help to identify and evaluate these potential benefits and drawbacks.

Overall, the study of experimental investigation of plastic mixed brick is needed to determine the feasibility and potential benefits of using plastic waste in brick mixtures, as well as to evaluate its performance under various conditions.

III. OBJECTIVES

The objectives of the experimental investigation of plastic mixed concrete are as follows:

1. To develop an efficient way to effectively utilize the waste plastics and that plastic wastes acts as a great threat for the sustainment of ecological balance.
2. To reduce the consumption of earth-based material as clay for the manufacturing of brick that resulted in resource depletion, environmental degradation.
3. To reduce the waste plastic quantities on the land and water to avoid land and water pollution.
4. To reduce the dumping area of waste plastic.
5. To produce the cost-effective material.
6. To prevent the people health from harmful diseases.

IV. MATERIALS USED AND ITS PROPERTIES

The show examination the taking after materials were utilized:

1. Waste plastic
2. Quarry dust
3. M-sand
4. Bitumen
5. Gypsum
6. Water

1. Waste plastic

By definition the plastics can be made to diverse shapes when they are warmed in closest environment it exists in the diverse shapes such as mugs, furniture’s, bowls, plastic bags, food and drinking holders, and they are ended up squander fabric. Accumulation of such squanders can result into dangerous impacts to both human and plant life. Therefore, need for proper disposal, Waste management in respect to plastic can be done by recycling. If they are not reused at that point they will ended up enormous poison to the environment as they not break down effectively and moreover not permit the water to permeate in to the soil and they are also poisonous. And, if conceivable, utilize of these squanders in their reused shapes, occurs. This can be done through prepare of plastic management.

Table 1: Origin of plastics

Waste plastic	Available As
Poly ethylene terephthalate (PET)	Drinking water bottles etc.
High Density Poly ethylene (HDPE)	Carry bags, bottle caps, house hold articles etc.
Low Density Poly ethylene (LDPE)	Milk pockets, sacks, carry packs, canister linings, beauty care products and cleanser.
Poly propylene (PP)	Bottle caps and closures, wrappers of detergents, biscuit etc.
Urea formaldehyde	Electrical fittings, handles and knobs
Polyester resin	Polyester resin



Figure 1: Waste plastic

Poly ethylene terephthalate (PET)

Bottles made of polyethylene terephthalate (PET, now and then PETE) can be utilized to make lower review items, such as carpets. To make a nourishment review plastic, the bottles require to be hydrolyzed down to monomers, which are decontaminated and at that point re-polymerized to make modern PET. In numerous nations, PET plastics are coded with the gum distinguishing proof code number "1" interior the widespread reusing image, ordinarily found on the foot of the holder. PET is utilized as a crude fabric for making bundling materials such as bottles and holders for bundling a wide extend of nourishment items and other shopper goods. Examples incorporate delicate drinks, alcoholic refreshments, cleansers, beauty care products, pharmaceutical items and consumable oils. PET is one of the most common client plastics utilized. Polyethylene terephthalate can too be utilized as the fundamental fabric in making water-resistant paper. The physical properties of the PET are listed in Table – 2

Table 2: Properties of PET

Coefficient of Thermal Expansion	7 x 10 ⁻³ /°C
Long Term Service Temperature	115 - 170°C
Melting point	260°C
Specific Gravity	1.3 – 1.4
Water Absorption	0.07 – 0.10%

2. Quarry dust

Quarry earth that stuff from blend crushers might supplant sand. Construction of pavements and building materials in expansive soils creates a lot of issues for civil engineers, stabilization with industrial waste like quarry dirt offers results. AP state's new capital is solely a black cotton soil space that ends up in the issues of swelling and shrinkage. It’s found that the swelling of expansive soils is controlled and improvement in soil properties is discovered by adding quarry dirt. The actual properties area unit is given in table-3.

Table 3: Properties of quarry dust

Property	Values
Specific Gravity	2.54-2.60
Bulk Relative Density (Kg/M3)	1720-1810
Absorption (%)	1.20-1.50
Moisture Content (%)	Nil
Fine Particles Less Than 0.075mm (%)	12-15

Figure 2: Quarry dust



3. M-sand

Manufactured Sand (M-Sand) is sand delivered from troublesome stone by smashing. The smashed sand is cubical shape with grounded edges. It is then washed and graded with consistency to be used as a substitute of river sand as a construction material. The table-4 shows the properties of m-sand.

Table 4: Properties of M-sand

S.NO	PROPERTIES	M-SAND
1	TEXTURAL COMPOSITION	
	COARSE SAND (4.75-2.00mm)	28.1
	Medium sand(2.00mm-0.425mm)	44.8
	Fine sand (0.425-0.075)	27.1
2	Specific gravity	2.63
3	Bulk density	15.1



Figure 3: M-sand

4. Bitumen

Bitumen may be a common cover utilized in construction. It's primarily obtained as a residual product in rock oil refineries when higher fractions like gas, petrol, kerosene, and diesel, etc., area unit removed. Indian standard foundation characterizes hydrocarbon as a dark or dull brown non-crystalline soil or gooey fabric having cement properties inferred from shake oil rough either by common or by works processes Indian Oil produces hydrocarbon from its refineries and markets it in bulk likewise as packed in steel drums. Indian Oil conjointly markets changed hydrocarbon CRMB and Emulsion. The properties of hydrocarbon as shown in table -5.

Table 5: Properties of bitumen

Experiments	Results
Penetration (mm)	67.5
Ductility (cm)	59
Softening point (°c)	58
Specific Gravity	1.01



Figure 4: Bitumen

5. Gypsum

Gypsum might be a delicate sulfate mineral composed of salt dry out, with the chemical. Selenite may occur in an exceedingly slick, fibrous kind, during which case it's usually referred to as "satin spar". Finally, it should even be granular or quite compact. Gypsum uses include: the Manufacture of flat solid, cement, plaster of Paris, soil acquisition, a hardening retarder in hydraulic cement and bricks. Styles of the mineral called "satin spar" and "alabaster" range unit utilized for a extend of enriching purposes; but, their moo hardness constrain their sturdiness. hearth evaluated mineral drywall is extra hearth-resistant as a result of it contains fiber support and elective added substances at interims its uncommonly created mineral center to help it impediment longer to a hearth exposure. Chemical formula of gypsum: $\text{CaSO}_4 \cdot 2(\text{H}_2\text{O})$, (Hydrated Calcium Sulphate).

6. Water

The water used for experiments was potable water Fresh portable water free from organic matter and oil is used in mixing the preparation of plastic bricks. Water in required amounts were measured by graduated bump and included to the quarry tidy and M-sand blend. The rest of the material for preparation of the mix was taken by weigh batching. The pH esteem ought to not be less than 7.

V. MIX DESIGN AND MANUFACTURING

The main objective of this analysis work is to develop associate economical thanks to effectively utilize the waste plastic that may be a nice treat for the maintenance of ecological balance, With the dirt quarry waste and M-sand to manufacture another artifact by that each the queries of scientific disposal of waste plastic yet because the insufficiency of ancient building materials will be answered. The dirt quarry waste was collected from the closest place of our society. Once the dirt stone is cut from the quarry nearly 15-20% of dirt waste is obtained. This waste was crushed victimization rammers and sieved in an exceedingly a pair of.36mm IS sieve. This sieved dirt soil was delivered to the laboratory for the preparation of bricks. This soil was preserved to cut back the water content. A mold of size 19x9x9cm was ready. Bricks of various combine proportions were ready, for every brick 3kg of the dirt quarry mud and M-sand was accessorial with variable hydrocarbon content of twenty-two at the side of variation in proportion 0,60,65,70,75% of plastic waste and five-hitter of the mineral was accessorial for increasing the fireplace resistance capability. Bricks were ready by compacting through vibration. 9kg of unpolluted sieved dirt

quarry waste is collected. At the ultimate stage, a pair of hydrocarbon and five-hitter of mineral by weight of soil are accessorial and mixed for uniform distribution to organize three bricks. The later combine is poured into the molds so compacted by vibration.

The bricks are remolded when thirty min and dry for an sum of 24hr for rectify chilling. (Of every combine, proportion bricks were ready and tested for compressive strength within the compressive testing machine (CTM).

Table 6: Mix design

S.no	% of plastic replaced with quarry dust and m-sand	% of quarry dust & m-sand	% bitumen 60/70	% gypsum
1	0	100	2	5
2	60	40	2	5
3	65	35	2	5
4	70	30	2	5
5	75	25	2	5

Manufacturing of Brick

In first step we should collect the waste plastic such as household vegetable chopping board, shampoo bottles, oil cans and bottles. Next the collected waste plastic products are cleaned with water and dried to remove the water present in it after this the plastics are made into small pieces and melted out by using stones and firewood. The stones are arranged to hold the pan and the Firewood is placed in the gap between the stones and it is ignited. The dish is set over the over setup and it is warmed to evacuate the dampness show in it. Then the plastic pieces are added to the pan one by one and the river sand is added to the plastic when it turns into hot liquid. The sand is included is blended completely utilizing pole and trowel some time recently it hardens. The mixture has a very short setting hence mixing process must not consume more time on the other hand the process should be complete. These blends are at that point poured in to the brick shape and they are compacted utilizing steel pole and surface is wrapped up utilizing trowel. Sometime recently setting the blend into the shape, the sides of the form are oiled to simple expulsion of bricks. After completion of legitimate blending, we put blend into required mould. In these projects we use the normal brick sizes (150x150x150mm). After 1 days evacuate the brick from the shape

Observation Done During Our Project

Observation done during our project

- Starting setting time of brick was 2min.
- Last setting time of brick was 60min.
- Total losses of plastic were 50% in gases form (20gm of bottle).
- Add up to time required for making of one brick was 25min.
- Time required



Figure-5: preparation of plastic brick specimen

VI. EXPERIMENTAL INVESTIGATIONS AND RESULTS:

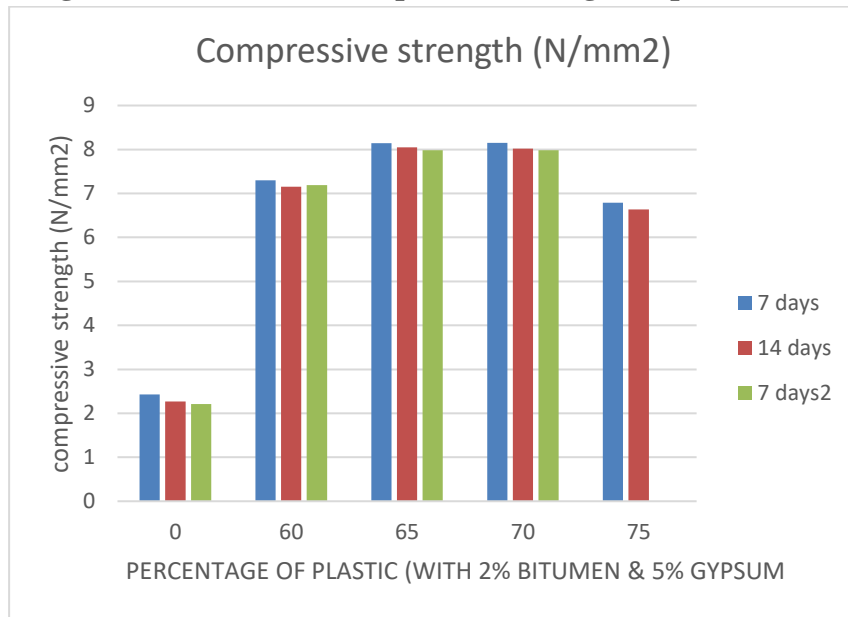
Compressive strength

This test is conducted to determine the compressive strength of the specimen. The compressive quality of the example might be calculated after the age of 7 days of curing, the compressive quality test performed on the five shifted brick examples. Then place the specimen flat-wise on the base of the compressive testing machine, plywood sheets are used to hold the brick in the correct position while testing. Then apply the load axially on the specimen at the rate of 14 N/mm² (140 kg/cm²) per minute gradually till the brick specimen get starts breaking.



Figure 6: Finding the compressive strength of brick using compressive testing machine

Figure 7: Variation of compressive strength of plastic brick



Water absorption test

The water absorption test is done as per IS 3495 Part2) 1992 was performed. Firstly the brick specimen weighted on a digital weighing scale (M1) and is dried at a room temperature then the specimen is immersed in the distilled water at a temperature of 27+ 2°C for a 24 hours. The specimens were removed after the 24 hours of immersion and wiped out the water with dried cloth. And each specimen is weighed (M2), compute it by using the formula. The good qualities of the brick do not absorb more than the 20% of its self-weight. The percentage of water absorption is determined by the formula. $W = [(M2 - M1) / M1] \times 100$

Table 7: Tabulation of water absorption

S.no	% of plastic	Dry weight (kg)	Wet weight (kg)	Water absorption (%)
1	60	3.1	3.18	2.4
2	65	2.97	3.02	1.6
3	70	3.06	3.09	0.8
4	75	2.93	2.95	0.6

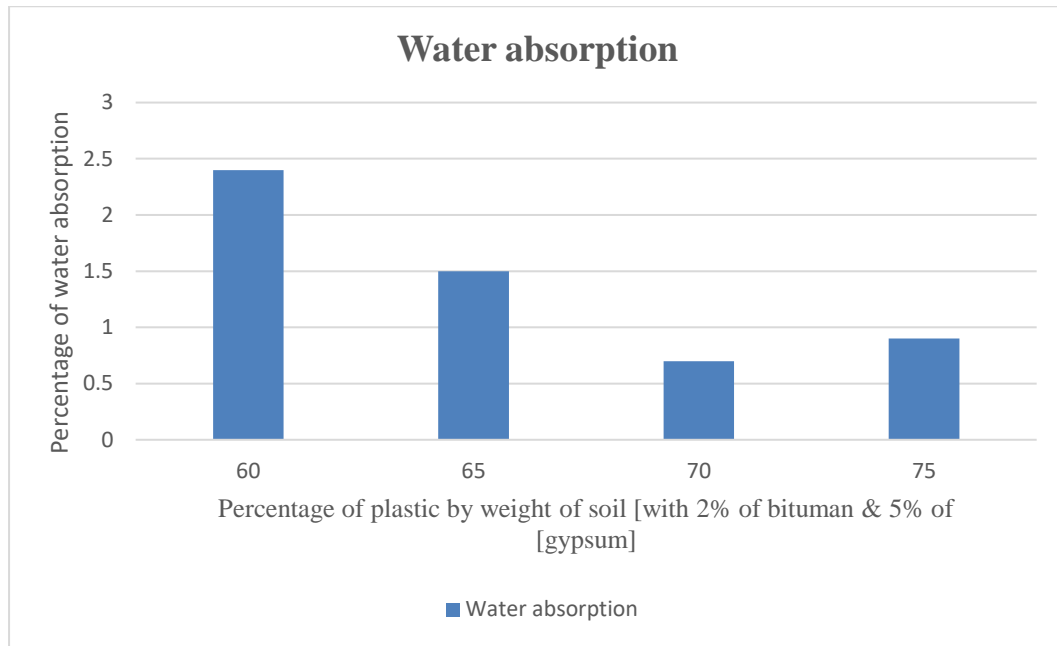


Figure 8: Percentage of water absorption of variation of plastic brick

Efflorescence test:

A whitish crystalline deposit or foggy salts on bricks consisting of calcium sulfate, magnesium sulfate, carbonate of sodium and potassium is called efflorescence. The built up of antacids in bricks is destructive to the structure.

The efflorescence test also showed the excellence performance of the plastic brick. There is absence of gray or white deposits were shown on its bricks surface for the 65 and 70 percentage. It was appeared soluble base and solvent salts 75 rate.

Table 8: Variation of efflorescence test

S. No	Specimen	Nil	Slight	Moderate	Heavy	Serious
1	0			□□		
2	60	□□				
3	65	□□				
4	70	□□				
5	75		□□			

Hardness test:

This test is performed to determine the hardness of the brick. In this test a sharp tool or finger nail is used to make scratch on the surface of the brick, if no impression is left on the surface, then the brick is taken enough heard. In this test we observe that there is no impression is left on the surface of all the five varied brick specimens due to the plastic waste which acted as a binder as well as the M-sand and quarry dust as fillers. Thus, all the brick specimens were considered hard.

VII. CONCLUSION

The compressive quality test result for plastic bricks with 70% plastic substance by the weight of soil with the cover fabric (bitumen) substance of 2% by the weight of soil will give a compressive strength of 8.18 N/mm² which is higher than the red burnt brick (7.18). It has a lesser water assimilation (0.8654%) than ordinary brick (12.58). So, it can be a better alternative building material from the compressive strength test result of bricks for 25 of binder (bitumen) content & 5% of gypsum by the weight of soil with consistent plastic substance of 70% by weight of soil. The fire resistance capacity is also similar to the clay brick. The effective utilization of squander plastic-soil bricks has come about in proficient utilization of plastic squander and in this manner can unravel the issue of secure transfer of plastics, too maintain a strategic distance from its wide spread littering. And utilization of quarry squander has diminished to a few degree the issue of its transfer. On the basis of result obtained during the experimental investigation, following conclusion was drawn Making brick from sand and waste plastic can be an alternative to the available traditional clay bricks. Sand plastic bricks have lower water assimilation, bulk thickness, and clear porosity when compared with those of typical clay bricks. Waste plastic which is available everywhere may be put to an efficient use in brick making. Plastic bricks can help to reduce the environmental pollution thereby making the environment clean and healthy.

COST ANALYSIS

Sl. no	Item	Quantity	Units	Unit rate (Rs –Ps)	Amount (Rs – ps)
1	Plastic (collection & Transportation)	1.96	Kg	0.7	1.37
2	Bitumen	0.056	Kg	23.00	1.28
3	Soil (transportation)	1.00	Kg	0.15	0.50
4	Gypsum	0.14	kg	1.7	0.2
5	Labour	lump- sum	-	-	1.3
TOTAL Rs.		4.6			

For all materials, it is required to know well in progress the surmised cost. Therefore, an endeavor is made to work out the fetched of a brick as in the table 9 which is giving significantly great quality. For this purpose, schedule of rates (2019- 2020) Nellore circles is used. In any case, the taken a toll of laterite quarry squander is not considered since, it is liberally profit- able in the quarry

Therefore, for each plastic brick =4.60 Rs
 Plastic bricks required for 1m³ =93 no’s
 Amount required for 1m³ = 93*4.6=429Rs
 Labour =195.00Rs
Total = 429+195 = 624Rs /m³

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