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Manufacturing And Testing Of Plastic Sand Bricks

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Abstract-**Plastic is a non-bio-degradable substance which takes thousands of years to decompose that creates land as well as water pollution to the environment. The quantity of plastic waste in Municipal Solid Waste (MSW) is expanding rapidly. It is estimated that the rate of usage is double for every 10 years. The Plastic usage is large in consumption and one of the largest plastic wastes is polyethylene (PE). The utilization of earth based clay material resulted in resource depletion and environmental degradation. As amount of clay required for brick is huge, in this project these waste plastics are effectively utilized in order to reduce the land space required to dump these wastes. This creates the prevention from various harmful diseases. Polyethylene (PE) bags are cleaned and added with fine aggregate at various ratios to obtain high strength bricks that possess thermal and sound insulation properties. This is one of the best ways to avoid the accumulation of plastic waste. It also helps to conserve energy, reduce the overall cost of construction andhence in this project, an attemptis made to manufacture the plastic sand bricks by utilizing the waste plastics.**

Key words
Plastic waste, low density polyethylene, polyethylene properties, plastic sand brick, bricks.

INTRODUCTION

1.1 General

Plastic is one of the daily increasing useful as well as a hazardous material. At the time of need, plastic is found to be very useful but after its use, it is simply thrown away, creating all kinds of hazards. Plastic is non-biodegradable that remains as a hazardous material for more than centuries.

The quantity of plastic waste in Municipal Solid Waste (MSW) is expanding rapidly. It is estimated that the rate of expansion is double for every 10 years. This is due to rapid growth of population, urbanization, developmental activities and changes in life style which leading widespread littering on the landscape. They are non-biodegradable and also researchers have found that the plastic materials can remain on earth for 4500 years without degradation In India approximately 40 million tons of the municipal solid waste is generated annually, with evaluated increasing at a rate of 1.5 to 2% every year.

Hence, these waste plastics are to be effectively utilized. Today, it is impossible for any vital sector to work efficiently without usage of plastic starting from agriculture to industries. Thus we cannot ban the use of plastic but the reuse of plastic waste in building constructions, industries are considered to be the most practicable applications.

1.2 SPECIFICATIONS

1.2.1 Cement

Cement is made by heating limestone (calcium carbonate) with small quantities of other materials (such as clay). In this project Ordinary Portland cement of 53 grade conforming to IS456-2000 was used. Tests were carried out on various physical properties of cement and the results are shown in test data of materials.cement will act as a binding material.

1.1 Physical Properties of Cement

S. No	Test	Obtained Result	Standards (IS:8112)
1	Initial setting time	32 minutes	30 minutes
2	Final setting time	580 minutes	600 minutes
3	Fineness	96 %	Not Less than 90%
4	Specific gravity	3.14	3.10 – 3.15
5	Standard consistency	34%	30 – 35%

1.2 Chemical Properties of Cement

S. No	Oxide	Present (%)
1	CaO	60-67
2	SiO_2	17-25
3	Al_2O_3	3.0-8.0
4	Fe_2O_3	0.5-6.0
5	MgO	0.1-4.0
6	Alkalies (K_2O, Na_2O)	0.4-1.3
7	SO_3	1.3-3.0

Fig 1.1 Ordinary Portland Cement

1.2.2 Sand

Natural river sand was used as a fine aggregate. The properties of sand were determined by conducting tests as per IS: 2386 (Part-1). The results are shown in test data of materials. The results obtained from sieve analysis are furnished. The results indicate that the sand conforms to zone 11 of IS: 383-1970.

1.3 Properties of Sand

S. No	Tests	Results
1	Specific Gravity	2.62
2	Bulk Density	1690 kg/m^3
3	Fineness Modulus	2.92

1.2.3 Water

Water used for mixing and curing of concrete shall be clean and free from oils, acids, alkalies, salts and organic materials or other substances the may be deleterious to concrete or steel. Portable water shall be used for mixing of concrete. Suspended solid matter in the water shall not exceed more than 200mg/l. The pH value of the water shall not be less than 6.

1.2.4 Fly ash

Fly ash is a residue resulting from combustion of pulverized coal or lignite in thermal power plants. About 80% of the total fly ash is in finely divided form which is carried away with flue gases and is collected by electrostatic precipitator or other suitable technology.

1.4 Physical Properties of Fly Ash

S. No	Tests	Results
1	Specific Gravity	2.67
2	Fineness	84%

This ash is called as dry ash or chimney or hopper ash. The balance 20% of ash gets collected at the bottom of the boiler and is referred to as bottom ash. Fly ash is very fine comparable to cement, however some particles have size less than 1 micron in equivalent diameter

1.5 Chemical composition of Fly ash

S. No	Components	Percentage (%)
1	Sio_2	35 – 59
2	Fe_2O_3	0.5 – 2
3	Al_2O_3	20 – 33
4	CaO	5 – 16
5	MgO	1 – 5.5
6	So_3	0.5 – 1.5
7	Loss on ignition	1 – 2

1.1.5 Waste plastics

Plastics are commonly used substances which play an important role in almost every aspect of our lives. The widespread generation of plastics waste needs proper end-of-lifemanagement. The highest amount of plastics is found in containers and packaging's (i.e. bottles, packaging, cups etc.), but they also are found in durables (e.g. tires, building materials, furniture, etc.) and disposable goods (e.g. medical devices). Diversity of plastics applications is related with their specific properties, low density, easy processing, good mechanical properties, good chemical resistance, excellent thermal and electrical insulating properties and low cost (in comparison to other materials). Post-production and post-consumer plastics are utilized in a wide range of applications

1.6 Waste Types

Waste plastic	Available as
Poly-ethylene terephthalate (PET)	Drinking water bottles etc.
High Density Polyethylene (HDPE)	Carry bags, bottle caps, house hold articles etc.
Low Density Polyethylene (LDPE)	Milk pouches, sacks, carry bags, bin linings, cosmetics and detergent bottles.
Poly propylene (PP)	Bottle caps and closures, wrappers of detergents, biscuit etc.
Urea formaldehyde	Electrical fittings, handles and Knobs
Polyester resin	Casting, bonding fibers (glass, Kevlar, carbon fiber)

Fig 1.2 Waste plastics

Results were taken from Chennai central institute of plastic engineering and technologies.

1.7 Plastic properties

S.no	Properties	Results
1.	Density at 23˚C	0.958
2.	Elastic modulus	9
3.	Tensile creep strength	8
4.	Bending creep modulus	1
5.	Tensile strength at 23˚C	2
6.	Elongation at break (%)	> 600
7.	Thermal conductivity	0
8.	Ignition temperature	3

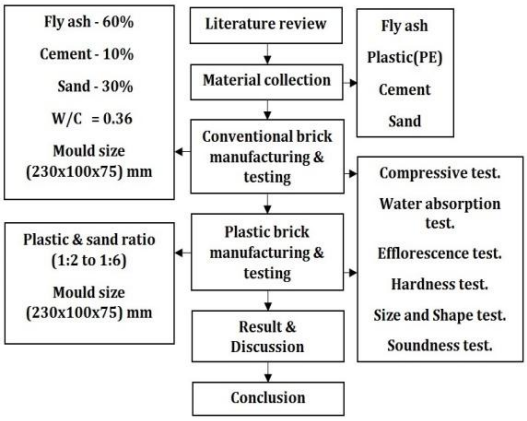
1.3 OBJECTIVES

- 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.
- To reduce the consumption of earth based material as clay for the manufacturing of brick that resulted in resource depletion, environmental degradation.
- To reduce the waste plastic quantities on the land and water to avoid land and water pollution.
- To reduce the dumping area of waste plastics
- To produce the cost effective materials
- To prevent the people health from harmful diseases

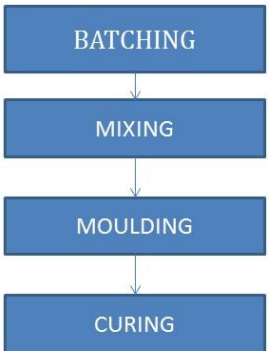
1.4MIX DESIGN

In order to find the plastic soil bricks that they possess high compressive strength with various mix proportions are made and they are tested using compressive testing machine [CTM]. The mix proportions were in the ratio of (1:3, 1:4, and 1:5). These are the ratio which represents the plastic, river sand respectively

1.5 Methodology



2.1 PROCEDURE OF CASTING FLYASH BRICKS



2.1.1 Batching

The measurement of materials for making brick is termed as batching. Use of weigh system in batching facilitates accuracy, flexibility and simplicity

2.1 Plastic Sand Brick Batching

Quantity (kg)	For 1 brick(kg)	For 10 brick(kg)
Fly ash	1.01	10.1
Cement	0.248	2.48
Sand	0.81	8.1

2.1.2 Mixing

Mixing of materials is essential for the production of uniform and strengthens brick. The mixing should ensure that the mass becomes homogeneous, uniform in color and consistency. Generally there are two types of mixing, Hand mixing and machine mixing. In this project, we adopted hand mixing.

2.2 Fly Ash Brick Mixing Percentages

Material	Percentage
Fly ash	60%
Cement	10%
Sand	30%

2.1.3 Moulding

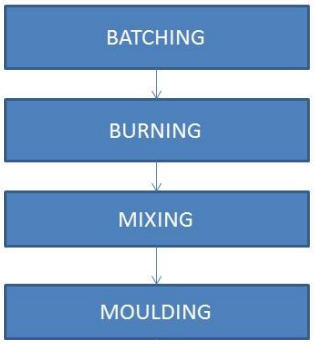
The mould is used for preparing brick in uniform shape. The size of mould is 230×100×75 mm. The mould were assembled and placed on the base plate.The faces must be thinly coated with mould oil to easily demould after casting.

2.1.4 Curing

The test specimens after compaction were allowed to dry for a period of 24 hours. The specimens were kept in ordinary curing tank and allowed to cure for a period of 7, 14 and 28 days

2.1 Manufactured Fly Ash Bricks

2.2 PROCEDURE OF CASTING PLASTIC SAND BRICKS



2.2.1 Batching

The collected waste bags are cleaned with water and dried to remove the water present inside the plastic and then weighted. The sand were sieved by using 600 micron sieve. The sand and the plastic bags were weighed in various proportions among which the plastic were taken for burning process.

2.3 Batching of Plastic Sand Brick

Mix ratio	1:3	1:4	1:5
For 1 brick (gram)	1000:3000	800:3200	670:3350
For 4 brick (grams)	4000:12000	4000:12000	2680:1300

2.2.2 Burning

After batching the plastic bags were taken for burning in which the plastic bags are thrown one by one into the drum and allowed to melt. The first step of burning process includes the arrangement of stones, drum and the required firewood. The stones are arranged to hold the drum and the firewood is placed in the gap between stones and it is ignited. The drum is placed over the setup and it is heated to remove the moisture present in it.

2.2.3 Mixing

The plastic bags are added one by one into the drum, until the entire plastic content required for making bricks of one mix proportion is added into it. When these plastic thoroughly by using trowel before it hardens. The mixture has very short setting bags are turned to molten state, the river sand is added to it. The sand added is mixed time. Hence mixing process should not consume more time.

2.2.4 Moulding

The mixture is then poured into the brick mould and is compacted by using tamping rod or steel rod. The surface is finished by using trowel. Before placing the mixture into the mould, the sides of the mould are oiled to easy removal of bricks. Mould removed after 24 hours.

2.2 Manufactured Plastic Sand Bricks

2.3 TESTS ON BRICK

2.3.1Compression strength test

The cube specimens was placed in compression testing machine and the load is to be applied without shock

and increased continuously at a rate of approximately 140 kg/cm^2 min untilthe resistance of the specimen to the increasing load breaks down and no greater load can be restrained. The maximum load applied to the specimens is to be recorded and the appearance of the brick and any unusual features in the type of failure is noted.

$$\text{Compressive strength} = \frac{\text{Maximum load}}{\text{Area of the specimen}}$$
$$= P/A$$

Where,
P -Maximum load (kN)
A - Area of the specimen (mm^2)

2.4 Comparison of compressive strength of Plastic sand bricks possessing various ratios

Mix Ratio	Plastic Sand Ratio	Compressive Strength(N/Mm2)
1	1:3	4.49
2	1:4	5
3	1:5	5.56

2.5 Comparison of compressive strength of Plastic sand bricks with its counterpart

S.NO	Type of Brick	Compressive Strength(N/mm^2)
1	Fly ash	3.83
2	Plastic Sand brick	5

2.3 Plastic Sand Brick Compression Strength Test

2.3.2 Water absorption test

In this test, bricks are weighed in dry condition and let them immersed in fresh water for 24 hours. After 24 hours of immersion, those are taken out from water and wipe out with cloth. Then, brick is weighed in wet condition. The difference between weights is the water absorbed by brick. The percentage of water absorption is then calculated. The less water absorbed by brick the greater its quality. Good quality brick doesn't absorb more than 20% water of its own weight

Water absorption = {[W2 – W1] / W1} x 100
Where,
W_1 = Weight of dry brick (kg)
W_2 = Weight of wet brick (kg)

2.6 Water absorption test of Plastic sand bricks possessing various ratios

S. No	Mix ratios	Water absorption (%)
1	1:3	0.935
2	1:4	0.727
3	1:5	1.033

2.7 Comparison of compressive strength of Plastic sand bricks with its counterpart

S.No	Type of Brick	Water absorption (%)
1	Fly Ash	6.97
2	Plastic sand	1.033

2.3.3 Efflorescence test

The presence of alkalis in bricks is harmful where it forms a gray or white layer on brick surface by absorbing moisture. To find out the presence of alkalis in bricks, this test isperformed. In this test, a brick is immersed in fresh water for 24 hours. Then, it is taken out from water and allowed to dry in shade. If the whitish layer is not visible on surface, it proofs that absence of alkalis in brick. If the whitish layer visible about 10% of brick surface, then the presence of alkalis is in acceptable range. If that is about 50% of surface, then it is moderate. If the alkali's presence is over 50%, then the brick is severely affected by alkalis

2.8 Efflorescence Test Results

S. No	Mix ratios	Nil	Slight
1	F.A	_	✓
2	1:3	✓	–
3	1:4	✓	–
4	1:5	✓	–

2.3.4 Hardness test

In this test a scratch is made on brick surface with steel rod (any hard material can be used) which was difficult to imply the bricks or blocks were hard. This shows the brick possess high quality.

2.3.5 Fire resistance test

The Plastic is highly susceptible to fire but in case of Plastic sand bricks/Paver blocks the presence of sand imparts insulation. There is no change in the structural properties of block of bricks up to 180˚C above which visible cracks are seen and the bricks deteriorate with increase in temperature.

2.3.6 Soundness test

The soundness test is also done in the field. After the manufacturing of the brick are allowed to dry in air for 2days.Then the bricks are made to hit each other the ring sound produced during the process, which denotes the quality of the brick that it is good. Good quality bricks produce the clear ringing sound. In our project both fly ash bricks and plastic sand bricks clear ringing sound produced.

3. CONCLUSION

Plastic sand brick possess more advantages which includes cost efficiency, resource efficiency, reduction in emission of greenhouse gases, etc.,Plastic sand 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 increases the compressive strength when compared to fly ash bricks. By use of plastic sand bricks, the water absorption presence of alkalies was highly reduced. Owing to numerous advantages further research would improve quality and durability of plastic sand bricks.

REFERENCES

[1] Dibya Jivan Pati, Riken Homma, Kazuhisaikt, “PLASTIC BOTTLES MASONRY AS ALTERNATE SOLUTION TO HOUSING PROBLEMS IN URBAN AREA OF INDIA” International Journal of Architecture Planning and Building Engineering, ISSN 2455-5045, Volume 2,Issued 2nd April 2015.

[2] Dinesh.S, Dinesh.A, Kirubakaran.K, “UTILISATION OF WASTE PLASTIC IN MANUFACTURING OF BRICKS AND PAVER BLOCKS’’ International Journal of Applied Engineering Research, ISSN 0973-4562, Volume 1, 2016.

[3] Gopu Mohan.C, Jikku Mathew, Jithin Ninan Kurian, John Thomas Moolayil,“FABRICATION OF PLASTIC BRICK MANUFACTURING MACHINE AND BRICK ANALYSIS” International Journal of Innovative Research in Science and Technology, ISSN (online) 2349-6010, Volume 2, Issue 11th April 2016,.

[4] Maneeth.P.D, Pramod.K, Kishore Kumar, Shanmukha Shetty, “UTILISATION OF WASTE PLASTIC IN MANUFACTURING OF PLASTIC-SOIL BRICKS’’International Journal of Engineering Research and Technology (IJERT), Volume 3, ISSN 2278-0181, Issued 8th August 2014.

[5] Nitin Goyal, Manisha, “CONSTRUCTION STRUCTURES USING ECO-BRICKS” International Journal of Recent Trends in Engineering & Research, ISSN 2455-1457.

[6] Puttaraj Mallikarjun Hiremath, Shanmukha shetty, Navaneeth Ral.P.G, Prathima.T.B, “UTILISATION OF WASTE PLASTIC IN MANUFACTURING OF PLASTIC-SOIL BRICKS’’ International Journal of Technology Enhancements And Emerging Engineering Research, ISSN 2347-4289, Volume 2.

[7] Sankuru Naresh, D.V.N.V.Laxmi Alekhya, Hannah Vijayamohan, “CREATION OF ECO FRIENDLY ENVIRONMENT BY MANUFACTURING AND TESTING OF GEO PLASTIC BRICKS AND USAGE OF STABILIZATION TECHNIQUES IN THE PREPARATION OF AND GEO PLASTIC BRICKS”International Journal of Research in Engineering and Technology(IJRET), eISSN: 2319-1163, pISSN: 2321-7308.