Poly 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.*

Plastics have been used widely in both water and food packaging due to their natural properties such as inertness and low bulk densities, which make them suitable mover materials and little risk to contaminants. Plastic bottles and sachets have become prevalent all over the country, particularly, urban areas. The packaging revolt has not been backed by proper plastic waste management policy, which has left a lot of cities in India littered with plastic wastes, hence, creating horrible visual troubles and other community health problems. Growing environmental awareness and reduction in available landfill capacity have prompted plastic recycling programmes in most developed countries. Currently, however only between 5 to 25% of plastic waste is being recycled. The paper discusses prospects of plastic waste management schemes. It is concluded that the existing rate of environmental worsening is likely to continue unless long term remedial measures are adopted for plastic wastes management in the country.

I. INTRODUCTION

General

Building materials like bricks, concrete block, tiles, etc. are popularly used in construction. However, these materials are expensive and hence common people find it difficult to easily afford them. Moreover, these building materials require certain specific compositions to obtain desired properties. Plastic is one of the recent engineering materials which have appeared in the market all over the world. 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.

It is a material consisting of a wide range of synthetic or semi-synthetic organic compounds that are malleable and can be molded into solid objects. Plastics can be made to different shapes when they are heated. It exists in the different forms such as cups, furniture, basins, plastic bags, food and drinking containers and they become waste material. Accumulation of such wastes can result into hazardous effects to both human and plant life. Therefore, need for proper disposal, and if possible, use of these wastes in their recycled forms arises. Plastic waste is increasing day by day throughout the world. Where proper garbage collection system is not available, waste plastics are strewn

II. UTILISATION OFPLASTIC-SANDBRICKS

The increase in the popularity of using environmental friendly, low cost and lightweight construction materials in building industry has brought about the need to investigate how this can be achieved by benefiting to the environment as well as maintaining the material requirements affirmed in the standards. Brick is one of the most accommodating masonry units as a building material due to its properties. Attempts have been made to incorporate waste in the production of bricks such as the use of paper processing residues, cigarette butts, fly ash, textile effluent treatment plant (ETP) sludge, polystyrene foam, plastic fiber, straw, polystyrene fabric, cotton waste, dried sludge collected from an industrial wastewater treatment plant, rice husk ash, granulated blast furnace slag, rubber, craft pulp production residue, limestone dust and wood sawdust, processed waste tea, petroleum effluent treatment plant sludge, welding flux slag and waste paper pulp. It describes the used of various types of waste materials in different proportions and adopted different methods to produce bricks. Different tests were conducted on produced bricks to evaluate their properties following the various available standards. Compressive strength and water absorption are two common parameters considered by most researchers as required by various standards. It is noted that although many of the studied bricks made from waste materials meet the various standard requirements and a number of patents have been approved, so far commercial production and application of bricks from waste materials is still very limited. The limited production and application of bricks from waste materials is also related to the absence of relevant standards and the slow acceptance by industry and public. Standardization plays an important role in disseminating knowledge, exploiting research results and reducing time to market for innovations. Recently, mentioned that there are various research works have been done to find out the safe and environment friendly disposal of plastics. India generates 56 lakh tons of plastic waste annually, where Delhi accounting for staggering 689.5 tons a day. Approximately, 60% of total plastic waste is collected and recycled in the country per day and remain is uncollected and littered. Besides of that, concrete all over the globe has been utilized for the required infrastructure. Both materials consumptions are increasing day by day in their respective field. The inclusion of waste plastic in concrete by replacing or adding the concrete ingredients is one of the appropriate ways to dispose it. In term of costing, cost comparison of available walling materials in Makurdi metropolis showed that the use of bricks made from 45% sand and 5% cement resulted in a saving of 30%-47% when compared with the use of sand concrete blocks

III. PLASTIC PRODUCTION

Plastics are derived from natural, organic materials such as cellulose, coal, natural gas, salt and, of course, crude oil. Crude oil is a complex mixture of thousands of compounds and needs to be processed before it can be used. The production of plastics begins with the distillation of crude oil in an oil refinery. This separates the heavy crude oil into groups of lighter components, called fractions. Each fraction is a mixture of hydrocarbon chains (chemical compounds made up of carbon and hydrogen), which differ in terms of the size and structure of their molecules. One of these fractions, naphtha, is the crucial compound for the production of plastics.

Two main processes are used to produce plastics - polymerization and polycondensation - and they both require specific catalysts. In a polymerizations reactor, monomers such as ethylene and propylene are linked together to form long polymer chains. Each polymer has its own properties, structure and size depending on the various types of basic monomers used.

There are many different types of plastics, and they can be grouped into two main polymer families:

- Thermoplastics (which soften on heating and then harden again on cooling).
- Thermosets (which never soften once they have been moulded).

Examples of Thermoplastics	Examples of Thermosets
Acrylonitrile butadiene styrene (ABS)	Epoxide(EP)
Polycarbonate (PC)	Phenol-formaldehyde (PF)
Polyethylene (PE)	Polyurethane (PUR)
Polyethylene terephthalate (PET)	Polytetrafluoroethylene (PTFE)
Polyvinyl chloride (PVC)	Unsaturated polyester resins (UP)
Polymethyl methacrylate (PMMA)	
Polypropylene (PP)	
Polystyrene (PS)	

IV. SCOPEANDOBJECTIVEOF STUDY

Scope

Bricks made from soft plastic waste that can each withstand six tonnes of pressure and relentless rain could replace the clay bricks currently used to build rural homes in monsoon-prone countries such as India.

Clay is susceptible to rain, and many homes in India can be badly damaged during the monsoon season, as clay bricks are washed away.

But the new waste-made material, which is both strong and lightweight could solve this problem, says Lise Fug sang Vestergaard, who developed the idea for the bricks during her design master’s at the Technical University of Denmark (DTU).

Earlier this month, as a winner of a DTU student competition called the Green Challenge, she was handed 15,000 Danish krone (around US$2,500) that will help her developed her concept.

Vestergaard got the idea while spending three months in 2013 as part of her studies developing a waste collection system in the east Indian town of Joygopalpur, West Bengal.

Back home, she experimented by melting plastic — including foil-covered snack bags, a huge part of India’s domestic waste — into moulds in an ordinary oven.

This resulted in prototypes that remained strong despite containing up to 60 per cent snack bags.

But as electricity is limited in places such as Joygopalpur, Vestergaard has come up with a way to melt plastic using a solar-powered grill. She plans to do more testing on her next trip to India.

However, not everyone in poor areas of India understands the importance of recycling, says Vestergaard.

"They are used to waste such as banana skins that disappears."

According to Waste Warriors, an NGO that seeks to clean up India, many people in the country suffer from pollution -induced diseases that are the result of waste. "India has a very serious garbage problem that could be managed with a bit of effort, [but] it needs to stop being at the bottom of everyone's agenda," says Jodie Underhill, Waste Warriors' co-founder.

V. 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
- Identifying the main challenges and barriers for reducing plastic waste in mixed waste and residual waste streams, hereby stimulating prevention and recycling of plastic waste
- An important feature of the Plastic Zero project is to set up cooperative forums involving public and private stakeholders, by bringing stakeholders together with shared responsibility. The forums and networks will identify and analyse relevant interfaces between the partners in the value chain, and provide the necessary production technology, infrastructure, physical planning, information, waste services, and technologies for reprocessing. By involving all stakeholders in the value chain there will be an opportunity to rethink product design through cradle-to-cradle methods.

PLASTIC-SANDBUILDINGBLOCKS/BRICKS

General

Polli-Bricks make the building structurally sound enough to withstand earthquakes and typhoons, environmentally friendly, and relatively cheap to build.The bricks can be blow-molded out of shredded PETÂ bits at a construction site. Next, they are stacked into rectangular panels. Workers then cover the bricks with a film similar to the coating found on smartphone screens. The coating makes the panels resistant to fire and water. The coating can even be laced with light-emitting diodes, or LEDs, to provide low-cost lighting.

The workers then hang the coated panels on a steel frame. The air inside the bottles works as a natural insulator. Because the panels are modular, buildings made from Polli-Bricks can be easily dismantled and the panels reused. This attribute makes Polli-Bricks appealing for structures in disaster zones and remote areas.

Polli-Bricks are currently being used to create buildings such as an entertainment campus, IMAX theaters, factory, and exhibition area in Taiwan, Malaysia, and China.

AvailabilityofPlastics

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)

Materials Required

PLASTICS

The reason for this is that plastic is the biggest culprit when it comes to waste production; we throw away more plastic than any other material. Not only this, it also accounts for around 90% of all the waste that bobs around in our seas and oceans. The 3rd worrying factor is that it can take hundreds of years to biodegrade, making it a serious problem for future generations to deal with as well.

But it's not all doom and gloom. There is a constant stream of new and innovative ideas to tackle the mounting problem of plastic waste. From plastic roads to plastic training shoes, people are finding new ways to deal with the issues at hand.

For example, researchers from the National Council of Scientific and Technological Research (CONICET) in Argentina have come up with a novel way to turn used plastic drinking bottles into eco-friendly building bricks. The PET (polyethylene terephthalate) material the bottles (and bricks) are made from is as strong as a conventional house brick made from sand and cement.

Figure: 1

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.

Figure: 2s

Types of sand

s:
Pit sand
River sand
Sea sand
Artificial sand

1. Pit Sand

This is natural sand.

Source: Pit sand is collected from the ground by digging a pit. The pit's depth is about 1m – 2m from ground level.

Grain: Pit sand consists of sharp, angular and rough grains. it is free from salt and organic materials. Because of the absence of salt in this sand it doesn't absorb moisture from atmosphere.

Sand Type: Pit sand is a coarse type sand (I'll discuss about coarse sand later in this post).

Color: Due to coating of a iron-oxide it shows red-orange color.

Uses: Due to its superior binding quality it is widely used in civil construction.

2. River Sand

River sand is also natural sand.

Source: It is obtained from river bed or river bank.

Grain: This sand consists of fine rounded grains and It is well graded.

Sand Type: River sand is a fine type sand (I'll discuss fine sand later in this post)

Color: It has white-grey color.

Uses: It is available in clean condition and can be widely used for all-purpose of construction activities like plastering and concreting.

3. Sea sand

Source: This type of sand is obtained from sea-shore.

Grain: It consists of rounded grains.

Sand Type: It is also fine type sand

Color: The color of sea sand is light-brown.

Uses: This type of sand is not normally used for **construction work**. Because it has salt which attracts the moisture from atmosphere and causes for dampness, efflorescence and disintegration of work? It should be thoroughly washed before using in construction.

4. Artificial Sand

It is an effective alternative to **river sand**. It is produced by crushing either basalt rock or granite. It is well graded and a coarse-type sand.

Properties of Sand

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

Table: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 binding materials

:

Figure:3

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%

Table: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

Table:3

Demand

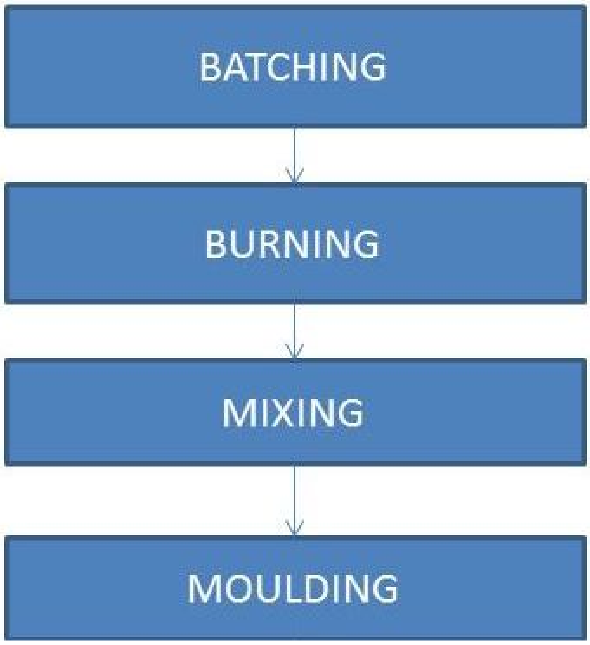
Growth of population, increasing urbanization, rising standards of living due to technological innovations have contributed to an increase both in the quantity and variety of solid wastes generated by industrial, mining, domestic and agricultural activities. Globally the estimated quantity of wastes generation was 12 billion tonnes in the year 2002 of which 11 billion tonnes were industrial wastes and 1.6 billion tonnes were municipal solid wastes (MSW). About 19 billion tonnes of solid wastes are expected to be generated annually by the year 2025. Annually, Asia alone generates 4.4 billion tonnes of solid wastes and MSW comprise 790 million tones (MT) of which about 48 (6%) MT are generated in India .By the year 2047, MSW generation in India, is expected to reach 300 MT and land requirement for disposal of this waste would be 169.6 km2 as against which only 20.2 km2 were occupied in 1997 for management of 48 MT . As it is studied that apart from municipal wastes, the organic wastes from agricultural sources alone contribute more than 350 MT per year. However, it is reported that about 600 MT of wastes have been generated in India from agricultural sources alone .The major quantity of wastes generated from agricultural sources are sugarcane baggage, paddy and wheat straw and husk ,wastes of vegetables, food products, tea, oil production, jute fiber, groundnut shell, wooden mill waste, coconut husk, cotton stalk etc.,. The major industrial non-hazardous inorganic solid wastes are coal combustion residues, bauxite red mud, tailings from aluminum, iron, copper and zinc primary extraction processes. Generation of all these inorganic industrial wastes in India is estimated to be 290 MT per annum . In India, 4.5 MT of hazardous wastes are being generated annually during different industrial process like electroplating, various metal extraction processes, galvanizing, refinery, petrochemical industries, pharmaceutical and pesticide industries.

VI. EXPERIMENTAL WORK

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 toindustries. Thus we cannot ban the use of plastic but the reuse of plastic waste in building constructionsindustries are considered to be the most practicable applications

Manufacturing process of Plastic-Sand Bricks



BATCHINGThe 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.

BURNINGAfter 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.

MIXINGThe 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.

MOULDINGThe 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.

VII. FLOWCHARTDIAGRAM

Plastic & Sand
↓↓↓↓
Weighing
↓
Plastic melting
↓
Mixing

↓
Moulding
↓
Remoulding
↓
WaterCuring
(7 to 20 days)
↓
Drying(oneor twodays
↓s
SortingandTestin
↓
Dispatch

Characteristics of Plastic Bricks

Thestandardsizeofthebrickis230x110x70.

- The bricks are manufactured and tested as per IS12894-2002.
- Plastic bricks are sound, compact and uniform in shape, size and color. Smooth rectangular faces of the bricks are accompanied with sharp and square corners.

Figure:4

1. They are free from visible cracks,war page,flaws and organic matter.
2. Economical & environment friendly.
3. 28%lighter than ordinary claybricks.
4. Compressivestrength:7.5N/mm2onanaverage.

Comparison of Cement Bricks and Plastic Sand Bricks:

CEMENTBRICK	PLASTIC SANDBRICK
Uniform pleasing color like cement	Uniform pleasing color like cement
Uniform in shape and rough in finish	Uniform in shape and smooth in finish
Lightly bonded	Dense composition
Plastering required	No plastering required
Heavier in weight	Lighter in weight
Compressive strength is around 45Kg/cm2	Compressivestrengthisaround100 Kg/cm2
More porous	Less porous

Table:3

Pollution Control

Needs Work men working with FlyAsh and at the mixing are aare to be provided with protective equipment like dust masks and safety goggles.

Energy Conservation

Needs The management has to be vigilantin ensuring higher productivity by the best utilization of man and machine hours. Periodic checks over workings tages, functioning of machinery and their preventive maintenance and timely repair etc. will help in energy conservation.

Preliminary laboratory tests:

Compressive strength AS/NZS4456.4:

Fairly obviously, this is the ability of the mas onryun it(brick or block) to resist crushing loads, e.g. the weight of the roof that the wall is supporting, plus the weight of the wall itself. The designer of the structure needs to be sure that the mas onryunit will be able to carry the load being placed upon it, including any live loads.

Dimensions AS/NZS4456.3:

AS/NZS 4455 *Masonry units and segmental pavers* calls for bricks and blocks to be classified into dimensional categories based on their deviation from their **worksize**,or the size specified in manufacture. This is usually a standard size; it is

important that deviations from this be controlled to a low level so brick layers are able to build the structure to the designer's specifications and with minimum joint thickness variation.
Under this standard test, 20 units can be either measured individually for length,width and thickness, or they can be placed side by side, end to end, etc. And their cumulative dimensions measured.

Brick making machine

Figure:5

Advantages

They also have several significant advantages over conventional bricks - they're thinner and lighter, have superb heat insulating properties (5 times more than standard bricks) and are just as strong as their stony counterparts. They're also great at insulating against noise and it only takes 20 bottles on average to make one brick.

90% of all waste is plastics. I don't know of any disadvantages, although I am sure there are!

Each brick helps rid the world of discarded plastic and is cheaper and more fuel efficient to manufacture than conventional bricks. It's also less energy intensive than recycling the plastic into other forms.

Disadvantages

- Less fire resistance
- Release of harmfull gases at time of preparation

VIII. TEST RESULTS AND DISCUSSION

General

The results of all the tests carried out on Plastic bricks and also the technical aspects are presented and discussed in this chapter.

Compressive strength Test:

Compressive strength of the specimen brick was calculated after 7, 14 & 28 days of curing using the formula as follows, Compressive strength = Applied Max load x 1000 (N)/Cross sectional Area (mm2). The universal testing machine is used for testing the compressive strength of bricks. After the curing period gets over bricks are kept for testing. To test the specimens, the bricks are placed in the calibrated compression testing machine of capacity 3000 KN (Kilo Newton) and applied a load uniform at the rate of 2.9 kN/min. The load at failure is the maximum load at which specimen fails to produce any further increase in the indicator reading on the testing machine.

Laboratory process of compressive strength test:

1. Aim

To determine the compressive strength of bricks

2. Apparatus

Compression testing machine, the compression plate of whichs hall have balls eating in the form of portion of asphere center of which coincides with the center of the plate.

Fig6:CompressionTestingMachine

Specimens

Three numbers of whole bricks from sample collected should be taken.the dimensions should be measured to the nearest 1 mm

Sampling

Remove unevenness observed the bed faces to provide two smooth parallel faces by grinding. Immersein water atroom temperature for 24 hours. Remove the specimen and drain out any surplus moisture atroom temperature. Fill thev frog and all voids in the bed faces flush with cement mortar (1cement, 1 clean coarses and of grade 3 mm and down).Store it under the damp jute bags for 24 hours filled by immersion in clean water for 3 days. Remove and wipe out any traces of moisture.

Procedure

1) Place the specimen with flat faces horizontal and mortar filled face facing upwards between plates of the testing machine.
2) Apply load axially at a uniform rate ($140\ kg/cm^2$) perminute till failure occurs and note maximum loada t failure.
3) The load at failure is maximum load at which the specimen fails to produce any further increase in the indicat or reading on the testing machine.

Formulae:

$$\text{Compressive strength} = \frac{\text{Maximum load at failure (N)}}{\text{Average area of bed face (mm}^2\text{)}}$$

The average of results hall be reported.

Result:

Average compressive strength of the given bricks= 8.88 N/Sq.mm

IX. CONCLUSION

On the basis of result obtained during the experimental investigation, following conclusion was drawn:

I. Making bricks from sand and waste plastics can be an alternative to the available traditional clay bricks.

II. Sand plastic bricks have lower water absorption, bulk density, and apparent porosity when compared with those of normal clay bricks.

III. Sand plastic bricks have higher compressive strength than normal clay bricks.

IV. Waste plastics which is available everywhere may be put to an efficient use in brick making.

V. Sand plastic bricks can help reduce the environmental pollution thereby making the environment clean and healthy

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