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ENVIRONMENTALLY FRIENDLY BRICKS IN BUILDING CONSTRUCTION

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ABSTRACT
In present time due to urbanization the plastic utilization in our daily life has been increased significantly as it being very useful and popular material. The only disadvantage is non-biodegradability. This study summarizes the work done by authors to use plastic as construction material in bricks. The recyclable properties of plastic waste can be utilized to recycle this waste and produce a new product having lesser negative impact on the environment. One of the options to recycle plastic waste is to form bricks of plastic by mixing plastics with sand which can be used to replace traditional bricks. Various authors performed comparative study with brick made up of other materials by using various testing method such as scratch test, apparent porosity, water absorption, apparent porosity test, soundness test, efflorescence test and analyzed that the further research on this field can enrich the strength, quality and durability of these masonry bricks. These bricks absorb very less water as compared to conventional bricks that is also very significant with the view of environmental sustainability.

1.INTRODUCTION

1.1 General

In building construction, brick is the major ingredient used for construction. In the process of brick making, it has to be burnt in kiln which emits CO2 gas and pollutes the environment. Waste plastic bottles are non-biodegradable and its disposal has always been a problem. Therefore, replacing the bricks with an alternative material, i.e .bricks made from waste plastic bottles is the solution. Waste Polyethylene Terephthalate (PET) bottles packed with dry solid wastes, sand or soil has been successfully used in a number of countries. The main objective of this paper is to use the waste plastic bottles and construction demolition waste in building construction which reduces the environmental pollution. Plastic bottles of size 600 ml are filled with finely crushed construction demolition waste in three layers and tamped each layer with tamping rod by 25 blows and used .These bottles were called as Eco-Bricks. The Prism is made with the size of (28 x 16 x 24) cm in which 6 Eco-Bricks were placed. Composite Eco-Brick is made with the size of (23 x 10 x7) cm in which a single Eco-Brick is placed. The Compression test is carried out for an Eco-Brick, Composite Eco-Brick and for Prism and compared with the Conventional one. As a result ,the Eco-Brick shows 90% increase in load carrying capacity than conventional one. Eco-Bricks are stronger than Conventional Bricks. Composite Eco-Bricks and Prism shows12% increase in strength. Therefore, it can be used for low rise buildings and temporary structure Plastic bottles are increasingly becoming a menaceto the environment due to the use of chemicals in the manufacture, use and disposal. It has resulted in pollution problems in waterways, landfills and continues to grow. Taking into account the increase of pollution new concept ofeco bricks has been introduced. When these bottles are filled with sand, gravel and cork or wood particles, they have great insulating capability. These walls can absorb abrupt shock loads; being non-brittle they produce

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much less construction waste compared to conventional bricks. They also reported that compared to brick and concrete block walls, plastic bottle walls cost 75% less. Being lighter, plastic bottle walls can be better against earthquakes due to the compaction offilling material in the bottles, they are 20 times more load resistant than conventional bricks these filling materials also make these walls bullet proof. These walls can also support themselves. PET is Polyethylene 2

2.LITERATURE REVIEW

Wahid et al.,2015

The increase in the popularity of using environmental friendly, low cost and light weight 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 4 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, in 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. 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. While the use of fired clay bricks resulted in a savings of 19% per square meter of wall.

J**. Basic. Appl. Sci. Res., 5(1)35-44, 2015** The sand brick preparation was done at SIZ Hardware and Supplier Sdn. Bhd Dungun Terengganu Malaysia. The proportion of sand, sand dust and cement (9:9:4) were put into the mixer. Then, two buckets of water (ratio of 2) were poured and mixed up together. The plastics materials then were put into ratios and were mixed together with the raw materials. Finally, the mixture was put into the mold to form brick The study therefore recommends the use of laterite bricks in Makurdi and other locations due to its more economical and environmental friendly than fired clay bricks Plastic waste preparation .The main objective of this research work is to develop an efficient way to utilize the waste of plastic bottle which is a great threat for the sustainment of ecological balance. The plastic bottles waste was collected from Global Dynamic (M) Sdn Bhd located at Bukit Marang, Terengganu, 5
Malaysia. The rejected bottles which have defects were collected and put into crusher to form small pieces. Then, the plastics were sieved to choose the smallest size.

“Fabrication and testing of Plastic sand bricks” by S S Chauhan, Bhusan Kumar, Prem Shankar Singh, Abuzaid Khan, Hrithik Goyal, Shivank Goyal (2019). They mixed the river

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sand and the PET plastic (molten form) in the ratio of 1:2, 1:3, 1:4 for mould size of (230*100*75) mm for which they found maximum compressive strength on the ratio of 1:2 mixture for the same size of the bricks. The water absorption of these bricks was observed less than 5% that is less than conventional clay bricks i.e. 15-20%. However, they failed in maintaining fire resistance property of these bricks.

"Utilization of plastic waste in manufacturing of plastic sand bricks." By Arvind Singhal, Dr. Om Prakash Netula (2018). They used the mixture of plastic and stone dust in the molten form in the ratio of 3:7 in standard brick mould for which stone dust was sieved through 4.75 mm using sieve analysis and conducted test on water absorption to be found as 0%. Compressive strength of plastic sand bricks is 5.6 N/mm2 at the compressive load of 96 KN.

"Plastic in Brick Application." By Siti Nabilah Amir & Nur Zulaikha Yusof (2018). The studies showed the possibility of using plastic as binder with the aid of catalyst through depolymerisation of PET to replace cement. It was observed that a significant decrease in compressive strength is observed for more than 50% replacement of binder with PET waste. With increased amount of PET, the softening point of the bricks produced was also increased. They used the different size of moulds like (150*150*150) mm, (200*100*100) mm etc.

"Study of plastic dust brick made from waste plastic" by Ronak Shah, Himanshu Garg, Parth Gandhi, Rashmi Patil, Anand Daftardar (2017). They used plastic dust as the main component of waste product which is the by – product of many industrial products such as PVC pipes and they have heated plastic dust at 220℃. The final product from plastic dust was tested for the compressive strength and it was observed as 6.66 N/mm2 which is higher than conventional bricks (3-5 N/mm^2).

3. PROPERTIES OF MATERIALS

- **Cement**
- **Sand**
- **Course Aggregate**
- **Water**
- **Plastic Bottles**

3.1 CEMENT

Cement is a binding material used in the preparation of concrete. It bends the coarse aggregates and fine aggregates with the help of water, to a monolithic mater and also it fills the voids in the concrete.

There are two requirements for any cement in the concrete mix design. That is compressive strength development with time attainment of appropriate rheological characteristics, type and production of cement.

3.2 SAND

The most prolific user of sand is the construction industry where it is almost vital for almost every aspect of a building project. Sand is used in everything from cement and concrete to plastering, roofing, grouting and paint. It's even used to help defend buildings from flooding when its in sandbags.

3.3COARSE AGGREGATE

Aggregate are the important constituents in concrete. They give body to the concrete, reduces shrinkage and effect economy. Earlier, aggregates were consider as chemically insert material but now it has has been recognised that some of aggregates are chemically activate and also that certain aggregate exhibit chemical bon at the interface of aggregate and paste. The more aggregates occupying 70-80 % of concrete: their impact on various characteristics and properties of concrete is undoubtedly considerable.

3.4 WATER

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Water is an important ingredient of concrete as it actively participate in the chemical reaction with cement. The strength of cement concrete mainly from binding action of the hydration of cement get the requirement of water should be reduced that required chemical reaction of un-hydrated cement as the excess water would end up in only formation undesirable voids or capillaries in the hardened cement past in concrete.

3.5 PLASTIC BOTTLES

In its raw state, plastic is made up of a range of organic polymers, including polyethylene and ethylene. “The different raw materials of plastic bottles include polyethylene terephthalate and high-density polyethylene

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, M-sand respectively.

4 TYPES OF TESTS

Waste PET bottles were collected and construction demolition wastes were crushed them up to the most possible fineness. These wastes were filled into the PET bottles. It is compacted well without any voids by tamping each layer with 25 blows and the Eco-Bricks.

➢ Compressive test
➢ water absorption test
➢ Efflorescence test
➢ soundness test

4.1 COMPRESSIVE TEST

Compression tests are performed to characterize the behavior of a material under compressive loading. During the test, pressure is applied to a specimen using compression platens or special tools mounted on a universal testing machine to determine various properties of the material being tested.

(1) Compacted
(2) Without Compact

Pet bottles Compressive strength test for each bottle was determined on universal testing machine and the average value was considered for analysis. Weight of empty PET bottles and completely filled ET bottles were noted and amount of soil used was calculated for the same. Similarly, compressive strength of brick was calculated by taking the average value and the results were compared and analysis .

Calculation of compressive strength of specimen

The compressive strength was calculated by the following formula.

Compressive strength =,

Where,

P = maximum applied load in N,

A = Cross sectional area in mm.

TABLE 4.1 RESULTS OF COMPRSSIVE STRENGTH TEST FOR CUBICAL SPECIMENS

TABLE 4.2

Plastic Sand Brick (1:2Ratio)	Maximum Load (KN)	Compressive Strength (kg/cm2)
Specimen 1	500	193.87
Specimen 2	525	203.56
Specimen 3	490	189.99

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Compressive strength for 1:3 plastic to sand ratio, Plastic Sand Brick

Plastic Sand Brick (1:3Ratio)	Maximum Load (KN)	Compressive Strength (kg/cm2)
Specimen 1	350	135.71
Specimen 2	320	124.07
Specimen 3	335	129.89

TABLE 4.3 For 1:3 ratios plastic to sand bricks, the water absorption

1:3 Ratio Brick	W1(kg)	W2(kg)
Specimen 1	2.532	2.601
Specimen 2	2.498	2.564
Specimen 3	2.594	2.678

5. RESULT AND DISCUSSION

The proposed project presented above intends to resolve in reducing the plastic waste disposal problem as it utilizes the waste even in its finest form and converts that useless material into a useful construction material. Extruder machine plays a prominent role in the conversion of waste plastic into its melted form. Also, extruder does not possess any threats to the environment and hence can be used without any restriction. It also helps in reducing the usage of natural resources which are utilized during the manufacturing of burnt bricks, also it reduces the pollution which is generated from kiln during brick manufacturing.

6.CONCLUSION

The final end product can be used as brick, which is having a higher strength than conventional brick. Also, the water absorption capacity is higher in comparison to conventional brick with a lower weight. Its uses are not restricted as only brick; it can even be utilized as a building block by increasing the dimension of the mould. Also, it reduces the use of wire used for fencing. Floor tiles, sleepers, etc. can also be produced from it. This brick also turns out to be economical than conventional brick, by reducing the cost of incinerators for burning purpose and landfills.

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