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Recycling of Plastic Waste into Construction Material

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ABSTRACT: Our project deals with recycling of plastic waste into construction material. The generation of plastic waste's in growing countries also increases in a faster rate. In India 15,000 tonnes/day is generated. According to EPA(Environmental Protection Agency) only 13.3% plastic is recycled. Now-days the recovery of PET soft bottles has been increased by 37%. There has been a considerable imbalance in availability of construction cost and demand in the recent days. And on the other hand availability of laterite soil waste in india is high and the disposal of plastic waste is also a biggest challenge. As repeated recycling of PET is harmful we use PET/PP waste's. In this work we have made an attempt of manufacturing of Bricks, Inter-locking Bricks, Paver block by plastic waste in the range of 60 to 80% by the weight of the laterite soil waste. And at the final stage a bitumen of 70/80 grade of varying percentage (0,1,2,3,4,5%) is used by the weight of soil waste in the molten form. The manufactured bricks posses the properties of high compression strength, negligible water absorption, with neat and even finishing as compared with conventional building material in-order to satisfy the demand of construction material. This is an Eco-friendly project which uses plastic waste into a useful construction material . Reduces pollution and economical.

KEYWORDS: PET, Laterite waste, Bitumen(70/80), Construction material(Bricks, Inter-locking bricks,paver block).

I. INTRODUCTION

In this modern world, Construction technology and architecture has been improved. The construction of buildings is difficult now-days due to lack of raw materials and increase in cost of construction material. Brick is commonly known as rectangular block used as a building material to make walls, pavements . It is referred to as a unit composed of clay. A manufacturing of conventional bricks consists of various process they are made into the mould of desired shape and size. Then it is made dried and then it is made to burn in kiln for about 7 days. Then it is transported and used for construction.

Municipal solid waste (MSW) consists of various types of waste's like agricultural, animal by products, biodegradable, medical, chemical and industrial wastes. Waste management in India is requires various activities and actions from its inspection to its final stage of disposal. This also includes collection, transportation, treatment and disposal of waste together with monitoring and regulation.

As there is large volume of laterite soil waste is available and also there is rapid increasing in plastic waste in MSW (Municipal Solid Waste). we have made an attempt of manufacturing bricks by recycling plastic. As plastic is a non- biodegradable material and it is also a global issue. As researchers said plastic remains about 4500 year on the earth without degradation. Salvaging is done and then the plastics wastes are cleaned and crushed for manufacturing.

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II. LITERATURE SURVEY

Asokan Pappu, Mohini Saxena, et al, (2007) concluded that Presently in India , about 960 million tones of solid waste is being generated annually as by-products during industrial, mining, municipal, agricultural and other processes. Of this ~350 million tones are organic waste from agricultural sources; ~ 290 million tones are inorganic waste of industrial and mining sectors and ~4.5 million tones are hazardous in nature. Advance in solid waste management resulted in alternative construction materials as a substitute to traditional material like bricks, blocks, tiles, aggregates, ceramics, cement, lime, soil, timber and paint. To safeguard the environment, efforts are being made for recycling different waste and utilize them in value added applications. In this paper, present status on generation and utilization of both non-hazardous and hazardous solid in India, their recycling potentials and environmental implication are reported and discussed in details.

Yurilee, June thet soe, Siqian zhang, EtAl, (2011) Concluded that Large quantities of fly ash are discharged as a by-product from coal power plants, therefore, an effective methods to recycle this waste material is necessary, in this regard, the high silica content of fly ash makes it a potential useful source for the synthesis of nanoporous materials, such as zeolites, mesoporous silica or silica aerogels, in this mini review, zeolite synthesis from fly ash was examined by considering the ash composition and synthesis temperature to identify an optimal set of synthesis conditions, these zeolites can be used as adsorbents and ion exchangers for environmentally hazardous materials including those present in the fly ash itself. The synthesis of mesoporous silica materials with a high surface area and large pore volume derived from fly ash was next assessed for their use as a support and as a surface-functionality host for capturing the global warming CO₂ and rare earth adiabatic foams, which are being considered as a potential building insulation materials, was briefly examined, cases of synthesizing these nanoporous materials using other solid wastes as silica and alumina sources were also examined. The synthesis of diverse porous materials Utilizing the waste sources would enable a high level of recycling for a sustainable society with a low environmental burden. Physicochemical pre-treatment of fly ash for nanoporous materials synthesis. Synthesis of nanoporous materials using solid wastes as silica and alumina sources Application of the synthesized nanoporous materials via fly ash recycling for sustainability.

Jaime solis-guzman, Carlous levia, Alejandro Martinez-rocamora et al, (2015) Concluded that Construction activity generates a large amount of waste, causing environmental and economic impacts due to waste elimination without recycling or reusing these materials, in this research, the incorporation of waste from different sectors (biomass power plants, construction and demolition process) in concrete with good fire resistance is studied. The chemical composition and grading curve of these wastes are determined fire resistance blocks are manufactured with a high percentage of waste in their composition. The new material are then subjected to several tests in order to analysis their fire resistance, mechanical properties, thermal conductivity, leaching, and radioactivity. A new faced solution is developed by changing traditional materials for some of new recycled material, and their technical features are compared. All four wastes studied decreased the density and mechanical strength of a 28 days-old blocks, and a higher water ratio is needed for block preparation. On the other hand, the blocks fire resistance are increased, decreasing their thermal conductivity, the properties of the new materials validate their possible usage for nonstructural applications such as blocks or prefabricated concrete panel for facades and inside partitioning, showing good environment. mechanical and thermal performance. Their use does not represent a significant risk to the environment.

III. PROPOSED METHODOLOGY AND DISCUSSION

The main objective of the project is to effectively use the plastic waste material that are widely available in the MSW. Since it is easily available and also at a larger quantity. It is helpful to recycle the plastic waste into a construction material. In our project PET/PP wastes are used they are recovered from the MSW and their are crushed in a smaller grain size of less than 10mm. The plastic waste is crushed, cleaned and dried. Then the plastic of required amount is calculated. We have used 60 to 80% of plastic by its laterite soil weight. We use 6kg of soil for 3 bricks. Here the plastic of required quantity is heated and melted in the molten form at a temperature of 250°C . Then a

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laterite soil waste is added at regular interval and proper mixing is done. At the final stage the bitumen of varying percentage (0,1,2,3,4,5 %) is added and mixed. Then the hot molten mix poured into the mould and then the surface is leveled for smooth finishing. Then the mould is de-moulded after 20 minutes. Then it is left for curing. here the curing is in the way of air curing and compaction is of self-compaction.

The material used for the plastic bricks and Inter-locking bricks are plastic waste and laterite soil waste. And the size of mould used for plastic and Inter- locking bricks are 20 x 10 x 6 cm. The material that is used for paver block is plastic waste and river sand. And the size of Paver block mould is 20 x 10 x 4 cm. The increase in plastic percentage results in increase in compression strength. For effective results use 70% plastic waste. The every material that are used in the work is tested as per the standard specifications. The manufactured inter-locking brick is considered to be a mortar-less brick. They are also called as LECO BRICKS or Reinforced bricks. The reinforcement is provided between the holes in the bricks and at the final level they are filled with concrete or mortar. Thus it reduces the workmanship, time required for construction and cost of construction. Here the manufactured product is considered to be economical when compared to conventional materials.



(a) Laterite soil waste.



(b) crushed plastic(<10mm).



(c) heating and melting Process.



(d) casting & finishing.



(e) Mould used.



(f) output (Brick, Inter-locking brick & paver block).

IV. EXPERIMENTAL RESULTS

A. Preliminary tests

Test on materials that are used in this work is done in-order to meet the IS Code requirements for manufacturing of bricks.

(1) Sieve analysis test

The test is conducted for laterite soil waste and the curve is obtained in the graph. As shown in fig1.1.

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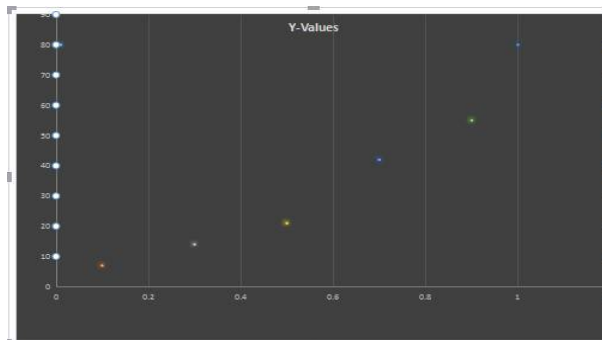


Fig A-1.1 graph for sieve analysis.

(2) Test on bitumen

There are various tests done on bitumen and material properties are obtained. The bitumen is considered as a good binding agent and also helps in transformation of thermo-plastic into thermo-setting plastic. The following tests are conducted:

S.No	Experiment	Result
1.	Penetration	72.5 (mm)
2.	Ductility	55 (cm)
3.	Softening point	58 (°C)

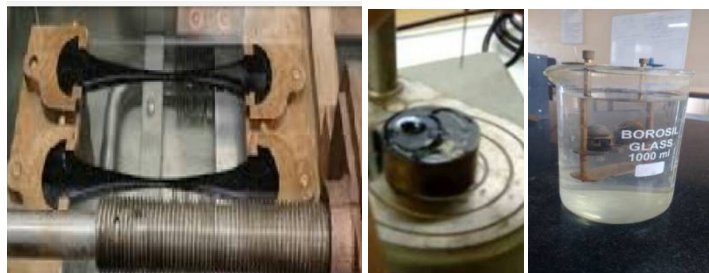


Fig A- 2.1 Testing on bitumen (Ductility, penetration & softening point).

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B. Compressive strength test

Compressive strength test on the plastic brick, interlocking brick and paver block provides the characteristics of the specimen.

S.No	Variation of bitumen(%)	Plastic (%)	Result for bricks (N/mm ²)	Result for inter-locking bricks (N/mm ²)	Result for Paver block (N/mm ²)
1.	0	70	5.0	4.5	7.0
2.	1	70	7.5	6.0	8.5
3.	2	70	8.0	7.5	9.8
4.	3	70	10.0	8.2	10.5
5.	4	70	12.0	10	12.5
6.	5	70	12.8	10.5	15.0



Fig B-1.1 compression strength test on plastic bricks, interlocking bricks & paver block.



Fig B-1.2 compression strength test on conventional bricks

The increase in percentage of plastic increases the compressive strength of the specimen. Thus for the effective result use 70% of plastic. For the strength comparison we have also tested the conventional brick with our plastic brick.

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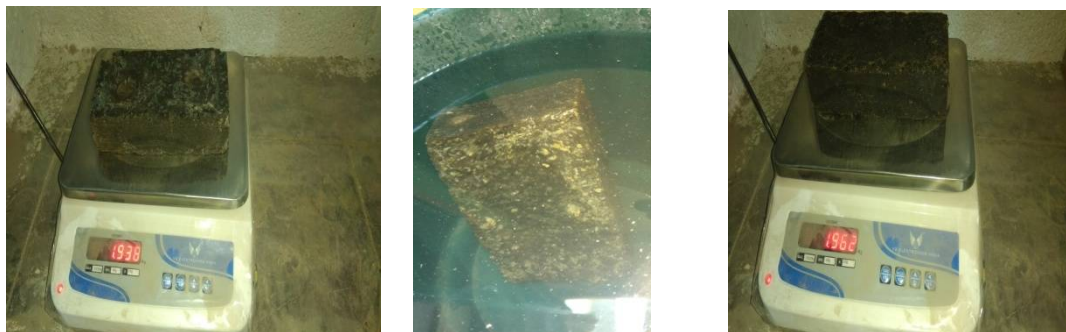
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C. Water absorption test

Water absorption is done for the plastic brick, inter-locking brick and paver block and results are obtained. In water absorption test the weight of the dry brick is measured as W1. Then the brick is immersed in water for about 24 hours. After 24 hours the brick is made dried for sometime then weighted and measured as W2. The difference in value multiply by 100 gives the percentage of water absorbed.

S.No	Sample	% water absorbed for plastic brick	% water absorbed for Interlocking brick	% water absorbed for Paver block.
1.	Sample 1	1.2	1.2	1.0
2.	Sample 2	2.0	2.2	2.0



(a) weight (W1)

(b) immersed in Water for 24hours

(c)weight (W2)

Fig C-1.1 water absorption test

There is only less water absorption of 1.0 to 2.0 % which is very much less compared to conventional brick. Where the normal brick has a water absorption of 14%.

V. CONCLUSION

We finally conclude that the plastic brick have more compressive strength, less Water absorption than normal brick. And the Inter-locking bricks which are mortar-less and use to build earthquake resistant structure. With high compressive strength, less water absorption. The paver block also have good compressive strength of and less water absorption compared to normal blocks. The cost of machine for manufacturing paver block is eliminated. These construction material is found to have better characteristic and economical than normal bricks. Thus also reduces the production time and workmanship.

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