

Application of Binding-Bonding technique for Plastic Solid Waste Management

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ABSTRACT

Plastic solid waste management is amongst the most menacing issue covered across the globe. Plastic is the material with multiple usages, replacement of plastic is a solution to reduce plastic based pollution but this is not possible in order to gather the needs of humans. Natural resources are depleting worldwide at the same time the generated wastes are expanding substantially. The usage of plastic when looking to its degradation rate has calamitous difference, at present the conversion of plastic into cement can provide an upgrade to environment as well as economic benefits. In this present study the Plastic waste management was done at educational institution in order to manage the huge amount of plastic waste generated everyday by the affiliates. Utilization of plastic waste in preparation of paved blocks originated from the known mechanisms for production of bricks and fly ash blocks. Plastic serves as a bonding agent when heated. Soil serves as binding agent when mixed with melted plastic. Properties of sandy soil shows that after heating it changes the colour, becomes non-sticky, has no effect of weather, compressive strength increases and surface becomes hard. The method used in this study for preparation of blocks from plastic was hypothesized form the technique of production of bricks in which soil is mixed with bonding clay. Sandy soil and clay mixture serves good quality by providing less shrinkage. The aim of this study is to manage plastic waste from depleting the environment.

Keywords: Plastic Solid Waste Management, Binding-Bonding technique, Paver blocks, Environment protection, Economic benefits

I. INTRODUCTION

Naturally existing essential resources are depleting worldwide at the same time the generated wastes are expanding substantially. The course of action adapted by humans for survival has lead to an exploitation of all the natural resources to an extreme level. Plastic waste can be categorized under that acts of humans

that are leading towards tremendous level of pollution and harming almost all living forms. The time taken for, the degradation of the exceeding requirements of plastic in our day to day as given in Fig.1 will clearly sensitize the major issues the world is dealing with i.e. Plastic Waste Management and over usage of plastics in daily living indispensables.



Fig 1:- Time required for natural degradation of plastic products that are used in our daily life

Plastics are imperishable or few are degradable but in a very slow rate. Day by day, the global demand of these polymers is speedily increasing; but, considering their abundance and potentiality in causing different environmental hazards, there is a great concern in the possible methods for degradation of plastics in order to protect the nature and prevent major health related diseases (Smriti et al., 2016).

Paver block paving is versatile, aesthetically attractive, functional, and cost effective and requires little or no maintenance if correctly manufactured and lain. The tenable development of construction involves the use of Non-conventional and innovative materials, and recycling of waste materials in order to compensate the lack of natural resources and to find alternative ways conserving the environment. Plastic wastes used in this study were collected from various sample collecting sites at the C.G.Bhakta Institute of Biotechnology. Currently about 56 lakh tones of plastic waste is dumped in India in a year. The dumped waste pollutants are surrounding the environment; as a result it affects both human beings and animals in direct and indirect ways. Hence it is necessary to dump plastic properly as per the regulations provided by our government. The usage of plastic when looking to its degradation rate has calamitous difference, at present the conversion of plastic into cement can provide an upgrade to environment as well as economic benefits (Shanmugavalli et al., 2017). In this present study the Plastic waste management was done at educational institution in order to manage the huge amount of plastic waste generated everyday by the affiliates.

(HDPE)	etc.
Polyethylene Terephthalate (PET)	Drinking water bottles etc.
Polypropylene (PP)	Biscuit packets etc.
Polystyrene (PS)	Food trays, bottle caps etc.

Table-1: Waste types and Source

II. METHODS AND MATERIAL

Utilization of Plastic waste:

Plastics can be made to different shapes when they are heated.

In first step we collected waste plastics from different sample collection sites. The plastics were cleaned with water by washing and were dried to remove water present in it, after this the plastics were weighed and burned out by using bricks, cardboards and firewood. The bricks were arranged to hold the drum and the firewood and cardboards were placed in the gap between the stones and it was ignited. The container was placed over the setup and was heated to remove the moisture content in it. Then the plastic wastes were added to the container one by one and the sand was added to the plastic when it turns into hot liquid.

The sand was added and mixed thoroughly using rod before it hardens. The mixture has a very short setting time hence mixing should not consume more time on the other hand the process should be complete.

This mixture was then poured in to the brick mould and they were compacted using wooden piece and surface was finished using trowel. Before placing the mixture into the mould, the sides of the mould were

<i>Types of plastic waste found in institutional survey</i>	<i>Source</i>
Low-Density Polyethylene (LDPE)	Carry bags, plastic wrappers etc.
High Density Polyethylene	Carry bags, bottle caps

oiled to easy removal of blocks (Shanmugavalli et al., 2016).

<p>Binding Agent</p> <p>Sandy soil was used as binding agent as it offers efficiency to bind with melted plastic and convert in to cement</p>	<p>Bonding Agent</p> <p>Melted plastic was used to bond with sandy soil as it offers efficiency to bond with sandy soil and convert it into cement</p>
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Binding-Bonding combination to produce cement



Fig 2:- a) Collection of plastic waste from institutional dustbins, b)Washing and Drying of plastics, c)Storage of plastic waste (PET plastic bottles)

III. SAMPLE PROCESSING STEPS



Fig 3:- 1) Weighed plastic, 2) Heating set-up, 3)Addition of plastics into the heated set-up, 4)Casting, 5)Drying and Molding, 6)Block

Steps for preparation of blocks from Polyethylene terephthalate (PET) and Low-density polyethylene (LDPE) plastics

The plastic waste was collected while segregating the waste from different sample collection sites. In order

to clean the bottles and wrappers to remove any leftover food content. The bottles were washed in tap water, dried and stored follows in Fig 2.

PREPARATION OF BLOCKS FROM PET PLASTIC WASTE

Plastic wastes were heated in a metal bucket at a temperature of above 150o for burning stones, cardboards and firewood were used. As a result of heating the plastic waste melts. When the plastic waste was converted to hot liquid the sand was added and mixed thoroughly using rod and trowel before it hardens. These mixtures of sand and plastic wastes was then poured in to the brick mould and they were compacted using wooden piece and surface was finished using trowel. Steps for preparation of blocks follows in Fig 3. A block weighing 4.800 kg was prepared from 5 kg of plastic waste and 1.5 kg of sand as our first trial.

WATER ABSORPTION TEST

In this the block was first weighed in dry condition and then was immersed in water for 24 hours. After that the block was taken out from water and then was wiped out with cloth. Then the difference between the dry and wet block percentage was calculated. The dry weight was found to be 4,800 kg and the wet weight was found to be 5,920 kg. The water absorption was interpreted with 1.120.

HARDNESS TEST

In this test a scratch was made block surface with steel rod which was difficult and that implied the block as hard. This showed the block possess high quality.

Table-2: Results obtained from different ratios of binding and bonding agents

SAMPLE	BINDING-BONDING AGENT RATIO	RESULTS
A	5 kg plastic waste (melted plastic-binding agent) 1.5 kg sandy soil (Bonding agent) $5+1.5=6.5$ kg $x=5$ kg $y=1.5$ kg total= 6.5 kg Proportion of $x=5/6.5=76.076\%$ Proportion of $y=1.5/6.5=23.076\%$	4,800 kg block Initial Setting time: 40 minutes Final Setting time:360 minutes
B	5 kg plastic waste (melted plastic-binding agent) 1 kg sandy soil (Bonding agent) $5+1=6$ kg $x=5$ kg $y=1$ kg total= 6 kg Proportion of $x=5/6=83.33\%$ Proportion of $y=1/6=16.67\%$	4,500 kg block Initial Setting time: 20 minutes Final Setting time:160 minutes
C	6.5 kg plastic waste (melted plastic-binding agent) 1 kg sandy soil (Bonding agent) $6.5+1=7.5$ kg $x=6.5$ kg $y=1$ kg total= 7.5 kg Proportion of $x=6.5/7.5=86.66\%$ Proportion of $y=1/7.5=13.33\%$	5,100 kg block Initial Setting time:60 minutes Final Setting time:400 minutes
D	5 kg plastic waste (melted plastic-binding agent) 2 kg sandy soil (Bonding agent) $5+2=7$ kg $x=5$ kg $y=2$ kg total= 7 kg Proportion of $x=5/7=71.42\%$ Proportion of $y=2/7=28.58\%$	5,000 kg block Initial Setting time: 80 minutes Final Setting time:400 minutes

IV. DISCUSSION

Utilization of plastic waste in preparing of paved blocks originated from the known mechanisms for production of bricks and fly ash blocks. Plastic serves as a bonding agent when heated. Soil serves as binding agent when mixed with melted plastic. Properties of sandy soil shows that after heating it changes the colour, becomes non-sticky, has no effect of weather, compressive strength increases and surface becomes hard. The method used in this study

for preparation of blocks from plastic was hypothesized form the technique of production of

bricks in which soil is mixed with bonding clay. Sandy soil and clay mixture serves good quality by providing less shrinkage.

The block we prepared in this study was tested for water resistance with good quality. Hardness test was performed in which scratch was made on the surface of block with steel rod which was difficult to imply. This shows the block possess high quality. We prepared a 4,800 kg block form 5 kg plastic waste both PET and Low density combined with 1.5 kg soil

likewise 4 trials were performed, but still more trials will be required to be done to have an exact data about strength of the plastic paver block. This process of plastic burning was performed with all essential health cares and in the night duration which deducts the amount of hazardous smoke. This method with closed system is under trials in order to prevent the pollution from smoke that comes followed by burning of plastic.

V. REFERENCES

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