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STUDY OF UTILIZING WASTE PLASTIC IN PAVEMENT BLOCKS

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Abstract: India is suffering from huge solid waste management problem in this rapidly developing era and the major portion of this solid waste comprise of polyethylene, especially HDPE (High Density Polyethylene). Plastic waste has become one of the major environmental problems, so by utilizing plastic in a useful way we can reduce the burden on environment by a huge margin. In this study, an attempt has been made by replacing the cement used in the fly ash blocks by high density plastic as the binding material. By using plastic as a binding material rather than concrete, it can be shown to benefit the environment in several ways. Hence, in this study HDPE waste is used for making fly ash block using molten plastic (instead of cement). The primary goal of this research work is to develop an efficient way to use the waste plastic successfully to sustain the environment and to lessen the plastic waste which is expanding day by day. In this experiment, efforts have been made to concentrate on the performance of fly ash blocks with addition of plastic. These plastic fly ash blocks for pavements are needed to be manufactured with large area, plastic moulding machineries, solid waste management plant, abundance of fly ash and this is easily available for making of these blocks. Compression test done successfully, the results are also comparatively good. The plastic used in this experiment is HDPE which is highly durable and also has good strength. The main aim of this project is to utilize those plastics and fly ash in the manufacturing of pavement blocks. Proportioning of plastic and fly ash is 100:0, 90:10, 85:15, 80:20, 75:25 respectively for making pavement blocks.

Introduction

In this study, plastic waste which is from garbage will be used to combine with fly ash to produce plastic fly ash blocks for pavements. The block will be then tested to know the compressive strength, efflorescence, drop test and water absorption. In the recent researches, the replacement and adding of different construction materials with plastic have been prepared with the direct addition of polyethylene, polyethylene terephthalate (PET) in shredded or melted form. Most of the replacements have been done by volume and weight calculation. The replacement of plastic waste in this project has been done by weight. Various attempts are made to place various waste resources in the production of plastic fly ash blocks like glass, cotton waste, plastic waste, fly ash, demolition waste, bagasse, sawdust, wood waste, block debris, quarry dust, etc. This project shows the effect of materials on the block properties like physical and the mechanical properties. For the pavement blocks as the construction material, many researches are made for the possible wastes which can be recycled as construction material in the manufacturing process of pavement blocks.

Types of waste

There are various types of solid waste and are described in procedure:

Organic Wastes, Inorganic Wastes, Bio medical wastes, E-Wastes, Construction & Demolition Wastes, Industrial hazardous wastes, Household wastes.

1.2 CURRENT METHODS OF DISPOSAL OF PLASTIC

Incineration, Recycling, Sanitary Landfill, Disposal in ocean and sea

1.3 MATERIAL WHICH ARE USED FOR MAKING BLOCKS

Waste Plastic,
Fly Ash

1.4 MATERIAL DESCRIPTION

1.4.1 HDPE (HIGH DENSITY POLYETHYLENE)

High density polyethylene, often abbreviated as hdpe, is a polymer whose monomer is ethylene. it is a thermoplastic having high strength to density ratio. hdpe is a very capable plastic that has extensive range of applications. when compared to other plastics, the melting point of high density polyethylene is comparatively high. hdpe is usually recycled for numerous purposes. hdpe is a type of polyethylene which is the most common plastic which covers for over 34% of the global plastic market. it is a polymer made up of a huge number of repeating units of monomers, and its chemical formula is generalized as (c2h4)n.

1.4.2 FLY ASH

Fly ash is the heterogeneous by-product of solid produced in the burning process of coal used in power stations. It is a fine grey colored powder having round glassy particles. As fly ash contains pozzolanic materials which react with the lime to form cementatious materials. Therefore Fly ash is used in concrete, mines, landfills and dams.

I. RESEARCH METHODOLOGY

2.1 COLLECTION OF WASTE PLASTIC

The plastic is collected from garbage. This includes cement bags, food grain bags, etc. They actually are HDPE type of plastic (High Density Poly Ethylene). This plastic has high strength and also durable so are considered good for making blocks.

2.2 PROCESS OF SHREDDING OF WASTE PLASTIC

Plastic is shredded in small pieces about 10-20mm small and are then forwarded for proportioning.

2.3 MIX PROPORTIONING OF PLASTIC AND FLY ASH (BY WEIGHT)

a. 100:0 (Plastic and Fly ash)
b. 90:10 (Plastic and Fly ash)
c. 85:15 (Plastic and Fly ash)
d. 80:20 (Plastic and Fly ash)
e. 75:25 (Plastic and Fly ash)

2.4 MELTING OF PLASTIC

The plastic generally melts at 110 degree celcius and its ignition point is 349 degree celcius.
Care to be taken that the temperature to be maintained between these points. It takes about 15-20 minutes to transform from solid to liquid phase.

2.5 MOULDING OF PLASTIC FLY ASH BLOCKS

Hexagonal moulds of 40mm of each six sides and height of 40mm is made. Then the melted plastic is then added in these moulds. External pressure is then added on the upper and lower side to give the blocks a proper shape. This specimen is kept in moulds for 2 minutes.

2.6 COOLING IN WATER AND DRYING OF BLOCKS

After the plastic being in moulds it is then directly put into water to cool. It is kept in water for 5-10 minutes. After that the block is removed from moulds and then it is dried for 3-4 hours in sun.

2.7 TESTING OF BLOCKS

These blocks are then taken for the following test:
a. Water absorption test
b. Efflorescence test
c. Compression test
d. Drop test

2.8 ANALYSIS OF RESULT

These blocks are then analyzed and compared to conventional concrete blocks and are hence forth considered according to the uses.

III. RESULTS AND DISCUSSIONS

Table no. 1. compressive strength of pavement blocks

Sr. no	Specimen	Load (kN)	Area (mm.sq)	Compressive strength of blocks (Mpa)
1	100% plastic, 0% fly ash	120 kN	4156.92 mm.sq	28.86 Mpa
2	90% plastic, 10% fly ash	123 kN	4156.92 mm.sq	29.58 Mpa
3	85% plastic, 15% fly ash	125 kN	4156.92 mm.sq	30.07 Mpa
4	80% plastic, 20% fly ash	123 kN	4156.92 mm.sq	29.58 Mpa
5	75% plastic, 25% fly ash	118 kN	4156.92 mm.sq	28.38 Mpa

Table no. 2. Water absorption test of pavement blocks

Sr. no	Specimen	W1 (gm)	W2 (gm)	Percentage of water absorbed
1	100% plastic, 0% fly ash	125 gm	125 gm	0%
2	90% plastic, 10% fly ash	127 gm	128 gm	0.78%
3	85% plastic, 15% fly ash	128 gm	129 gm	0.78%
4	80% plastic, 20% fly ash	129 gm	131 gm	1.55%
5	75% plastic, 25% fly ash	129 gm	132 gm	2.32%

1. From the above observation it is possible to use plastic in pavement, and it is having the bonding property with fly ash.
2. The plastic showed good properties of durability and strength and can be used as pavement blocks.
3. The fly ash also played a major role for increasing the strength of blocks.
4. As the fly ash was increased the water absorption of the block also increased.
5. When the plastic percentage was more water absorption was low also there was no efflorescence on the block.
6. The softening point also increased with increase in fly ash and also these blocks are light weight so they are easy to manufacture.
7. As the strength of the blocks increased with increase in fly ash, the strength of block increased only to a certain extent i.e. at 85% plastic and 15% fly ash and it gave a compressive strength of 30.07 Mpa.

IV. CONCLUSION

On the basis of result obtained during the experimental investigation, following conclusion was drawn:
1. Plastic when used in pavement blocks helps in protecting the environment and also reduce solid waste disposal.
2. The utilization of waste plastic in production of plastic blocks has productive way of disposal of plastic waste
3. Plastic blocks made using plastic waste, fly ash have shown better result.

4. Plastic blocks have lower water absorption, bulk density, and apparent porosity when compared with those of normal clay blocks.
5. By using the plastic the weight of the plastic blocks has reduced as compared to the conventional blocks.
6. Waste plastic which is available everywhere may be put to an efficient use in block making.
7. Plastic blocks can help reduce the environmental pollution thereby making the environment clean and healthy.
8. The increased rate of waste generation in Pune is an indicator of increasing economy level of the people.
9. There is requirement to establish more waste collection centers for enhancing the recycling efficiency.
10. Sort your waste material to help for recycling and segregation process, use separate dustbin which PMC provides.

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