Eco-friendly Brick by utilizing High Density Polyethylene Waste

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Abstract: The High Density Polyethylene Waste HDPE plastic (HDPE) waste is the substance or material or by-product discarded after primary use or it is worthless. Example for HDPE wastes like pipes, milk bottles, detergent bottles, bleach bottles shampoo bottles etc… Few common type of plastics which are being used to serve daily needs of consumer are Polyethylene Terephthalate (PET), Polyvinyl chloride (PVC), polypropylene (PP), Polystyrene (PS), High Density Polyethylene (HDPE) and Low Density Polyethylene (LDPE) etc. Some of these wastes are difficult to disposal and leads to land pollution. Among these wastes HDPE & LDPE requires high volume space & land for disposal. This paper deals with manufacture of plastic brick to produce an eco-friendly construction material without any natural resources.

Key Words: *Polyethylene, Polyvinyl chloride, polypropylene, Polystyrene, construction material*

I. INTRODUCTION

The probable solution is effective recycling in addition to use in pavement structure so as to come up with an ultimate safe disposal together with improvement in the performance of pavement through better mix design. An aggregate material from waste plastic bags referred to as Recycled Plastic Waste Aggregate (RPWA) is developed which would partially replace the conventional material to improve desired mechanical characteristics for a particular road mix. Preliminary investigations have indicated that use of RPWA (1.2 – 3mm in size) in the surface and base mix design, when utilized up to 2.5% by weight substitution has shown improved stability and flow (Marshall test) having unit weight and bulk specific gravity falling within the acceptable limits for light and heavy traffic loads. It is envisaged that use of RPWA in the conventional asphalt hot mix design is likely to improve the pavement performance with a sustainable solution for the disposal of plastic waste (Nonthaphong Phonphuak et al., 2016, Romualdo et al., 2005 and Syed et al., 2016). The physical and chemical properties of the waste material were studied. The test results revealed that as the content of the waste increased the water to cement ratio for the mix also increased, since the waste has a high degree of water absorption (Badr El-Din Ezzat Hegazy et al., 2012, Miqueleiz et al., 2013 and Mucahit Sutcu et al., 2015.

II. MATERIALS AND METHOD

The HDPE plastic waste is the substance or material or by-product discarded after primary use or it is worthless. Example for HDPE wastes like pipes, milk bottles, detergent bottles, bleach bottles shampoo bottles etc…

COLLECTION OF PLASTIC WASTE

The quantity of plastics consumed annually all over the world growing phenomenally. Its exceptionally user friendly characteristics, features, flexibility are the sources. HDPE polymers are members of family of inorganic polymers. Plastics collected from disposal area were sorted to get superior one. We are collected the HDPE plastic waste from disposal site and trash boxes. We collected the wastes material from Salem city corporation in dumping yard with free of cost.

CUTTING OF PLASTIC WASTE

Cutting is the action of dividing or incision of material by using sharp tools. In manufacturing of plastic bricks cutting process plays a major role. The collected materials which were in irregular shape and size.so we shredded the wastes material in same size. The HDPE plastic wastes are cut into small size of 1inch pieces.

HEATING AND MOLDING

The cleaned and dried plastic wastes are heated upto 2900 C to 350 0 C at this temperature the plastic wastes are melted. In heating process, the heater is used to melt the plastic wastes. The capacity of heater up to 3500C. Once the plastic is melted to a sticky and tacky consistency scoop it out into the brick mould with a slotted. Press the plastic into the mould, filling all edges and corners.

DE MOLDING OF PLASTIC BRICK

Plastic brick cool for few minutes and then demoulded without damaging the edges. The mould must be thoroughly cleaned after demoulded for next moulding (Figure 2.1).

Figure 2.1 Demoulded Brick

III. TESTS ON PLASTIC BRICKS

WATER ABSORPTION TEST

The increase in mass from dry condition to a soaked condition is called water absorption. The percentage of water is absorbed in the sample is determined by the test is called water absorption test. Water absorption of brick is observed in figure 3.1. The specimen is cooled to room temperature and obtain its weight (M1) specimen too warm to touch shall not be used for this purpose. Immerse completely dried specimen in clean water at a temperature of 27+2°C for 24 hours. Removed the specimen and wipe out any traces of water with damp cloth and weigh the specimen after it has been removed from water (M2).

$$W = \frac{M_2 - M_1}{M_1} X\ 100$$

$$= \frac{2.0-2.0 * 100}{2.0}$$

$$= 0\%$$

Figure 3.1 Water absorption of brick

COMPRESSIVE TEST

The ultimate compressive strength of material is that value of uniaxial compressive stress reached when the brick fails. Placed the plastic brick with flat faces horizontal in the testing machine (Figure 3.2). The load is applied axially at a uniform rate of till failure occurs and note maximum load at failure (Figure 3.3). The load at failure is maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine.

$$\text{Compressive Strength (N/mm}^2\text{)} = \frac{\text{Maximum Load at failure (N)}}{\text{Surface area (mm}^2\text{)}}$$

$$= \frac{197000}{220*10}$$

$$= 0$$

$$= 8.9\ \text{N/mm}^2$$

Figure 3.2 Compressive testing machine

Figure 3.3 Stage of Failure

SCANNING ELECTRON MICROSCOPE (SEM)

- A scanning electron microscope (SEM) is a type of electron microscope that produces images (Figure 3.4) of a sample by scanning the surface with a focused beam electron.
- That contains information about the sample's surface topography and composition.
- It also detects and analyze surface fractures.

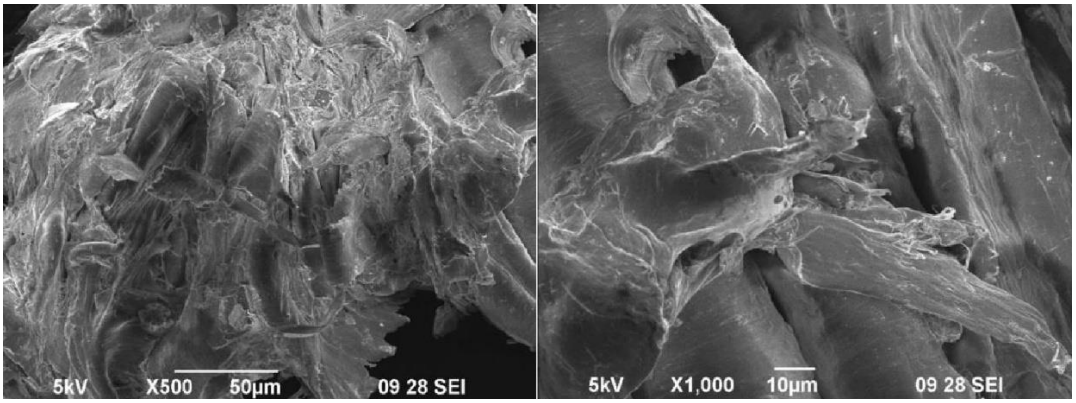

Figure 3.4 SEM analysis Photographs

ENERGY DISPERSIVE X-RAY SPECTROSCOPY

- Edax is an analytical technique used for the elemental analysis or chemical characterization of a sample.

- The peak corresponding to the elements making up the true composition of the sample analyzed (Figure 3.5).
- It helps in full control of environmental factors, emissions ect.
- Improves quality control and process optimization.

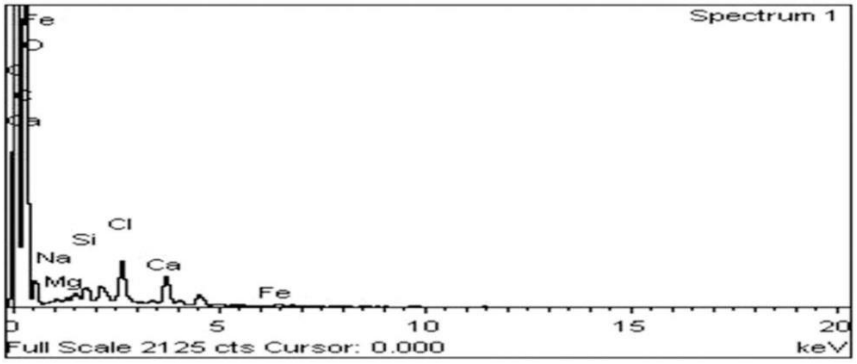

Figure 3.5 EDAX graph

IV. Results And Discussion

Plastic brick is type of brick made up of HDPE plastic wastes. These bricks are weight less and its compressive strength comparatively equal to nominal bricks.

- The density of HDPE can range from 0.93 to 0.97 g/cm3 or 970 kg/m3.
- It can withstand higher temperature (1200 C for short periods & 650 C continuously).
- Strength is differing from density ratio.
- Tensile Strength is 0.20 to 0.40 N/mm$^{2.}$
- Compressive Strength is 8.5 to 9.0 N/mm^2
- Melting point of HDPE is 1260 C.
- Flexible, translucent & chemical resistance.
- Water absorption is nil.

Table 1 COMPARISON OF CLAY BRICK AND PLASTIC BRICK

S.No.	Description	Clay brick	Plastic brick
1	Factory Location	On site of raw material	Preferable site near waste disposal area.
2	Raw material availability	Varies daily	Consistent
3	Raw material need for 1000 bricks	4.5 Tons clay	1.5 to 2 Tons of waste
4	Mixing dry material	Required	None
5	Drying in green units	7 Days	4 Hours
6	Temperature	1000 ^{0}C to 1300^{0}C	250 ^{0}C to 300^{0}C
7	Water absorption	10% to 20 %	NIL

V. Conclusion

- Manufacture of plastic bricks is very essential to reduce the plastic waste and waste is recycled in an effective manner.
- The proposed idea is to construct the water structure by using plastic brick will solve many problems.
- The Compressive strength of Plastic Brick is comparatively equal to the clay brick.
- It produces eco-friendly construction material without depleting any natural resources for raw material.
- There are numerous resins are available to bind the plastic bricks Comparing to clay bricks. The seepage is controlled by using plastic bricks and water absorption of plastic brick is zero percentage

VI. References

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