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Ecological Brick by Use of Waste Plastic and Sand

Prof. A. S. Moon[1], Pranay Bansod[2], Vilas Chavan[3], Akash Bopche[4], Saurabh Tayde[5], Kiran Sakhre[6]

[1] *Assistant Professor, Department of Civil Engineering, SRPCE. Nagpur*

[2,3,4,5,6] *Students, Department of Civil Engineering, SRPCE, Nagpur*

Abstract

The exponential rise in the production of plastic and the consequential surge in plastic waste have led the scientists and researchers look out for innovative and sustainable means to reuse/recycle the plastic waste in order to reduce its negative impact on environment. Construction material, converting waste plastic into fuel, household goods, fabric and clothing are some of the sectors where waste plastic is emerging as a viable option. Out of these, construction material modified with plastic waste has garnered lot of attention. Modification of construction material with plastic waste serves a dual purpose. It reduces the amount of plastic waste going to landfills or litter and secondly lessens the use of mined construction materials, thereby mitigating the negative impact of construction industry on environment. This paper summarizes the developments with regard to the use of plastic waste as a constituent of construction material. Inclusion of plastic waste as a binder, aggregate, fine aggregate, modifier or substitute of cement and sand in the manufacturing of bricks, tiles, concrete and roads has been comprehensively reviewed. Also, the influence of addition of plastic waste on strength properties, water absorption, durability, etc. has been thoroughly discussed. The research studies considered for this review have been categorized based on whether they dealt with the use of plastic waste for bricks and tiles or in concrete for road construction.

Key Words: Waste Plastic, Conventional bricks, Compression Test, water absorption Test, Efflorescence Test

1.INTRODUCTION

Brick is one of the most common masonry units used as building materials. Building materials like bricks, concrete block, tiles are popularly used in construction and these materials are expensive and find it difficult to afford easily. A large demand has been placed on building material industries especially in the last decade owing to the increasing population which causes a chronic shortage of building materials. Recycling of waste plastic in construction work as raw material alternative may contribute in the exhaustion of the natural. Plastic is a non-biodegradable waste material. Plastic waste is increasing due to increase in population, urbanization and development. Many people throw out plastic after using it. It is not decomposed easily and affect the growth of plants. So, vegetation gets affected. It is also harmful to animals when consumes it. Plastic waste is increasing due to increase in population, urbanization and development. To overcome these defects, we can use the plastic in construction sector as raw materials in different ways. The reuse of plastic waste in building constructions, industries are considered to be the most practicable applications. Plastic can be reused in various sectors like marketing, manufacturing and transportation etc.

Plastic waste along with being non-biodegradable also causes land and water pollution. Among the various types of plastics used, Polyethylene (PE) is one of the most used. It is

usually used in single use plastics such as carry bags, plastic bottles etc. One viable solution to using this plastic waste can be Plastic bricks. These bricks will eventually be able to enhance our management of plastic along with promoting sustainable development. Traditional Bricks are made by clay, which puts stress on soil and also leads to soil erosion. The use of plastic sand bricks can be beneficial and would help to reduce waste. Thus, the use of plastic bricks is a promotion to sustainable development and eco-conservation at the same time.

2. Methodology

The materials used for the fabrication of the plastic sand bricks are the PET bottles and river bed sand. For this plastic PET bottles are collected and sorted. Generally, the cold drinks bottle is made of PET and those bottles are used for the purpose of fabricating the bricks. The PET bottles cannot be used as they are in usual shape and size, for our use the bottles need to be cut into smaller pieces of same size. First of all, the bottles are cleaned and dried to remove moisture. Then these bottles are cut into smaller pieces, in this case we used a shredder for shredding the plastic into smaller pieces. The plastic is melted in a drum and sand is mixed with it form the bricks. The processes can be explained as follows:

2.1 Collection of Material

The process is incredibly simple. Put the dustbin in the canteen for collection of waste bottles. Select the plastic bottles of cold drinks and water from canteens. Bring river sand for plastic brick. IS2386 (Part- I) The more you collect the more plastic you will divert from the landfill or clean up out of the environment.

2.2 Fixing the Proportion of Sand and Plastic

For the fabrication of plastic sand bricks, plastic and sand are mixed in different proportions and bricks containing different amount of plastic and sand are made. Plastic and river sand are mixed in different ratios 1:2, 1:3, 1:4. The reason behind taking different proportions of plastic and sand is to find the optimum proportion which gives the desired results. The bricks made of these ratios will further be investigated for various desired properties.

Table 1: Mixing Proportions

Mixing Ratio	1:2	1:3	1:4
For 1 brick (in gram)	1100:2200	850:2550	650:2600
For 2 bricks (in grams)	2200:4400	1700:5100	1300:5200

2.3 Preparation of Brick Mould

The moulds used are wooden moulds and are made in the carpentry shop. All the sides and surfaces of the mould should be even for the brick to have better surface finish. Both fixed and movable moulds can be used for the purpose. Wooden mould will be cost effective and serve the purpose whereas if better surface finish is needed then cast-iron moulds can be used. Mould size would be (230*100*75) mm.

3. Materials and Methods

3.1 Manufacture of mould

Handmade wooden mould has made in the dimension of 23 cm X 10 cm X 8 cm. since dimension of normal brick was 19 cm X 9 cm X 9 cm is recommended as per BIS.

3.2 Sand

Natural river sand was used as a fine aggregate. The properties of sand were determined by conducting tests as per IS: 2386 (Part-1). The results are shown in test data of materials.

3.3 Waste Plastic

Plastic is material consisting of any of a wide range of synthetic or semi-synthetic organic compounds that are malleable and so can be molded into solid objects. While most plastics are produced from petrochemicals, bio plastics are made substantially from renewable plant materials such: as cellulose and starch. The widespread generation of plastics waste needs proper end of-life management. The highest number of plastics is found in containers and packaging's (i.e., bottles, packaging, cups etc.), but they also are found in durables (e.g., tires, building materials, furniture, etc.) and disposable goods (e.g., medical devices). Post-production and postconsumer plastics are utilized in a wide range of applications. The following Results were taken from Chennai central institute of plastic engineering and technologies.

Due both to the finite limits of the petrochemical reserves and to the threat of global warming, the development of bio plastics is a growing field. They are broadly classified into two categories they are thermoplastics and thermosetting plastics. Thermoplastics are the linear polymers, which become soft on heating and become hard on cooling. The molecule of these polymers is synthesized in the shape of long threads and undergoes no chemical change in the molding operation. Some of the common examples are polyethylene, PVC, polystyrene, Nylon and acetate.

Thermosetting plastics are cross linked polymers, which become soft only on first heating with pressure and get hard permanently on cooling due to chemical change by condensation and polymerization, and becomes unaffected by the heat or solvents. Some of the common examples are epoxy resins, phenolic resins and unsaturated polyester resins.

3.4: Mix proportion

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 (1:2, 1:3, and 1:4). These are the ratio which represents the plastic, river sand respectively.

Advantages of Ecological Brick by Use of Waste Plastic and Sand

1. The main benefit of eco-bricks is that they transform something that would have been harmful to the environment into something that benefits local communities.

2. Plastic is an extremely useful material, but we produce far too much of it and dispose of it in an environmentally unsustainable manner. Plastic's hardness, lifespan, and water resistance, which make it so difficult to dispose of, are also what make it a fantastic building material.

3. Each brick contributes to the reduction of discarded plastic in the world and is produced at a lower cost and with less energy than traditional bricks. It also consumes less energy than recycling plastic into other forms.

4. When you see the amount of rubbish you put into an eco-brick, you'll see how much you throw away. This process also helps you be more careful about what you buy and how you dispose of it.

5. Eco-bricks help prevent hazardous material from being burnt or ending up in the ocean. When plastic is burnt, it emits CO2, increasing carbon emissions and contributing to global warming.

Disadvantages of Ecological Brick by Use of Waste Plastic and Sand

1. Despite its obvious benefits, some people believe that building structures out of plastic will be harmful to the environment in the long term.

2. These non-recyclable plastics are made from inorganic compounds. This means they can leak into the natural environment when the eco-bricks are exposed to sunlight.

3. Photo-degradation also makes the plastic fragile and vulnerable to breakage, releasing micro-plastics into the area. This is known to be harmful to animal and human health.

4. Eco-bricks have been criticized as not being a long-term solution to the plastic dilemma. Many consider eco-bricks to merely be a means of delaying the problem for a few more years.

4. Testing of Materials

4.1 Compressive strength test

Compressive strength test on bricks is carried out to determine the load carrying capacity of bricks under compression with the help of compression testing machine. Bricks are generally used for construction of load bearing masonry walls, columns and footings. These loads bearing masonry structures experiences mostly the compressive loads. Four specimens of bricks (1:2, 1:3, 1:4 and

conventional Bricks) were taken and tested one by one. In this test, a brick specimen is put on compression testing machine and applied load till its breaks. The load at failure shall be the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine.

4.2 Soundness test

The soundness test is also done in the field. The Plastic bricks and conventional bricks are were taken. The bricks are made to hit each other the ring sound produced during the process, which denotes the quality of the brick that it is good. Good quality bricks produce the clear ringing sound. In our project both fly ash bricks and plastic sand bricks clear ringing sound produced.

4.3 Water absorption test

Four specimens of bricks (1:2, 1:3, 1:4 and conventional Bricks) were taken and weighed in dry condition (W1). Let them immersed in fresh water for 24 hours. After 24 hours of immersion, those are taken out from water and wipe out with cloth. Then brick is weighed in wet condition (W2). The difference between weights is the water absorbed by bricks. The percentage of water absorption is calculated. The less water absorbed by bricks the greater its quality. Good quality brick doesn't absorb more than 20 % water of its own weight.

4.4 Hardness test

In this test a scratch is made on brick surface with steel rod (any hard material can be used) which was difficult to imply the bricks or blocks were hard. This shows the brick possess high quality.

As per the code IS 3495 (1992): Common Burnt clay building brick - specification the above tests are to be performed. Compressive strength test, Water absorption test and Efflorescence test. In addition, there two more tests to be conducted to know the quality of Plastic bricks. In these tests some are to performed in a laboratory and rest on the fields with a reference of literatures and journals.

5. Conclusion

The test results show the compressive strength of conventional brick for a maximum load of 32KN is 1.27N/mm^2. In the case of plastic sand bricks, the compressive strength decreases with increasing the plastic sand ratio. The various mix proportions used are 1:2, 1:3 & 1:4. The crushing values of plastic brick for the loads 232KN, 162KN and 88KN are 9.17N/mm2, 6.2 N/mm^2 and 3.50N/mm^2 respectively. There is no alkali in plastic brick whereas it is present in conventional brick.

In water absorption test presence of alkali is highly reduced. Hence plastic sand bricks could reduce a large amount of water absorption and shows resistance to alkali reaction. The bonding between plastic and sand can be achieved by using general purpose resin. It also shows improved quality and durability than conventional bricks.

Weight is also lesser for plastic sand bricks compared to conventional bricks. In comparison with conventional brick, the strength of plastic sand bricks is high. Strength wises we can go for 1:2 (Plastic: Sand) mix, which is giving high strength compared to other mixes. But in economic wise if we need a brick similar to conventional brick, we can go for 1:4 ratio. Since its process charge is lesser than other two. The applications of plastic sand bricks are numerous in civil engineering namely precast bricks, partition wall and canal lining.

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