PREPARATION OF CONCRETE BRICKS USING AGGREGATE AS COARSE AGGREGATE REPLACEMENT

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ABSTRACT

The plastic waste is the hazardous problem in today's world. This is most dangerous problem in front of humanity. The most hazardous type of wastes are HDPE and PTE and the plastic below 50micron is also causing a serious problem. This plastic mixed in the soil; it directly effects on fertility of the soil. Nowadays, the large amount of plastic is deposited into sea. This plastic wastes gives hazardous effect on the aquatic life and quality of sea water also polluted by this plastic. So, we try to find efficient way to solve this problem of plastic waste. So, we made this plastic wastes into the plastic coarse aggregate in the preparation of concrete bricks. It is most economical solution present in the construction industry, and it is also economical and environment friendly solution of the plastic wastes.

The concrete bricks prepared by replacing natural coarse aggregate by 0%, 5%, 10%, 15%, 20%, 25%, 30% and cement, fine aggregate and water kept constants for all mixes. Compression test, water absorption test, fire ignition, Soundness test, drop test, shape and size test, Efflorescence test, Colour test and Structure test were conducted to analyze their suitability as a construction material.

1. INTRODUCTION

1.1 General

All the waste products in the world, plastics and municipal solid trash are of particular importance. The urgent requirement is to find an appropriate application for the disposed of plastic garbage. On the other hand, more load bearing capacities are required due to rising traffic on the roadways. The use of plastics coated aggregate for hard pavement enables the reuse of plastic waste (use polymer or plastic consistently; the focus is on plastic waste). Plastics are useful packaging materials that are widely utilised by people; however, they have negative environmental effects. Plastic bags, cups, films, and foams composed of polyethylene, polypropylene, or polystyrene are the most often used plastic items after they have been used.

By 2015, India's plastic usage is expected to increase by 15 million tones, making it the third-largest consumer of plastics worldwide. The majority—about 55%—is utilised for packaging. After the contents have been devoured, they are frequently dumped and left to pollute the surroundings. Municipal solid waste disposal is complicated by the non-biodegradable material, scattered plastics, which mingle with household garbage. Municipal solid trash is either burned or dumped on the ground. Both disposal techniques are not the ideal ways to get rid of the garbage, because they pollute both the land and the air. Additionally, burning

municipal solid trash that comprises LDPE and HDPE waste might release dioxin-like hazardous fumes.

The primary focus of current research efforts is the environmentally friendly disposal of plastic garbage. This initiative created a cutting-edge method for using used plastics to build hard pavement. This method can help waste plastic gain value and is environmentally benign. As we all know, the rapid industrialization needed a great quantity of construction materials as well as land needs, therefore it is a common phenomenon in a big portion of the world for old buildings to be demolished together with its traffic infrastructure and replaced with new ones. In the current study, recovered plastics were employed to coat the coarse aggregates, offering a sustainable solution to today's problem of plastic waste.

There are several recycling factories throughout India, however when plastics are recycled, they lose their strength due to the plastic trash. Plastics have become an essential component of our modern lifestyle, and global plastic manufacturing has skyrocketed over the previous 50 years. Plastics have gradually been employed in a wide range of goods due to its advantageous qualities, which include low density, high strength-to-weight ratio, high durability, simplicity of design and manufacture, and low cost.

Plastic is essentially inert, which means it is less impacted by chemicals and has a longer lifespan. So, based on the foregoing, we admit that we must conduct different tests on aggregates such as common aggregate and plastic-coated aggregate, compare all physical qualities and all needed tests, and investigate such a new item that will be employed in the future of civil engineering.

2. LITERATURE REVIEW SURVEY

Praveen Mathew et. al. Recycled plastics as coarse aggregate for structural concrete was the subject of a 2013 study. They tested concrete using various ratios of plastic particles in lieu of coarse aggregates and discovered that 22% replacement of coarse aggregates with plastic aggregates produced the best results. They went on to examine the other qualities of concrete that contained 22% plastic particles and discovered that it had lower fire resistance.

Lhakpa Wangmo Thingh Tamang et. al. 2017 saw the completion of an experiment using plastics as coarse aggregate in concrete. They tested the mechanical characteristics of concrete that contained plastic particles. The percentages of plastic aggregates they utilize are 10%, 15%, and 20%. They discovered a little loss in strength and recommended 15% replacement as the ideal outcome.

Chaitradip Sarkar et. al Comparison of Concrete with Natural and Recycled Aggregates In this essay, they looked at According to the test results, recycled aggregate concrete performs satisfactorily even when coarse natural aggregate is completely replaced with coarse recycled aggregate. This indicates that there is a huge market for this aggregate both now and in the future, beyond just its mechanical properties.

3. OBJECTIVE AND METHODOLOGY

3.1 Objective of study

- To develop an efficient way and to effectively utilize the waste plastics.

- To examine the results of replacement of coarse aggregates with varying amounts of used plastic aggregate from 0% to 30%.
- To investigate the distinction between regular aggregates and plastic aggregates.
- To minimize and reuse generation of waste plastic on the land and water to avoid land and water degradation and consequent pollution hazard.
- To produce cost-effective materials which a common person can afford easily.
- To reduce the plastic in waste streams saving non-renewable resources.

3.2 Methodology

LITERATURE REVIEW

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COLLECTION OF MATERIAL

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MELT THE PLASTIC AND CREATE PLASTIC AGGREGTE

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MIX DESIGN FOR M10 FOR PREPARATION OF CONCRETE BRICKS

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CASTING OF BRICKS SAMPLES

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TESTING OF BRICKS

↓

RESULT ANALYSIS

4. MIX DESIGN

4.1 Mix design calculations

Density of cement = 1440kg/m^3

Density of sand = 1600kg/m^3

Density of aggregates = 1800kg/m^3

Dry volume = 1.54 to 1.57*wet volume

M10 =1:3:6

Sum of ratios =1+3+6 = 10

Assuming 1.54(wet volume) = dry volume.

4.1.1 Basic calculations

For 1m^3 volume

Volume(V) = length(L)*breadth(B)*height(H)

V = 1m*1m*1m = $1m^3$

Weight of cement = 1/10*1.54*1440 = 221.76kg

Weight of sand = 3/10*1.54*1*1600 = 739.2kg

Weight of aggregates = 6/10*1.54*1*1800 = 1663.2kg

4.1.2 For 100mm x 100mm x 100mm size

FOR 100*100*100mm size brick

Volume = 100*100*100 = $0.001m^3$

Assume 10% wastage, n = 1 brick

Final volume of brick = n*[1+wastage] *0.001

= 1*[1+10/100] *0.001

= 0.0011 m^3

Weight of cement = 0.0011*[1/10*1.54*1440]

= 0.0011*221.76

= 0.244

= 244gm

Weight of sand = 0.0011*[3/10*1.54*1600]

= 0.0011*739.2

= 813gm

Weight of aggregates = 0.0011*[6/10*1.54*1800]

= 0.0016929*1663.2

= 1.829

= 1830gm

Weight of water:

w/c = 0.55 (assume)

w = 0.55*244 = 134.2 ml

4.1.3 For 1 Brick making

Table. 1: Material weights requirement for making 1 brick.

Plastic aggregate (%)	Cement (gm)	Fine aggregates (gm)	Coarse aggregates (gm)	Plastic aggregate (gm)	Water contents (ml)
0	244	813	1830	0	134.2

5			1738.5	91.5	
10			1647	183	
15			1555.5	274.5	
20			1464	366	
25			1372.5	457.5	
30			1281	549	

5. EXPERIMENTAL WORK

5.1 Plastic aggregate

The plastic aggregates and natural aggregate were tested after cooling as follows:

- ✓ [IS: 2386 (Part-IV)] Aggregate Crushing Value (%)
- ✓ The total impact value (%) - IS: 2386 (Part-IV) (Part-IV)
- ✓ (%) Water Absorption - (IS:2386 Part III) (IS:2386 Part III)

Table. 2: Tests results of aggregates.

Test	**Pure aggregate**	**Plastic aggregate**	**Standard value**
Crushing (%)	18%	12%	30% Max
Impact (%)	12%	8%	30% Max
Water absorption (%)	1.8%	0.2%	Max 2%

5.2 Sample production

Control mix: The cement, fine and coarse aggregates were weighted according to mix proportion of M10. All are mixed together in a bay until mixed properly and water was added at a ratio of 0.55. The water was added gradually and mixed until homogeneity is achieved. Any lumping or balling found at any stage was taken out, loosened and again added to the mix.

Plastic aggregate based Concrete bricks: The cement, plastic aggregate, fine and coarse aggregates were weighted according to mix proportion of M10. All are mixed together in a bay until mixed properly and water was added at a ratio of 0.55. The water was added gradually and mixed until homogeneity is achieved. Any lumping or balling found at any stage was taken out, loosened and again added to the mix.

A standard 100x100x100 mm brick specimens were casted for all above various types of concrete mixes. The samples were then stripped after 24hours of casting and are then be sprinkling of water for curing 7days (daily 2 times). As casted, a total of (21) 150x150x150mm bricks specimens were produced.

5.3 CONCRETE BRICKS TESTING

5.3.1 Compression Test

- Brick specimen to be tested is placed on a horizontal surface and the specimen is to be centered between the plates on Compression testing machine.
- Apply the load at a uniform rate till the failure occurs.
- Note down the maximum load at failure.

Fig. 1: Compression test.

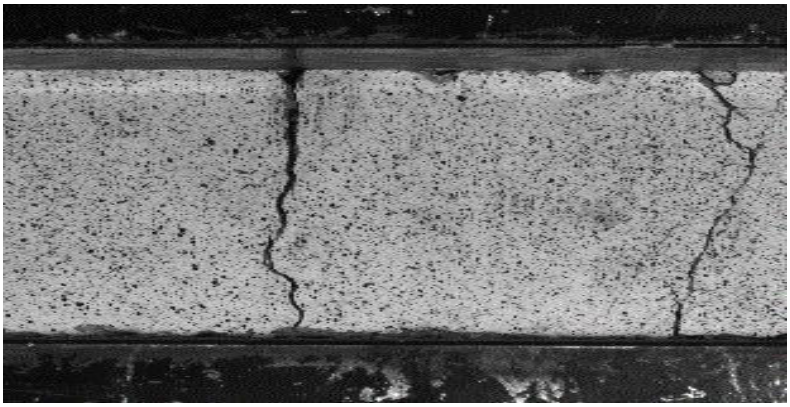

Fig. 2: Compression test after brick.

5.3.2 Water Resistance Test

In this the bricks first weighted in dry condition and they are immersed in water for 24 hours. After that they are taken out from water and they are wipe out with cloth. Then the difference between the dry and wet bricks percentage are calculated. The less water absorbed by bricks the greater its quality. Good quality bricks don't absorb more than **20%** water of its own weight.

5.3.3 Efflorescence test

The presence of **alkalis** in bricks is harmful and they form a gray or white layer on the brick surface by absorbing moisture. To find out the presence of alkalis in bricks this test is performed. In this test, a brick is immersed in fresh water for **24** hours and then it's taken out

of the water and allowed to dry in shade. If the whitish layer is not visible on the surface it proofs that absence of alkalis in brick. If the whitish layer visible about **10%** area of the brick surface, then the presence of alkalis is in the acceptable range. If that is about **50%** of surface area then it is moderate. If the alkali's presence is over **50%** of the brick surface area, then the brick is severely affected by **alkalis**.

5.3.4 Shape and Size Test

Shape and size of bricks are very important consideration. All bricks used for construction should be of same size. The shape of bricks should be purely rectangular with sharp edges. Standard brick size consists length x breadth x height as 10cm x 10cm x 10cm.

5.3.5 Colour Test

A good brick should possess bright and uniform colour throughout its body.

5.3.7 Soundness test

Soundness test of bricks shows the nature of bricks against sudden impact. In this test, 2 bricks are chosen randomly and struck with one another. Then sound produced should be clear bell ringing sound and brick should not break. Then it is said to be good brick.

5.3.8 Hardness test

A good brick should resist scratches against sharp things. So, for this test a sharp tool or finger nail is used to make scratch on brick. If there is no scratch impression on brick then it is said to be hard brick.

5.3.9 Drop test

When bricks are dropped from the height of 1 to 1.2m (4 feet), it should not crack or break. This ensures the durability and quality of bricks.

5.3.10 Structure of Bricks

To know the structure of brick, pick one brick randomly from the group and break it. Observe the inner portion of brick clearly. If there are any flaws, cracks or holes present on that broken face then that isn't a good quality brick.

6. RESULTS AND DISCUSSIONS

As per experimental programme results for different experiments were obtained. They are shown in table format or graph, which is to be presented in this chapter.

6.1 Brick Test Results

6.1.1 Compression Test

Table. 3: Compression test results.

S. No	Plastic Aggregate (%)	Compression (MPa)
1	0	7.8
2	5	8.1

3	10	8.5
4	15	8.7
5	20	9.3
6	25	9.5
7	30	8.9

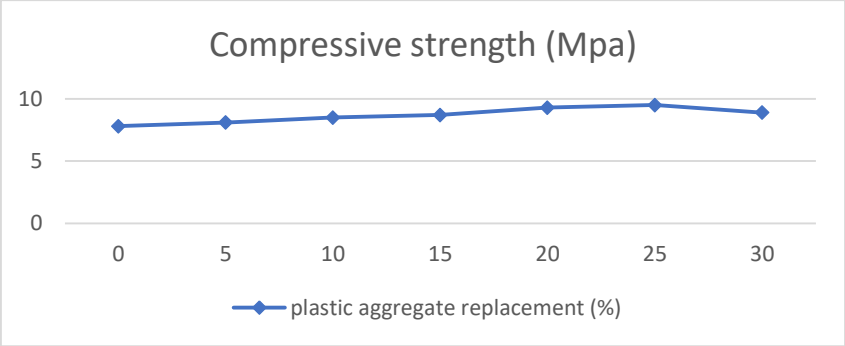

Fig. 3: Compressive strength test results graph.

The compressive strength increases up to 25% replacement of plastic aggregate in the place of coarse aggregate after that decreased the strength.

6.1.2 Efflorescence test

No efflorescence visible on all bricks.

6.1.3 Shape and Size Test

For all bricks are rectangular shape and size 10 cm x 10 cm x 10 cm.

6.1.4 Fire Resistance Test

The Plastic is highly susceptible to fire but in case of Plastic aggregate bricks the presence of sand imparts insulation. There is no change in the structural properties of bricks up to 200°C above which visible cracks are seen and the bricks deteriorate with increase in temperature.

6.1.5 Water Resistance Test

Table. 4: Water resistance test results.

S. No	Plastic Aggregate (%)	Water absorption (%)
1	0	1.8
2	5	1.5
3	10	1.45
4	15	1.37
5	20	1.23
6	25	1.21

7	30	1.18

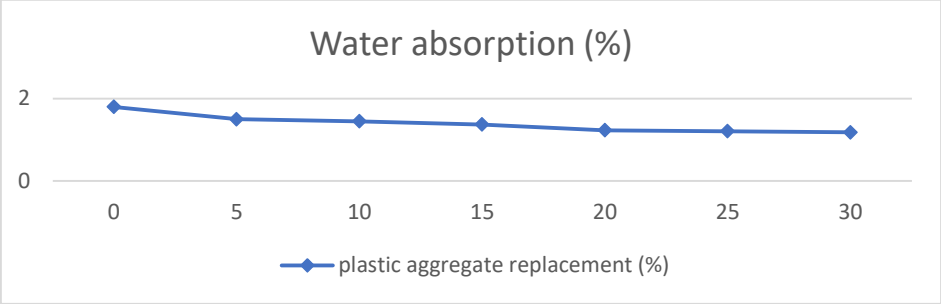

Fig. 4: Water absorption test results graph.

The water absorption value decreases with increasing plastic aggregate replacement in the coarse aggregate in the preparation of concrete bricks.

6.1.6 Colour Test

Table. 4: Colour test results.

Plastic Aggregate (%)	Colour test
0	Cement Colour as present even after 24 hours in water
5	
10	
15	
20	
25	
30	

6.1.7 Soundness test

Table. 5: Soundness test results.

Plastic Aggregate (%)	**Soundness test**
0	ringing sound produced and bricks are not break
5	
10	

15	
20	
25	
30	

6.1.8 Drop test

Table. 6: Drop test results.

Plastic Aggregate (%)	Drop test
0	Not broke
5	
10	
15	
20	
25	
30	

6.1.9 Structure of Bricks

There are no flaws, cracks or holes present on that broken face then that is a good quality bricks.

6.1.10 Hardness test

Little bit scratch visible on all bricks.

6.2 Advantages

1. The main advantage of this project is it is Eco-Friendly.
2. Reusing of plastic will reduce the amount of scattered plastic present in the land and in the water bodies.
3. This type of bricks can be used in sea shores as it does not absorb more water and it is also not reactive towards water.
4. With certain changes these bricks can be used for constructing buildings. This brick can be used in normal atmosphere without any harmful effect to environment and living organisms.

7. CONCLUSIONS

1. This project reuses the waste plastic and prevents the environment from plastic pollutants. This project is done with different percentages of coarse aggregate replacing with man-made plastic aggregate.
2. Waste plastic as plastic aggregate can be used up to 25% replacement to natural granite coarse aggregate in concrete gives the higher strength as compare the other replacements.
3. This plastic waste helps in reusing in concrete to avoid difficulties in recycling of plastic, difficulties in proper collection and disposing of waste plastic, helps to avoid death of cattle's by eating plastic covers at garbage yards and finally keeps the environment safe by reusing plastic waste. Light weight concrete can be made as the lesser density of plastic aggregates.

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