

EXPERIMENTAL INVESTIGATION ON CONCRETE USING NON-BIODEGRADABLE WASTE

Submitted in partial fulfilment of the requirements for the award of Bachelor of engineering
degree in civil engineering

By

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INSTITUTE OF SCIENCE AND TECHNOLOGY
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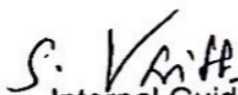
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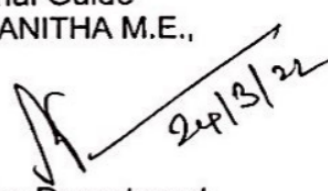
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **MEENASHI V (38200019)** and **SUMI NADIA C. P (38200034)** Who have done the project entitled "**EXPERIMENTAL INVESTIGATION ON CONCRETE USING NON-BIODEGRADABLE WASTE**" under my supervision from December 2021- April 2022


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DECLARATION

We **MEENASHI V (38200019)** and **SUMI NADIA C. P (38200034)** hereby declare that the project report entitled "**EXPERIMENTAL INVESTIGATION ON CONCRETE USING NON-BIODEGRADABLE WASTE**" was done by us under the guidance of **Mrs. S. VANITHA M.E.,** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering

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ABSTRACT

The disposal of waste plastics is a serious issue in today's world, as the use of plastics is increasing all the time, and plastic material takes hundreds of years to disintegrate. So many practical methods for recycling and reusing plastics are being developed. This study looks into replacing natural fine aggregate in concrete with non-biodegradable plastic aggregate made out of High-Density Polyethylene waste (HDPE plastics). Replacement of fine aggregate weight by 10%, 20%, 25%, 30% in order to derive the optimum replacement. To determine the qualities and behaviour of concrete utilizing plastic aggregate, several tests are carried out, including compressive strength, split tensile strength, and flexural strength in the hardened state of concrete and basic tests on fresh concrete were taken care of which are slump cone test and compaction factor test. The results of concrete created strength in the hardened state of concrete and basic tests on fresh concrete, such as slump cone test and compaction factor test, were taken care of after the casted specimens were tested for various days which are 7th, 21st and 28th days . The results of concrete constructed using plastic aggregate are compared to those of normal concrete after being tested for 7 days, 14 days, and 28 day

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CHAPTER 1 INTRODUCTION

Concrete's long-term viability, while being the most frequently used construction material on the planet, is a major issue for the global construction industry. Noise pollution, air pollution, destruction of flora and animal habitats, as well as landscape degradation, land loss, deterioration of water quality, and population displacement, are all negative consequences of using aggregates in construction. Shredded plastics have become more popular as a partial replacement for aggregates in civil engineering projects. Waste inclusion in concrete has an extra benefit in terms of environmental and possible economic considerations. An attempt is undertaken to determine the best crushed plastic alternative for fine aggregate in concrete. Fine aggregates in cement concrete are substituted in known percentages by finely crushed plastics, and the optimal proportion at which increased strength is attained is estimated. Durability, insulating characteristics, a high strength-to-weight ratio, and economy are only a few of their benefits. The disposal of plastics is the most serious issue related to their use. As plastics disintegrate slowly, their disposal has resulted in a plethora of environmental problems, resulting in the so-called "plastic menace." Recycling has long been recognised as a feasible solution to the waste management problems associated with plastics. The density, specific gravity, and sieve analysis tests are used to analyse the properties of plastics after the various processes of plastics manufacture have been completed. The density of a material is calculated by calculating the weight and volume of a certain material. Then, for a given amount of material, sieve analysis and specific gravity were performed. It's also been discovered that because the cleaned plastic material is nearly inert, there's minimal reactivity between aggregate and reinforcements.

CHAPTER 2

LITERATURE STUDY AND METHODOLOGY

2.1 LITERATURE REVIEW

Wei Wang in 2021 Agricultural and Aquaculture Wastes in Concrete referred that Agricultural as well as aquaculture waste have the potential to drastically decrease the price of concrete production. Most of the waste may increase the working performance, mechanical characteristics, and durability of concrete from a usability standpoint. However, incorporating garbage into concrete may diminish some concrete qualities.

Vikas Khandelwal in 2019(Vol. 8) refers that shredded plastics can be used effectively in concrete without compromising the strength of the concrete. When 4 percent shredded plastic is added to concrete, the maximum compressive strength is seen. Additionally, after 28 days of adequate curing, addition will result in a reduction in compressive strength. The addition of 0 to 2% shredded plastic to concrete had no discernible effect on the concrete's 28-day compressive strength. The addition of 4% shredded plastic to concrete increases flexural strength to its maximum level. Additionally, after 28 days of adequate curing, addition will result in a reduction in flexural strength.

Karthikeyan M, Balamurali K, Barath Kumar V, Manoj Prabakar S, and Janarthanan R in 2019 When the amount of plastic is increased, there are noticeable losses in compressive strength. The percentage expansions of the specimens cast with partial plastic replacement are within allowed limits, indicating that the materials are suitable for construction. The use of plastic in concrete construction improves the strength and longevity of the material.

Elango A and Ashok Kumar A in 2018 In the concrete study, flexible tiny particles were employed. The materials utilised were crushed aggregates, river sand, and OPC 53 grade. Ten percent, twenty percent, and thirty percent plastic were utilised in three distinct quantities. They test the mechanical and long-term durability of concrete samples.

LhakpaWangmoThinghTamanget. al. in 2017 Coarse Aggregate was used to substitute plastics in concrete. They used plastic particles to examine the mechanical properties of concrete. Plastic aggregates are used in three distinct proportions: ten percent, fifteen percent, and twenty percent. They observed a slight deterioration in strength and suggested a 15% replacement as the best option.

MB Hossain et. al. in 2016 They were utilised to substitute coarse particles in varied amounts, and the concrete was judged to be lighter as a result. The compressive strength, on the other hand, was lower than the nominal mix.

S. Vanitha et al. in 2015 conducted research on the utilization of waste plastic in concrete blocks. Plastic was substituted for aggregates in proportions of 2%, 4%, 6%, 8%, and 10%, respectively. They discovered that replacing 4% of the aggregates with plastic aggregates yielded the best results for paver blocks. In the case of solid blocks, there is also 2% plastic.

Daniel Yaw Osei in 2014 it was found that by replacing aggregates more than 36% in the concrete structure, the strength and density has decreased. They also advised that plastic be used to make lightweight concrete.

Iris Sanchez Soloaga in 2014 said that they show that, despite the fact that the multilayer plastic's uneven and angular shape makes it harder to work with the concrete, it reduces settling. Increases in water and cement can compensate for the reduction in settling. Although this would raise the cost, it should be considered in the perspective of environmental sustainability. As the quantity of plastic trash included rises, the resistance reduces in the hardened condition. However, the findings are satisfactory when compared to the minimal resistance required for structural light concrete, allowing us to select from a variety of bearing and non-bearing plates.

Praveen Mathew et. al. in 2013 Plastic aggregates are intended to employ in place of coarse aggregates, with the greatest results achieved when coarse aggregates were substituted at a rate of 22 percent with plastic aggregates. They also looked at other characteristics of concrete that had 22% plastic particles and determined that concrete with replaced aggregates had a worse thermal resistance.

RaghatateAtul M. in 2012 as per the weight of the concrete, he included fibre in different proportions which are, 0.2%,0.4%,0.6%,0.8% and 1% and also it was derived that the percentage of plastic is inversely proportional to compressive strength so, if percentage of plastic increases, compressive strength decreases whereas the tensile strength of the concrete increased in 0.8 percent.

Venu Malagavelli Volume1,No 3,2010 When compared to standard high-performance concrete, fibres boost the ultimate load bearing capability of the material. With 1% HDPP fibre, concrete's ultimate load bearing capacity improved by 4.62 percent, while with 1% PET fibre, it increased by 9.11 percent. With 1% HDPP fibre, concrete's compressive strength improved by 4.2 percent, while with 1% PET fibre, it increased by 5.63 percent.

Dr. Haider K. Ammash, et.al. looked into the possibility of fine aggregate made from waste glass with a diameter of up to 5mm can be utilised in concrete. Broken and waste glass was used as a partial weight substitute material of sand at weight replacement percentages of 10, 20, 30, and 40%. They discovered that waste glass aggregate can successfully substitute natural fine aggregate at a rate of up to 20%.

M. Iqbal Malik, et.al. Waste glass may substitute fine aggregates that weighs up to 30-percent, resulting in a 9.8% improvement in compressive strength after 28 days. The proportion of water absorption reduces as the waste glass content rises. For a mixture with 40% waste glass content, the average weight drops by 5%, producing waste glass concrete light weight. The tensile strength of splitting glass diminishes as the waste glass content rises.

Gunalaan Vasudevan, Seri Ganis KanapathyPillay The purpose of the research was to see how recycled glass powder affected concrete. The performance of the concrete containing the control sample and the glass powder after use was tested in the lab. They found that recycled glass powder concrete had stronger strength after 14 days on average, however when it came to concrete on day 28, the control mixture outperformed the recycled glass powder mixture. As a result, the value of class M30 was always high.

G.Murali, et.al. We conclude that concrete made from steel powder has a high compressive strength, which is 41.25% higher than that of conventional concrete. Adding scrap steel powder to the concrete improved the split strength. While compared to standard concrete block, the strength increased up to 40.87 percent. After bending, the sample was discovered to be suitable for the waste closure of soft drink bottles.

Mostafa Jalal studied the mechanical behavior of recycled steel fiber (RSF) reinforced concrete recovered from milling machines and machining processes. By using scrap fiber, the crack distribution during rupture is much more uniform. The desired fiber content from a compressive strength standpoint has been found to be between 2 to 3 percent.

Dr. G.Vijayakumar et al. Concrete produced by partially replacing cement with waste glass powder with a particle size of 75 mm was performed and tested. We replaced the used glass powder with 10%, 20%, 30% and 40% binders to create a mixture design. The glass powder has to be crushed to the proper size before being added to the concrete. The glass powder was crushed/smashed into spherical form for 30-60 minutes in these investigations, resulting in particle sizes of fewer than 150 m and sieve sizes of 75m. The Indian standard for M20 grade-controlled concrete was used to develop the concrete mix design. With a cement concentration of 330 kg/m³ and a water-to-cement ratio of 0.53, the mixture was created. The glass powder has a compressive strength of 41.96 N/mm² after 28 days and 30 months. The pH of the samples was measured using an alkalinity test, which revealed that they were more alkaline and thus more corrosion resistant.

Ali N. Alzaed He referred that adding 30% iron filler to the concrete mixture increased the compressive strength of the concrete by 17%. When the proportion of iron powder used exceeded 10%, the tensile strength of the concrete had little effect. Adding 10% iron filler to the concrete mixture increased the tensile strength of the concrete by 13%.

KabiruUsmanRogo and SalehAbubakar conducted experiments on coconut shells, which could be an alternative to aggregate. Coconut shells are primarily used as a source of gems and activated carbon. Powder shells are also used in the plastics, adhesives and abrasives industries. The concrete strength of the coconut shell with a mixing ratio of 1: 1.5: 3 reached 16.5 N / mm² in 28 days, so it can be used as pure concrete. Therefore, a 48% cost reduction was achieved.

Mohd Monish et. Al. This paper addresses the impact of replaced partially with coarse aggregate with demolition waste which studies the workability and compressive strength at 7 and 28 days. They stated that concrete made from recycled aggregate was comparable to conventional concrete when coarse aggregate was replaced by concrete manufactured from recycled aggregate by up to 30%. When up to 30% of the coarse aggregate is replaced with demolition debris, the strength of the cubes is comparable to that of regular concrete, with strength retention in the range of 86.8494.74 percent.

P.Krishna Prasanna and M.Kanta Rao They did an exploratory concentrate by using E-squander particles as coarse totals in concrete with a rate substitution from 0% to 20%. The solidified properties of concrete were investigated using leading tests for both samples. The e-squander concentration was calculated based on weight as coarse aggregate in a standard blend. The coarse total fineness modulus was found to be 6.937 with various E-squander concentrations. At the ages of 7, 14, and 28 days, compressive strength tests were conducted to analyse the strength development of concrete having various E- squander contents. It was additionally seen that the compressive strength of cement was viewed as ideal when the coarse total was supplanted by 15% with E-Waste. Past it the compressive strength is diminishing.

Dr. A.M. Pande and S.G.Makarande Rice husk ash (RHA), an agricultural waste, has been investigated not only to improve the strength of concrete but also to be used as a material for concrete. They concluded that replacing 12.5% of the cement in the matrix with rice husk ash would reduce cement utilization and cost. As a result, the pozzolanic reaction of rice husk ash in the matrix composite was small at a young age, but aging of the sample up to 90 days showed a significant effect on the intensity.

Youcef Ghernouti et. Al. They experimented with substituting plastic bag trash for varying percentages of sand, such as 10, 20, 30, and 40%. In comparison to control concrete, the impact of waste on attributes of concrete in the fresh and hardened phases, such as workability, bulk density, ultrasonic pulse velocity testing, compressive and flexural strength, has been investigated and analysed. They discovered that replacing sand with plastic garbage reduced the bulk density of all concretes significantly, and that plastic waste is also lighter with 40% plastic rubbish. They also discovered that a 10 percent and a 24 percent loss in compressive strength after 28 days contained 10 percent and 20 percent waste, respectively.

Jain D. and Kothari A. Human hair has high tensile strength and can be used as a fibre reinforcing material, according to the researchers. Hair Fibre (HF), a non-biodegradable substitute, is plentiful and inexpensive. They used compressive, crushed, and flexural strength to investigate the impact of human hair on regular cement concrete. Experiments were carried out on concrete and cubes with varying percentages of the human hair fibre, particularly 0%, 1%, 1.5%, 2%, 2.5%, and 3% by mass of cement. Compressive strength improved by 22% while flexural strength raised by 8.6% when 1.5 percent hair was substituted in M15 grade concrete

2.2 METHODOLOGY

- ***Material Collection***

- > HDPE WASTE

- > M-SAND

- > COARSE AGGREGATE

- > PPC CEMENT

- > WATER



Fig 2.2.1: HDPE plastic

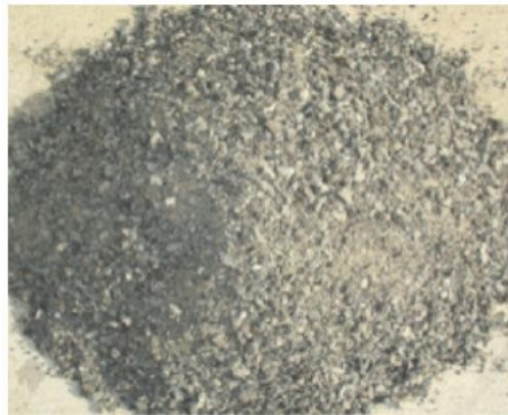


Fig 2.2.2 : M-sand



Fig 2.2.2 :3Coarse aggregate



Fig 2.2.4 : PPC Cemen

- ***Material Testing***

- > Specific gravity Density

- > Fineness modulus

- > Water absorption

- ***Mix Design***

- ***The casting of mixer in the mold***

- ***Curing***

- ***Test On Concrete***

Tests On Fresh Concrete

- >Slump Cone Test

- >Compaction Factor Test

Tests on Hardened Concrete

- >Compression Strength Test

- >Flexural Strength Test

- >Split Tensile Strength Test

CHAPTER 3 OBJECTIVE AND SCOPE

3.1 OBJECTIVE

- To determine test on a plastic aggregate and analyze with normal aggregate
- To determine the replacement of M-Sand
- To determine the properties of fresh concrete
- To determine the mechanical properties of hardened concrete
- To compare the blocks with conventional concrete blocks

3.2 SCOPE

Quarrying and crushing stones provide the bulk of aggregates. Crushing releases dust particles into the environment, much as stone quarrying alters the region's geological properties. As a result, the environment suffers from two detrimental effects. Researchers focused on the reuse of trash goods that had a negative influence on the environment to decrease this. Few of them are now in use, which are iron slag and crusher dust, while others are still being explored. As a result, repurposing these abandoned things serves a dual purpose: it reduces the consumption of raw concrete resources while also utilising environmentally damaging waste elements. Another advantage of using these waste materials is that they help to improve concrete properties. We used plastic as one of the waste materials in our study. Plastic has a harmful impact on the environment; but, due to certain properties, it can be used in concrete.

CHAPTER 4 MATERIALS AND METHODS

4.1 MATERIALS USED

1. HDPE Plastics - High-density polyethylene (HDPE) or polyethylene high-density polymer is a thermoplastic polymer (PEHD). Shampoo bottles, toys, chemical containers, milk jugs, supermarket bags, recycling bins, and other items typically contain it. The used HDPE plastic wastes were collected, melted, and crushed to produce plastic granules with a diameter of less than 4.75mm. As indicated in the properties of HDPE plastics, the specific gravity, gravity, Fineness Modulus and Melting point are the major properties required in order to add the product in the concrete mixture. These High Density plastics are easy to process by most methods and these are economically friendly. The melting point indicates that these plastics can be moulded into any shape and size.

Table 4.1.1: Properties of HDPE Plastics

S.NO	EXPERIMENTS	RESULTS
1.	Specific Gravity	1.04
2.	Gravity	955kg/m ²
3.	Fineness Modulus	0.5mm
4.	Melting Point	130.8°C



Fig 4.1.1

2. M-Sand- For concrete buildings, manufactured sand (M-Sand) is used as a supplement to river sand. The crushed sand is cleansed and classed as a construction material since it is cubical in shape with rounded borders. Manufactured sand (M-Sand) has a decreased thickness of 4.75 mm. This is an alternative for natural sand because by using natural sand, the environment gets affected as the water level decreases. As referred in the properties of M- Sand, most of the m-sand does not contain silt content or its does not exceed 8% of silt content. Water absorption property is one of the important property because the absorption water affects the m-sand's durability.

Table 4.1.2 : Properties of M-Sand

S.NO	EXPERIMENTS	RESULTS
1.	Silt Content	8%
2.	Water Absorption	3.32%
3.	Passing Percentage	Less than 4.75mm
4.	Specific Gravity	2.7
5.	Density	1850 kg/m ³



Fig 4.1.2

3. Coarse Aggregate- Coarse aggregates, such as sand, gravel, or crushed stone, are uneven and granular materials used to produce concrete. Coarse is frequently found naturally, but it can also be made by blasting quarries, manually crushing it, or utilising crushers. Before being utilised to make concrete, they must be thoroughly cleaned. The concrete is affected by its angularity and strength in a number of ways. Without a doubt, selecting these aggregates is a critical undertaking. This aggregate has an major effect on concrete properties which are abrasion resistance, hardness, elastic modulus and other characteristics. These help in shrinkage and surface cracking of the concrete.

Table 4.1.3 : Properties of coarse aggregate

S.NO	EXPERIMENTS	RESULTS
1.	Density	1830 kg/m ³
2.	Size	20mm
3.	Specific Gravity	2.78
4.	Water Absorption	1.60%



Fig 4.1.3

4. Cement (PPC) - Pozzolana is a natural or man-made substance that includes reactive silica. Cement made from Pozzolanic elements is known as Portland Pozzolana Cement. In particular quantities, OPC clinker, gypsum, and pozzolanic ingredients make up this cement. Fly ash, volcanic ash, calcined clay, and silica fumes are examples of Pozzolanic materials. These elements are incorporated in percentages ranging from 15% to 35% by cement weight.

Table 4.1.4: Properties of Cement

S.NO	EXPERIMENTS	RESULTS
1.	Specific Gravity	3.15
2.	Consistency	31.5%
3.	Initial setting time	25 mins
4.	Final setting time	165 mins



Fig 4.1.4

4.2 EXPERIMENTAL PROCEDURE

By varying the ratio of fine aggregates replaced with HDPE Plastic aggregates, different types of mixtures were created. Total 5 types of mixes are prepared. One is a conventional concrete block and the others are the blocks in which the fine aggregates are replaced by 10%, 20%, 25% and 30% of plastic aggregates.

Block 1- The first block is made with zero percent of HDPE plastic. The quantity of cement in order to make 3 conventional blocks is 9kg followed by sand with 19.24 kg for 3 conventional normal blocks and then coarse aggregate required in 20mm is 13.736 kg and for 12.5mm the coarse aggregate has to be 13.745 kg at last 3.622 kg of water is required for 3 conventional blocks with 0% plastic.

Block 2- This block is made of 10% of HDPE plastic by replacing the fine aggregate. This includes 9 kg of cement, and 17.316 kg of sand as 10% of plastic has been added to it which is 1.924 kg of HDPE plastics, but the coarse aggregate and water quantity remain the same for these mixes.

Block 3 – This block is made of 20% HDPE plastic replaced with fine aggregate in order to check the workability and mechanical properties of concrete. The required materials for this proportion are 9kg cement, 15.392 kg of sand with 3.848 kg of HDPE plastic, 13.736 kg of 20mm coarse aggregate and 13.745 kg of 12.5mm coarse aggregate and the water required for this proportion is 3.622 kg.

Block 4 - This block is made of 25% HDPE plastic replaced with fine aggregate in order to check the workability and mechanical properties of concrete. The required materials for this proportion are 9kg cement, 13.468 kg of sand with 5.772 kg of HDPE plastic, 13.736 kg of 20mm coarse aggregate and 13.745 kg of 12.5mm coarse aggregate and the water required for this proportion is 3.622 kg.

Block 5 - This block is made of 30% HDPE plastic replaced with fine aggregate in order to check the workability and mechanical properties of concrete. The required materials for this proportion are 9kg cement, 11.544 kg of sand with 7.696 kg of HDPE plastic, 13.736 kg of 20mm coarse aggregate and 13.745 kg of 12.5mm coarse aggregate and the water required for this proportion is 3.622 kg.

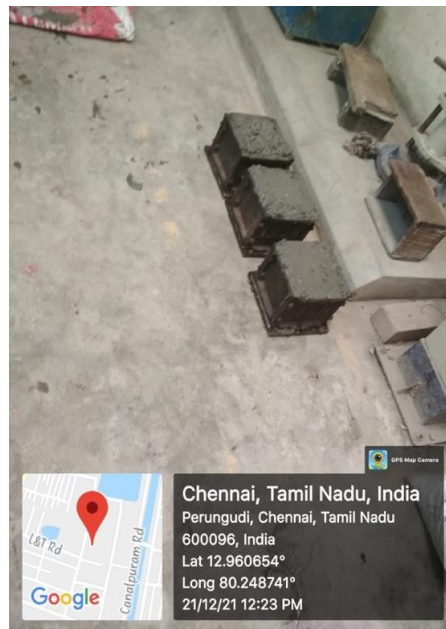


Fig 4.2.1



Fig 4.2.

4.3 MIX DESIGN

Table 4.3.1 : Mix Proportion for Reference Concrete

Reference Block	Cement: Sand: Aggregate
Concrete Block M30	1:0.75:0.5

**Table 4.3.2: Mix Proportions for Partially Replaced Plastic Waste Concrete
(Cement: Sand: aggregate)**

% Of Plastic waste replacement (mix design)	Cement: Sand: Aggregate
10% plastic waste replacement	1:0.65:0.5
20% plastic waste replacement	1:0.55:0.5
25% plastic waste replacement	1:0.5:0.5
30% plastic waste replacement	1:0.45:0.5



Fig 4.3.1

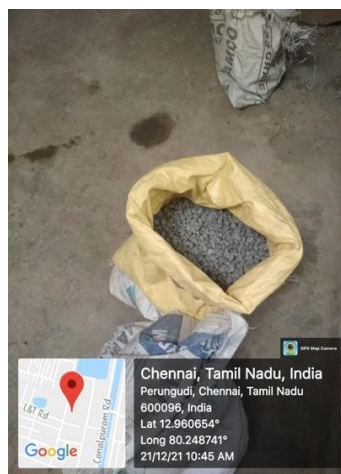


Fig 4.3.2

CHAPTER 5 RESULTS

5.1 WORKABILITY TEST

Slump Cone Test: there are two main test that help you to determine the workability of concrete. The first test is known as the slump test. After mixing each sample, a sedimentation test was performed. The slump test does not measure the workability of concrete. However, this is denoted as a measure of consistency and is one of the most effective tests for detecting variations in mixing uniformity. Before being moulded, a fresh concrete sample was evaluated. At various periods, four distinct concrete mixtures are made. To eliminate vibrations and shocks, the slump cone was put on top of the sample tray. This also ensured that the slump cone was positioned on a level, smooth, and horizontal surface. After that, the droop cone was fastened to the ground by putting two feet on the handle to ensure that it was secure. Using a trowel, the slump cone was then filled in three equal thicknesses. The layers were tamped consistently with 25 strokes of the tamping rod as they were poured into the cone. To guarantee that the cone was severely compressed, the concrete was poured until it overflowed. The tamping rod was used to roll off the surplus mixture after the final layer was poured and tamped. The cone was raised in two to three seconds, and the full test took around 150 seconds in total. After the specimen was taken from the slump cone, the cone was flipped upside down to support the tamping rod, allowing a measurement of the slump to be made. The table shows the results of the slump cone test for concrete grade M30.

Table 5.1.1 : Slump cone test results

S.I No	Mix design	Values
1)	M30 concrete mix	90 mm
2)	10% HDPE aggregate replacement mix	110 mm
3)	20% HDPE aggregate replacement mix	102 mm
4)	25% HDPE aggregate replacement mix	92 mm
5)	30% HDPE aggregate replacement mix	69 mm

In table 5.1.1, the values for normal conventional block and blocks with different plastic proportions are obtained. The tabular column indicates that, with normal M30 concrete mix with 0% plastic waste has obtained 90mm in the slump cone test whereas the concrete mix with 10% of plastic has increased significantly by adding 10% of HDPE plastic and 20% of plastic mix has decreased compared to the 10% of plastic followed by the 25% of plastic but higher than the conventional concrete mix, however the least slump value has been obtained by 30% of concrete mix with plastic. So, therefore increasing percentage of plastic decreases the workability of concrete.

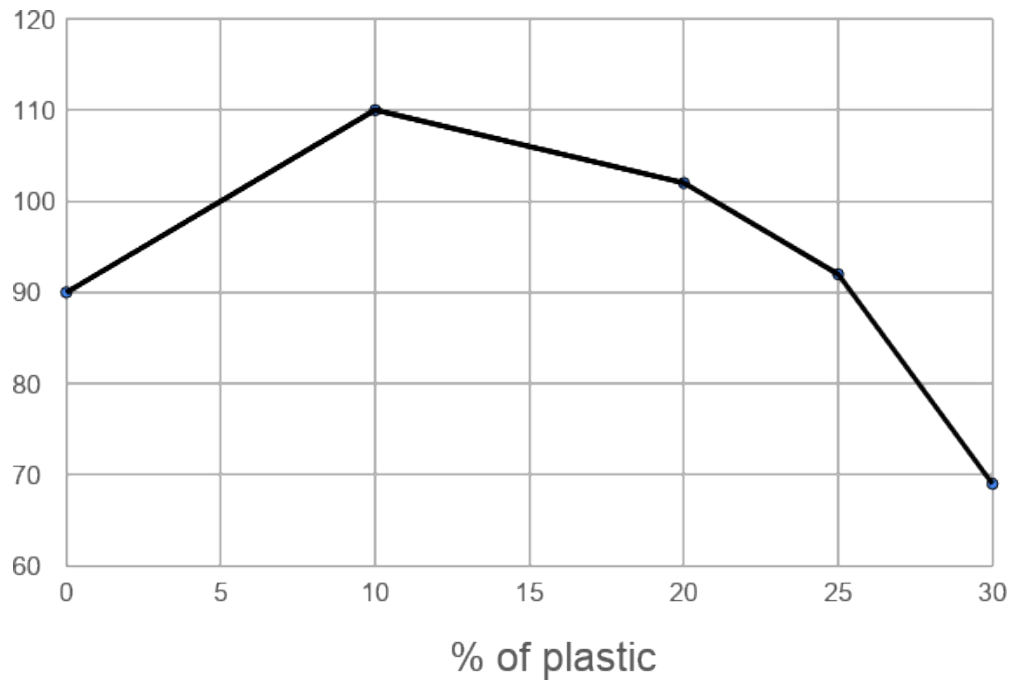


Fig 5.1.1 : slump cone



Fig 5.1.2



Fig 5.1.3

Compaction Factor Test: This is the second test that is conducted to check the workability of the concrete. This can also be called as Degree Compaction Test. This provides a reference to the compatibility of concrete. The compaction factor test was done on the same mix that was slump cone tested for workability. Firstly, the concrete will be transferred from the mixer and poured into another container in order to distribute the concrete equally to check the compaction factor of the concrete mix. Once the container is filled with the concrete mix, the excess concrete mortar has to be removed and should have a smooth surface. Then the vibrating table will be activated which allows the concrete mix to compact until no further reduction of volume. Once the concrete has been compacted, we could derive the value for each concrete mix where the experiments are conducted. The following table summarises the findings of the compaction factor test for the workability of several M30 grade concrete replacement mixes.

Table 5.1.2 illustrates the compaction factor for different concrete proportions. Sample 1 refers to the concrete mix with zero percent plastic in concrete mix and the value of compacted concrete has been mentioned as 0.87. Then sample 2 indicates the concrete mix with 10% of HDPE plastic and this sample holds the highest compaction of 0.91 followed by the sample 3 which 20% of HDPE plastic by replacing fine aggregate in concrete. The value for 20% of plastic aggregate slightly increased than the conventional concrete but decreased when the plastic percentage increased. In sample 4 and sample 5, the compacted values are lesser than the conventional block with 0% of the plastic mixture. This refers that, inducing an excessive amount of plastic in concrete decreases the workability of concrete.

Table 5.1.2 compaction factor test results

S.I No	Description	Sample 1 (0% waste)	Sample 2 (10% waste)	Sample 3 (20% waste)	Sample 4 (25% waste)	Sample 5 (30% waste)
1)	W_1	4.34	4.34	4.34	4.34	4.34
2)	W_2	14.38	14.52	14.41	14.24	14.21
3)	W_3	15.80	15.56	15.72	15.94	16.13
4)	$W_P = W_2 - W_1$	10.04	10.18	10.07	9.90	9.87
5)	$W_F = W_3 - W_1$	11.46	11.22	11.38	11.60	11.79
6)	Compaction Factor = W_P / W_F	0.87	0.91	0.88	0.85	0.83

W_1 – the weight of the empty cylinder

W_2 – the weight of empty cylinder + free fall

W_3 – the weight of empty cylinder + hand compacted concrete

W_P – the weight of partial compacted

W_F – the weight of fully compacted concrete

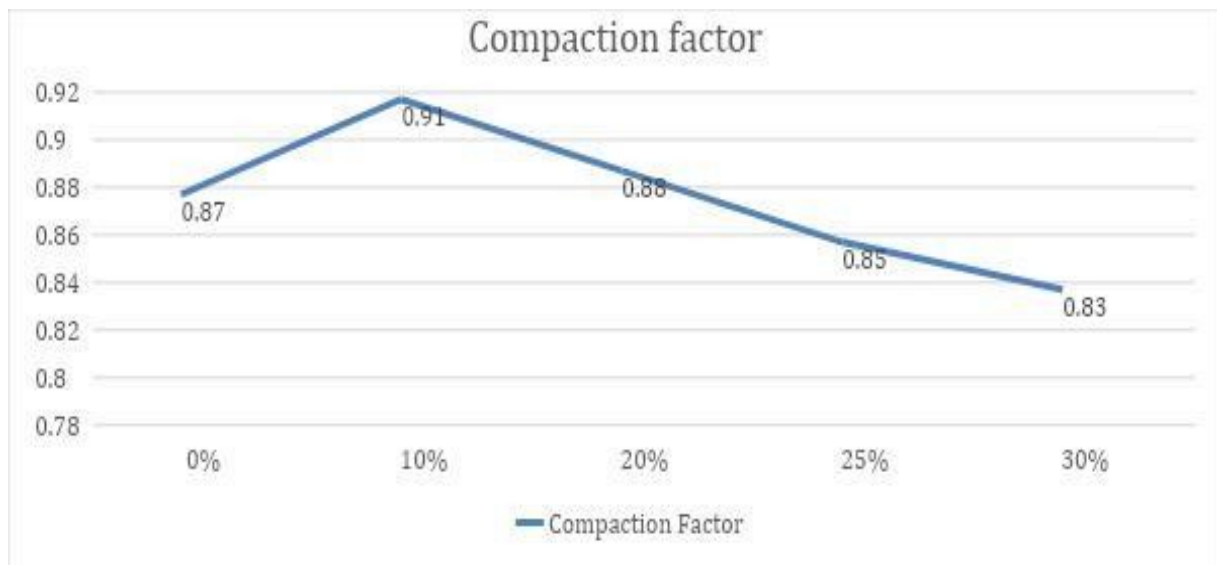


Fig 3.5.1 compaction factor



Fig 5.1.4

5.2 MECHANICAL PROPERTIES OF CONCRETE

Compressive strength on concrete: Concrete's compressive strength is one of its most essential characteristics. In general, increases in compressive strength are proportional to increases in all other concrete qualities, i.e., these properties improved as compressive strength increased. A total of 12 cubes measuring 150 x 150 x 150mm were cast and tested for seven days, fourteen days, and twenty-eight days. The concrete is mixed in a precise quantity, put into the mould, and tempered appropriately to avoid voids. The results are listed in the table below.

Table 5.2.1 : Compressive strength of concrete

PERCENTAGE OF PLASTIC	7 TH DAY	14 TH DAY	28 TH DAY
0%	18.5	24.4	29.9
10%	19.9	25.6	33.1
20%	21.1	27.4	35.6
25%	19.5	24.7	30.9
30%	14.7	18.5	24.9

Table 5.2.1 denotes the compression strength of various concrete mixtures including plastic by different percentages such as 0%,10%,20%,25% and 30% and the results are achieved for three different time periods which are 7th day, 14th day and 28th day. The concrete mixture with 0% of plastic is the normal M30 concrete mix and the compressive strength for the 7th day, 14th day, and 28th day are derived. Then, compression strength tests were taken for 10% of plastic aggregate in the concrete mix which clearly states that there is a gradual increase in each time period. 20% of plastic aggregate in the concrete mix has the highest compressive strength value derived compared to all other proportions. However, the lowest compressive strength value is calculated in 30% of fine aggregate replaced with plastic. Therefore, an increase in plastic percentage decreases the compression strength.

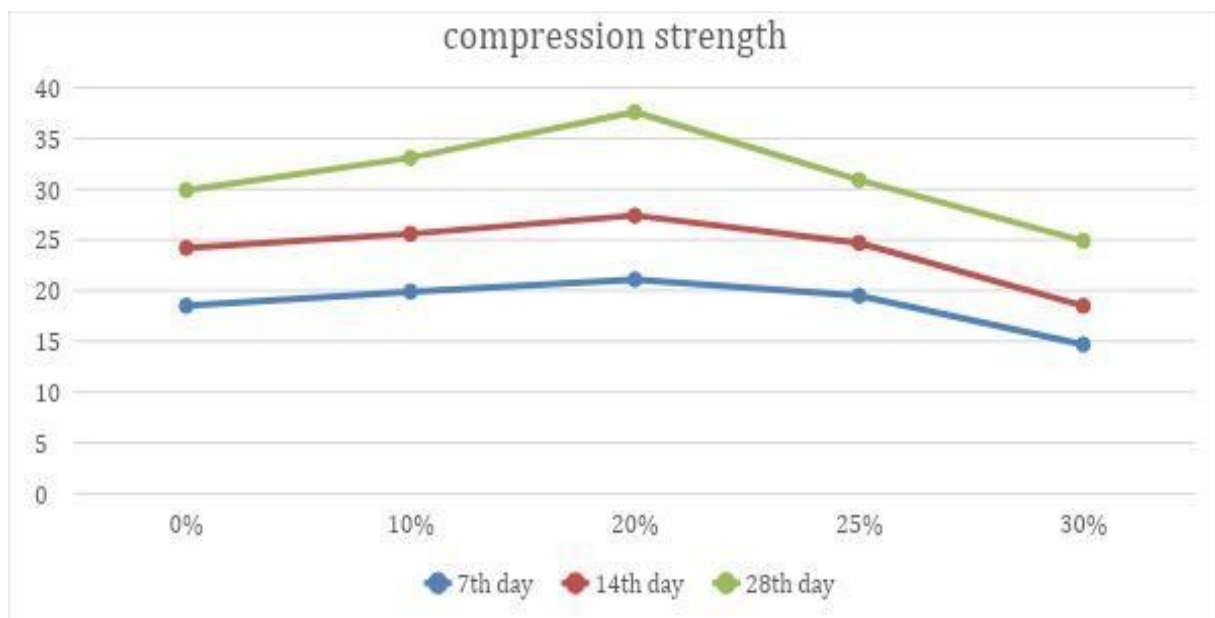


Fig 5.2.1 : compression strength of concrete



Fig 5.2.2

Flexural strength on concrete: The specimen is made by putting the concrete in the necessary mould form of 15 cm x 15 cm x 70 cm beam with adequate compaction, then placing the specimen in water for 24 hours to cure. The flexural strength of all the mixes prepared for various replacements acquired by testing the cylindrical specimen for the M30 grade of concrete are listed below.

The table 5.2.2, The flexural strength of concrete for the concrete mixtures has been calculated. The test is conducted on five different proportions of plastic aggregate which are 0%, 10%, 20%, 25% and 30%. The result for concrete mix with 0% plastic which is M30 conventional concrete has been taken for 7th day, 14th day and 28th day respectively. The highest flexural strength with inclusion plastic aggregate is achieved by 20% of plastic aggregate and the lowest flexural strength is derived for 30% of plastic aggregate.

Table 5.2.2 : Flexural strength of concrete

PERCENTAGE OF PLASTIC	7 TH DAY	14 TH DAY	28 TH DAY
0%	25.1	31.2	41.1
10%	28.9	35.7	45.2
20%	34.2	44.0	50.3
25%	25.4	32.1	44.3
30%	14.5	29.9	30.8



Fig 5.2.3

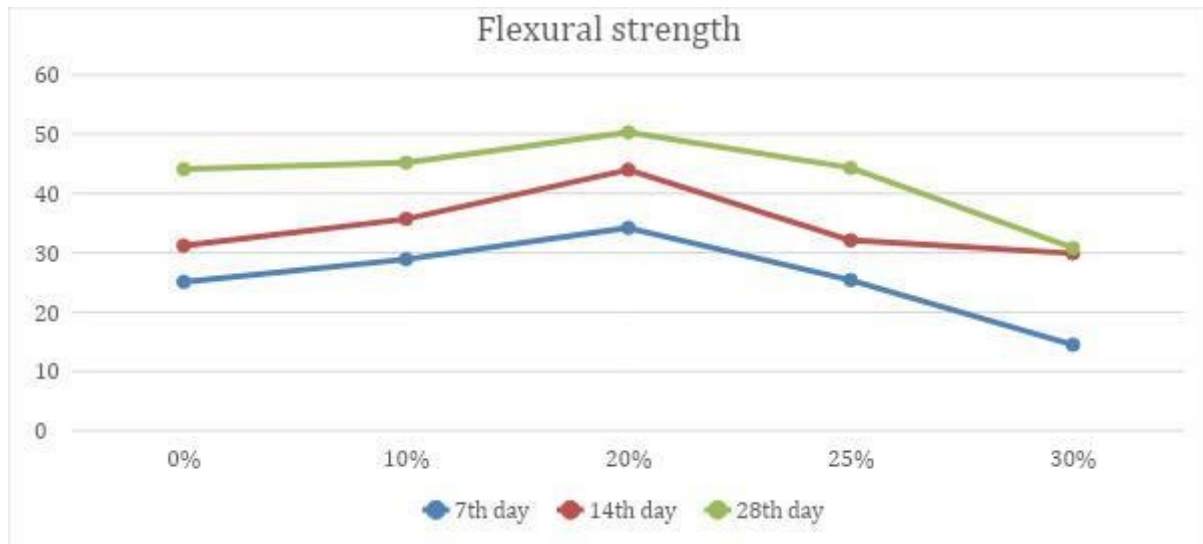


Fig 5.2.4 : Flexural strength of concrete

Split Tensile strength: After 24 hours, the concrete is mixed to the right proportions, and the specimen is made by pouring the concrete into a 15 cm x 30 cm cylinder mould and compacting it properly. Immerse the specimen in water to cure it. The split tensile strength of all the mixes prepared for various replacements acquired by testing the cylindrical specimen for M30 grade of concrete is presented below.

The table 5.2.3 indicates the Split Tensile strength of concrete for five different proportions of concrete mixture with the addition of HDPE plastics and the results are derived for 7th day, 14th day and 28th day. Sample 1 refers the normal conventional M30 concrete block with zero percent of plastic in it. Then, sample 2 indicates the concrete with 10% of plastic aggregate and the value of that mixture has increased compared to the normal conventional concrete block and 10% of plastic concrete mix holds the highest tensile strength compared to other concrete mixture with different percentage of plastic.

Table 5.2.3 : Split Tensile strength of concrete

PERCENTAGE OF PLASTIC	7 TH DAY	14 TH DAY	28 TH DAY
0%	15.9	28.1	36.8
10%	24.1	31.8	45.6
20%	21.8	27.2	38.1
25%	18.1	25.7	35.1
30%	15.3	21.2	29.8



Fig 5.2.5

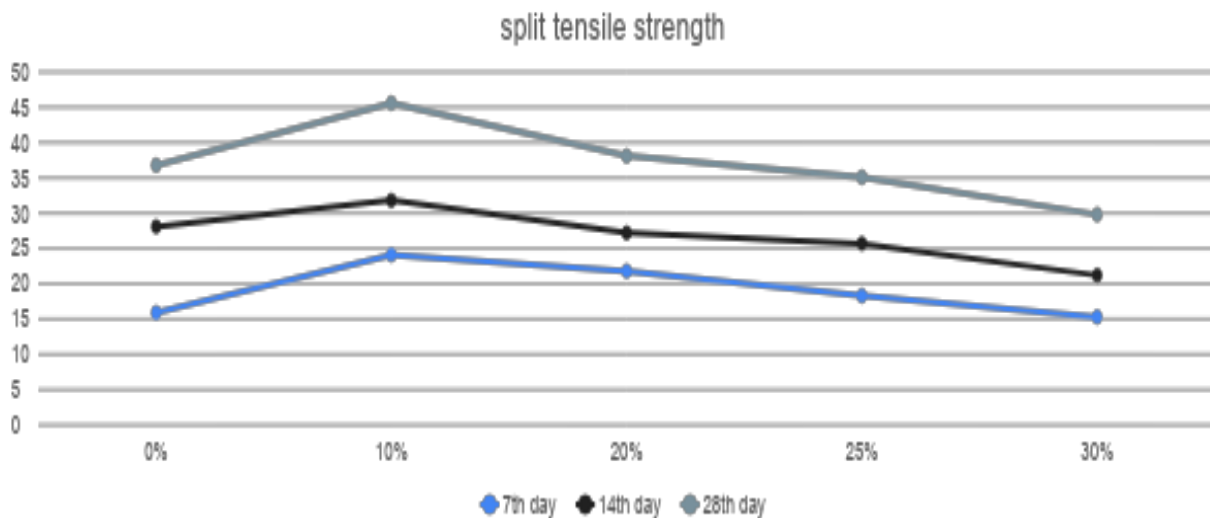


Fig 5.2.6 Split Tensile Strength

5.3 DISCUSSION

The key benefit of this project is that it will improve workability by reducing the amount of water absorbed by the plastic. Furthermore, environmental pollution, fine aggregate scarcity, and material prices are also lowered. The results of the tests on components including cement, sand, and aggregate were all within permitted limits, according to IS requirements.

1. When it comes to workability testing, the slump cone test of the nominal mix is at its optimal value of 90mm, followed by the concrete blocks induced with plastic aggregates that vary in percentages of plastic. The slump value has grown up to 100mm in 10% of the sample and 102mm in 20% of the sample, however the slump value has swiftly dropped in 25% and 30% of the sample mix. As a result, the ideal slump value is calculated to be 20%.

2. The Compaction factor test has been conducted on the M30 concrete specimen in order to check the workability of the concrete. There is a slight increase in compaction factor for the sample 10% which is 0.91. Apart from the 10% sample, the other samples have similar values. Therefore, nominal mix and plastic induced mix have similar values in compaction factor.
3. The compressive strength of the concrete has reduced as the percentage of plastic increased. The optimum value had been derived in the 20% sample whereas the lowest value is from the 30% sample.
4. The flexural strength of concrete also decreased when the ratio of plastic increased. The concrete mixture with 30% of plastic has the lowest flexural strength at 28 days whereas the concrete mixture with 20% of plastic mix has the highest flexural strength at 28 days.
5. Similarly, the split tensile of concrete has decreased when the addition of plastic increased. The concrete mixture with 10% of plastic has the highest split tensile value whereas the lowest is at 30% plastic mix in concrete.

CHAPTER 6

CONCLUSION

On the whole, inclusion of plastic mixture in concrete blocks leads to several beneficial activities such as reducing the pollution of the environment, scarcity of fine aggregate and also reducing the cost of material. However, increase in plastic percentage tend to decrease the mechanical properties of the concrete whereas the workability of the concrete mixture did not change significantly. Without adding admixtures, the ideal percentage of plastic mix in concrete is 20% which has the optimum values in all the mechanical properties. The utilization of waste plastic aggregate can be beneficial from a conservation standpoint, as well as cost-effective and energy-saving.

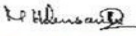
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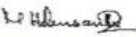
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