

Study On Concrete Made By Partial Replacement Of Sand With Shredded Plastic

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Abstract – India, in 21st century is facing a big problem of plastic waste which is increasing year after year. No current solution is adequate enough to use the huge amount of plastic waste that we are facing because the land area used for waste disposal and height of waste piled up there is increasing every year. A solution is needed which is about the same scale as the rate of plastic waste produced per year. The highest amount of artificial material that humans use is Concrete. If waste plastic is mixed in concrete in shredded form replacing a small amount of its constituents it can provide a possible solution for the above mention plastic problem. In this study the suitability of plastic is checked whether it is beneficial or not to be used as a building block. PVC plastic is mixed in shredded form replacing sand in concrete in proportions of 2%, 4%, 6% and 8% by weight of sand. The concrete made using plastic was then tested for its compressive strength and split tensile strength. The results were compared with regular concrete and it was that compressive strength and split tensile strength were maximum at 6% replacement of sand with plastic.

Key Words: Plastic, concrete, PVC, waste, compressive strength test, split tensile strength.

1. INTRODUCTION

The majority of the world that humans have now constructed is comprised of concrete. Concrete is used in virtually every structure that humans have created. Nowadays, concrete is used to build everything from malls to skyscrapers to residences, bridges, railway sleepers, dams, and more. This artificial stone's formula was created over time, not in a single step, with ongoing improvement. A variety of substances have been evaluated for use as constituents, and a select handful of them have been approved as admixtures. These admixtures improve the qualities of concrete and make it more suited to the shifting demands of a rising world. Some of the admixtures increase the concrete's resistance to chemicals and water, some make it lighter and stronger, some cause it to set more rapidly while others cause it to set more slowly. There is still a desire to produce concrete that is even more useful. Recycled plastic is one of the elements that is now being considered because, firstly, it would be a boon if we could use the tonnes of plastic garbage that are thrown away each year, and secondly, plastic is a very

versatile material, and utilising it in concrete can improve its qualities. Plastic in the form of shreds is being examined in the current experimental investigation as an additive for plain cement concrete.

1.1 Need of Study

Human activity is destroying the planet at a rate that has never been seen before. The land, the water, the glaciers, and the air are all being impacted. We still require natural resources for the contemporary way of life, but we also produce garbage in the process. People want to preserve the environment, but they also don't want to give up their existing way of life. In the modern world, a sustainable strategy is necessary, which entails using resources in a way that meets our generation's demands while replenishing them so that our next generation may benefit from the same resources as we do. This concept includes recycling trash which is produced now a days in order to attain zero waste disposal on the globe. The goal of zero waste on the planet is to maximise the resource utilisation.

The purpose of this study is to find a solution to the ongoing issue of the production of large amounts of plastic waste by counteracting the enormous rate at which this waste is produced each year. Statista.com [1] estimates that India will consume 328, 327, and 349 million metric tonnes of concrete in 2019, 2020, and 2021, respectively. Additionally, it is predicted that 379 million metric tonnes would be consumed in 2022. There are 3.4 million tonnes [2] of plastic garbage produced every year, which represents around 1% of the concrete used in construction. This demonstrates that, at least in terms of quantity, concrete may be the best way to utilise discarded plastic.

1.2 Objective of the study

The study's goal is to demonstrate that plastic garbage may be crushed and added to ordinary cement concrete as an additive without significantly changing the concrete's qualities. Additionally, to demonstrate that a little portion of sand may be replaced with shredded plastic to reduce the cost of the concrete, which is excellent news for everyone. To demonstrate this, various samples (cubes) of plain cement concrete and plain cement concrete with plastic admixture were created using various plastic admixture percentages. In order to draw conclusions on the acceptability of plastic in concrete, these cubes are next tested for strength, durability, and efflorescence. The

findings are compared between regular plain cement concrete and concrete with plastic admixture.

Using plastic as one of the basic materials for concrete would be a gift to the planet at a time when plastic waste poses a serious danger to the seas and marine life. The amount of plastic-debris that accumulates on land is enormous and it not only floats on the ocean. According to censusindia.gov.in, India, a big developing nation with a 3.39 Mkm² territory and more than 1.3 billion people[3], is through an era of fast building. Setting up a plastic concrete business might be highly beneficial for the nation's future.

2. Experiments and Results

2.1 Materials Used

Cement used: ordinary Portland cement of grade 43 was used.

Water used: Fresh Tap water was used.

Sand used: River sand was used.

Coarse Aggregate used: Crushed Stones were used.

Plastic used: Finely shredded PVC plastic was used.

Table -1: Properties of cement

| Physical Properties | Test Results |
|----------------------|------------------------|
| Consistency | 28% |
| Initial Setting Time | 44 min |
| Final Setting Time | 460 min |
| Compressive Strength | 44.3 N/mm ² |

Table -2: Properties of Fine Aggregate

| Physical Properties | Test Results |
|---------------------|--------------|
| Fineness Modulus | 2.63 |
| Specific Gravity | 2.66 |

Table -3: Properties of Coarse Aggregate

| Physical Properties | Test Results |
|---------------------|--------------|
| Fineness Modulus | 7.48 |
| Specific Gravity | 2.61 |
| Crushing Value | 17.4 % |



Fig -1: Shredded Plastic

2.2 Concrete Mix: Cubes and cylinders of M25 grade concrete were made with partial replacement of sand by 0%, 2%, 4%, 6% and 8% PVC shredded plastic. Water cement ratio 0.45 was adopted.

Table -4: Quantity of Material Used

| Material | 0% PVC | 2% PVC | 4% PVC | 6% PVC | 8% PVC |
|------------------|---------|----------|----------|----------|----------|
| Cement | 6.2 kg | 6.2 kg | 6.2 kg | 6.2 kg | 6.2 kg |
| Fine Aggregate | 6.2 kg | 6.076 kg | 5.952 kg | 5.828 kg | 5.704 kg |
| Shredded PVC | 0 g | 124 g | 248 g | 372 g | 496 g |
| Coarse Aggregate | 12.4 kg | 12.4 kg | 12.4 kg | 12.4 kg | 12.4 kg |

Table -5: Compressive Strength of Concrete with Plastic

| PVC percentage in concrete | 7 day Strength | 14 day Strength | 28 day Strength |
|----------------------------|----------------|-----------------|-----------------|
| 0 % | 17.4 kN | 22.59 kN | 25.10 kN |
| 2 % | 18.5 kN | 22.77 kN | 25.30 kN |
| 4 % | 19.9 kN | 24.14 kN | 26.82 kN |
| 6 % | 20.2 kN | 24.88 kN | 27.64 kN |
| 8 % | 19.5 kN | 21.34 kN | 23.71 kN |

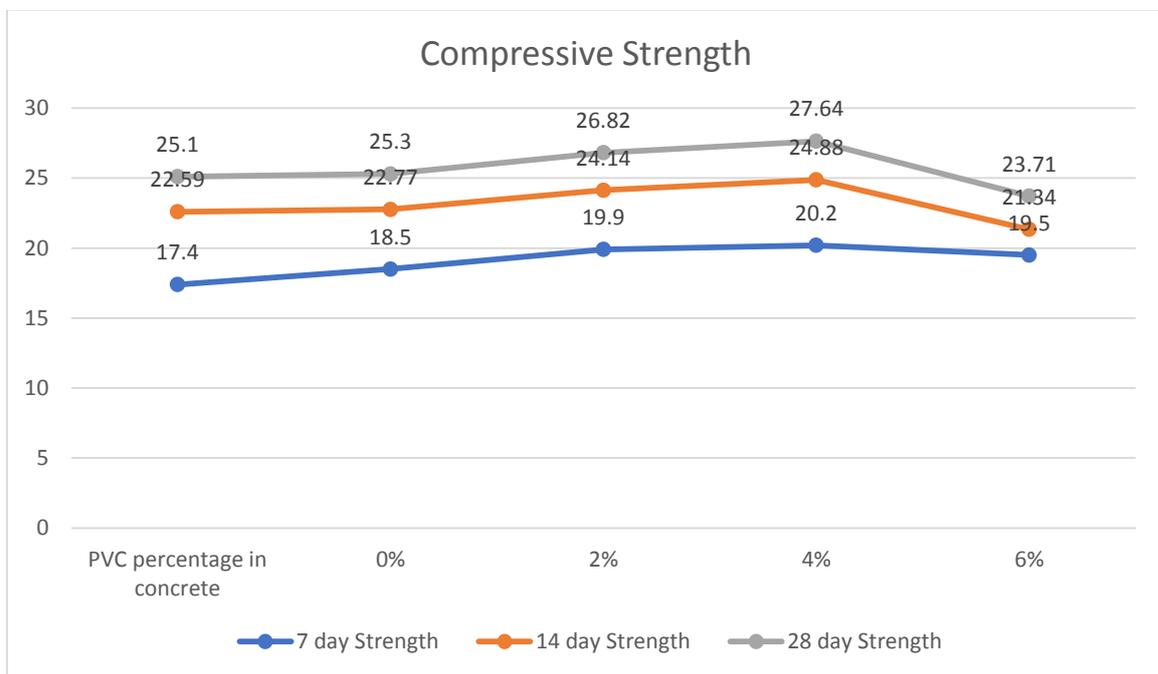


Chart -1: Compressive Strength of Concrete with Plastic

Table -6: Split Tensile Strength of Concrete with Plastic

| PVC percentage in concrete | 7 day Strength | 14 day Strength | 28 day Strength |
|----------------------------|----------------|-----------------|-----------------|
| 0 % | 1.73 kN | 2.29 kN | 2.54 kN |
| 2 % | 1.76 kN | 2.28 kN | 2.51 kN |
| 4 % | 1.81 kN | 2.37 kN | 2.63 kN |
| 6 % | 1.93 kN | 2.45 kN | 2.72 kN |
| 8 % | 1.64 kN | 2.03 kN | 2.31 kN |

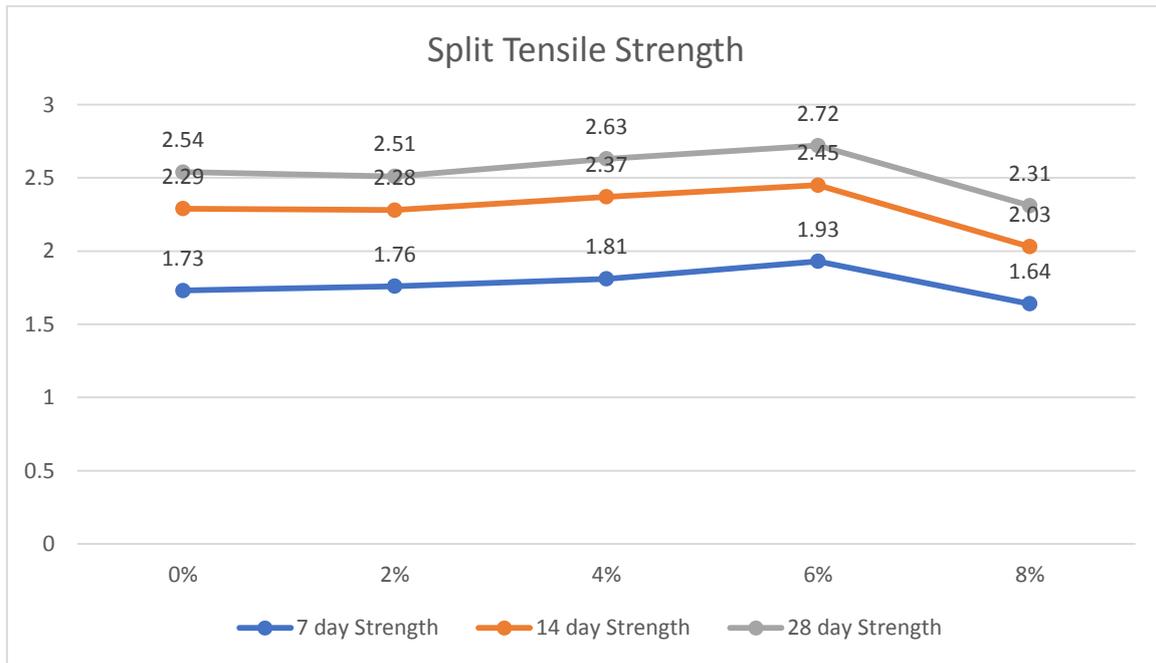


Chart -2: Split Tensile strength of Concrete with Plastic

3. CONCLUSIONS

- a) PVC in shredded form can be used effectively in concrete because it makes concrete cheaper and stronger to some extent.
- b) At 6% replacement of sand PVC plastic gives best compressive and split tensile strength results.
- c) On increasing the amount of PVC plastic furthermore a decline in compressive and split tensile strength occurs.

REFERENCES

- [1] <https://www.statista.com/statistics/269322/cement-consumption-in-india-since-2004/>
- [2] <https://plasticoceans.org/the-facts/>
- [3] <https://www.india.gov.in/india-glance/profile>