

Mechanical Properties Investigation on M40 Grade Cement Concrete by Utilization of Waste Plastic and Crumbled Rubber

Bopparaju Maheshbabu

Sri Mittapalli College of Engineering, Tummalapalem, NH-16, Guntur, Andhra Pradesh

Abstract

Waste plastic and crumb rubber is an industrial by product; they possess the problem of disposal as waste and is of environmental concern. In the present era, demand for aggregate in construction industry is increasing rapidly and so, is the demand for cement concrete. Thus, these waste materials become important to seek suitable alternatives for aggregates in future development. My thesis will study the natural coarse aggregate were partially replaced with crumb rubber and waste plastic as aggregate at various proportions like 0, 2.5%, 5%, 7.5%, 10% to find the optimum usage value of crumb rubber in concrete and the natural coarse aggregate is partially replaced with waste plastic at various proportions of 5%, 10%, 15%, 20%, 25% in the obtained optimum value of concrete. Experiment was conducted on M40 grade concrete to determine the compressive strength, split tensile strength and ultrasonic pulse velocity. The results were compared with Traditional concrete.

Keywords: Crumb rubber • Waste plastic • M40 grade • Environmental pollution • Alternate aggregates

Introduction

Ecological development is become the prime focus and responsibility of the civil engineers, engineers and society are collectively working for development and validating environment approachable solutions for recycling materials and scrap management is the one type construction part of civil infrastructure. For the past decades, there has been a drastic change in the way of thinking about the approach and evolution of new and advance construction materials. Aborting of waste tyre rubber and waste plastic are one of the major concerns for all over the world. With drastic increase in the country automobiles and waste plastic during the past few decades, the demands of utilization of both are increased. The disposed materials are to the landfills constitutes one of the important part of solid waste from the remaining. Among the disposal methods, burning of tyres & plastic in open air is causing serious fire hazards. Besides this, the final residue after burning pollutes the fresh atmosphere by increasing carbon monoxide reducing the oxygen levels as well as the natural earth by its deposition. By the end of 2040, the number of tyres deposition in to landfills from automobiles is about to reach 1600 million assuming that almost 7000 million tyres will be discharged. India ranked second largest producer in the world. According to FICCI study The processing of plastic materials and related industry is estimated to grow to twenty two metric tonnes (MT) a year by 2020 from in 2015 the estimated grow is 13.4 only , this paper major aim is utilizing the bias tyres rubber and plastic use as replacement materials for the concrete mix [1].

Research Significance

- Durable & Corrosion Resistant

**Address for Correspondence:* Bopparaju Maheshbabu, Assistant Professor, Sri Mittapalli College of Engineering, Tummalapalem, NH-16, Guntur, Andhra Pradesh, Tel: + 0863 234 4422; E-mail: babu.mahesh899@gmail.com

Copyright: © 2020 Maheshbabu B. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Received 28 July, 2020; **Accepted** 19 August, 2020; **Published** 26 August, 2020

- Good insulation in summer and winter seasons
- It is cost effective
- Maintenance free
- Longer life span

Used materials

- Crumb Rubber
- Waste plastic
- Cement
- Fine aggregate
- Coarse aggregate
- Water
- Admixture

Methodology & Tests

I casted the required cube specimens of sizes 150 mm × 150 mm × 150 mm according to Indian standards followed by Mix Design, Mix design was formulated according to IS 10262-2009 and used IS 456-2000 [2,3].

Also Conducted the material Tests on Portland cement of grade 53 Deccan cement, zone –II sand with fineness modulus 2.2 and coarse aggregates used are 12 mm and 20 mm angular sizes used, I got the satisfactory results on raw materials (Table 1, Figures 1, 2 and 3).

Results and Discussion

- A. Comparison Graph of Normal Mix, Waste Plastic & Crumb Rubber 7 Days shown in Figure 4 [4].
- B. Comparison Graph of Normal Mix, Waste Plastic & Crumb Rubber 28 Days shown in Figure 5.

Table 1. Results on raw materials.

Property	Cement	Sand	Gravel	Crumb Rubber	Waste Plastic
Specific Gravity	3.15	2.65	2.71	1.16	-
Bulk density	1440	1480	1620	650	-
Fineness	2400	2.2	7.1	-	-
Water absorption	-	1	1	-	-
Surface moisture	-	0.06	0.09	-	-
Color	Grey	Beige	Blue	Black	white



Figure 1. Addition of fibres.



Figure 2. Preparation of mix.

- C. Comparison Graph of Compressive Strength 7 days vs. 28 days shown in Figure 6
- D. Comparison Graph of Split Tensile Strength shown in Figure 7.
- E. Ultrasonic Pulse Velocity Test Reports for Cubes shown in Table 2.



Figure 3. Casting cubes.

GRAPH OF NORMAL MIX, WASTE PLASTIC & CRUMB RUBBER 7 DAYS

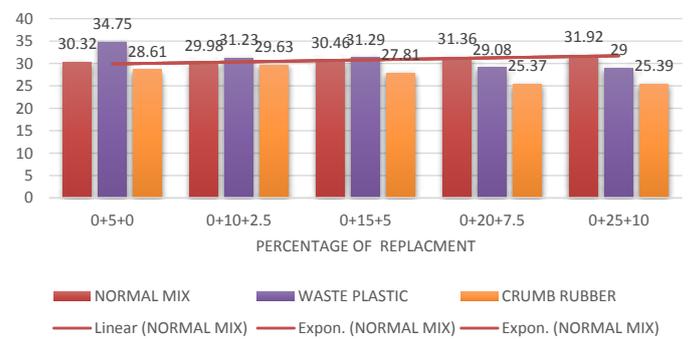


Figure 4. Comparison graph of normal mix, waste plastic & crumb rubber in 7 days.

GRAPH OF NORMAL MIX, WASTE PLASTIC & CRUMB RUBBER 28 DAYS

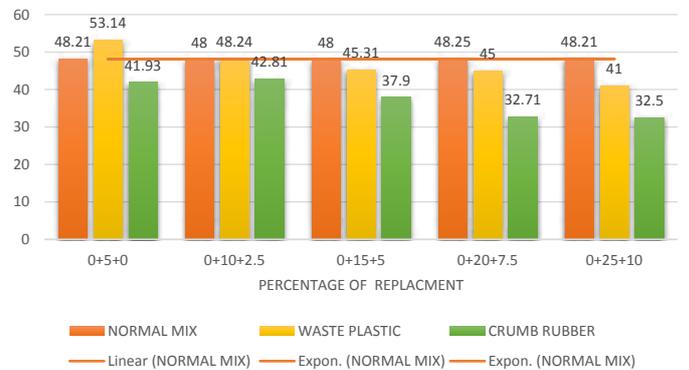


Figure 5. Comparison graph of normal mix, waste plastic & crumb rubber in 28 days.

7 DAYS Vs 28 DAYS

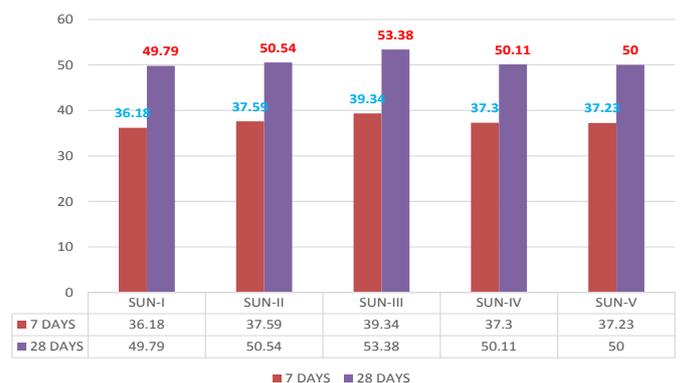


Figure 6. Comparison graph of compressive strength 7 days vs. 28 days.

7 DAYS Vs 28 DAYS

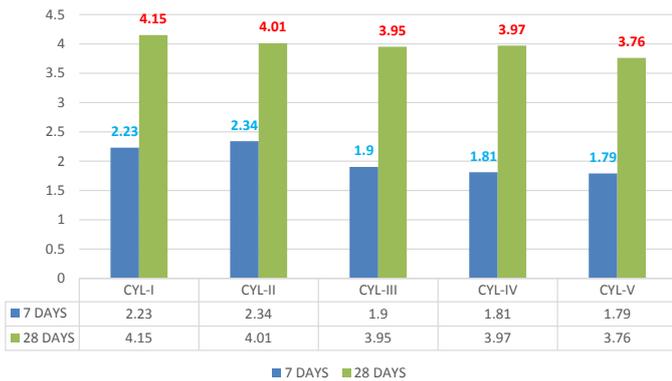


Figure 7. Comparison graph of split tensile strength.

Table 2. Ultrasonic pulse velocity test reports for cubes.

S No.	Cube Id	Obtained average velocity (m/s)	Quality of Concrete
1	SUN-I	3821	Good
2	SUN-II	4245	Good
3	SUN-III	4287	Good
4	SUN-IV	4891	Excellent
5	SUN-V	4896	Excellent

Conclusions

- This research is entirely new, by studying all the literature reviews of the waste plastic, crumbled rubber I set a perspective stage on by combining the both environment hazard materials in environment concern as wells it is useful to construction industry I think so.
- Both materials are very tough in nature and very useful when they are in civil engineering constructions too.
- By observing all the compressive strength results about this combination is a good one generally we have 65 % compressive strength for first seven 7 days in normal concrete mix, after casting cubes of the virgin mix we got 72 % of compressive strength achieved while testing.
- After testing 28 days compressive strength cubes we get what we expected, normal we have a target mean strength of 48.25 N/mm²,

we obtained 53.38 N/mm² at 28 days as for the replacement of 15% of crumb rubber and 5 % waste plastic [5].

- From the compressive strength results we obtained positive results in every stage of mixing those two materials.
- On other hand we have split tensile strength for the cylinders for the curing periods of seven and Twenty-eight days.
- Observing the graph, we have best replacement is 10 % of crumb rubber and waste plastic.
- We conducted UPV test on cubes in every aspect got excellent and good in quality of concrete
- We need to further checks on long term curing periods too like 56 days and 90 days.
- Concrete can be assessed on long term curing periods, we suggest this also a new replacement among the advanced materials.

Funding Agency

No funding received.

Acknowledgement

I am very thankful to my college management and Head of the department who supported up to completion of my report.

References

1. Shetty, MS. "Concrete Technology" (2019).
2. Raviraj, S. "Concrete mix proportioning Guidelines IS: 10262-2009" (2009).
3. <https://archive.org/details/gov.in.is.456.2000>
4. Subramani, T and VK Pugal. "Experimental Study On Plastic Waste as Coarse Aggregate for Structural Concrete" *International Journal of Application or Innovation in Engineering & Management* 4 (2015).
5. Prasoon, P, MS Ravi Kumar and Vaisakh G. "Experimental Investigation on Effect of Partial Replacement of Coarse Aggregate by Plastic Aggregate on M 40 Grade Self Compacting Concrete" *International Journal of Civil Engineering and Technology* 9 (2018): 964-970.

How to cite this article: Maheshbabu, Bopparaju. "Mechanical Properties Investigation on M40 Grade Cement Concrete by Utilization of Waste Plastic and Crumbled Rubber." *Civil Environ Eng* 10 (2020): 359 doi: 10.37421/jcce.2020.10.359