

# EXPERIMENTAL INVESTIGATION ON THE REUSE OF POLYPROPYLENE FIBERS FOR ADVANCING ON CONCRETE STRENGTH PROPERTIES

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**Abstract**—covid 19 pandemic resulted in the enormous growth in the use, production and disposal of PPE , face mask , gloves, face shield etc... plastic pollution to the environment is a major concern that is increasing due to the negligence of the waste management by human. After covid-19 health pandemic it created a extra pressure on the regular waste management system personal protective equipment. PPE is the main medical waste generated during the pandemic . it lead to the inappropriate waste management. PPE kits are made of polypropylene plastic that are non biodegradable like any other plastic which take 20 to 30 years and thus it is essential to develop a reusing approach of polypropylene in the various ways. In this paper we discuss the study procedure to utilize the polypropylene waste to effectively reuse in the concrete mix. The main objective of the study was to investigate the effectiveness of polypropylene in concrete mix to modified the mechanical properties. The different properties such as tensile, compression, flexural strength is compared with conventional concrete mix. The PPE were added by the volume of 0%, 5%, 1%, 1.5%, 2% and 2.5%. it is observed that PPE waste composite has better performance as compared to conventional concrete mix. This study is expected to enhance a new sustainable approach to utilization of polypropylene waste to concrete mix in the construction sector

**Keywords**-Concrete, Compressions strength, Split tensile strength, Flexural strength ,PPE

## I. INTRODUCTION

Plastic has become a major threat to natural Ecosystem. The global massive production of plastic is more than million tons and it limit the capabilities of waste management. After covid 19 outbreak consumption of plastic as personal protective equipment are vulnerable and contagious . during the corona virus health pandemic PPE personal protective equipment is used by the health care professionals and workers for the prevention against the virus. The use of PPE has emerged as a most preventive control measure to keep the covid 19 transmission. PPE consist of polymers and materials like polypropylene which are plastic which take years to be degraded. The enormous

usage of PPE will lead to massive generation of waste due to its single usage . one of the innovative way of managing waste of polypropylene from PPE is utilization along with the existing construction material . it is way of ecofriendly approach because the major problem occur in contagious waste produced after the single usage of PPE which is the root cause of severe environmental problems and health threat. Therefore, it is essential to integrate and reuse the plastic waste like polypropylene converted to product with relatively longer life time. In this work PPE waste been used as a material along with commonly used concrete construction mix . various strength and durability properties were assessed and result are compared with existing concrete mix.. Nowadays sustainable development is a highly concern . it is approachable method adopted to benefit the polypropylene fibers be reusing it in construction material by applied to concrete mix to improve the mechanical properties as well as converting the brittle to ductile nature

## II. OBJECTIVE

The objective of our study is to compare the compressive strength , flexural strength and tensional strength of conventional concrete mix and the effect of concrete mix made by utilization of polypropylene fibers and their impact on the concrete properties

## III. MATERIALS

**1.Cement:** OPC grade 53 cement was used for the experimental work as per The following test were conducted on the cement as per IS standard Given in the table 1.

TABLE 1 : Test on the cement

SI no	Name of the test	Result
1	Fineness	9%
2	Standard consistency	32%
3	Initial setting time	Less than 30 minutes
4	Final setting time	10 hrs
5	Specific gravity	3.06

**2.Fine aggregate:** The aggregate was chosen with respect to IS standard .Fine aggregate has a size upto 4.75mm

TABLE 2 : Test on fine aggregate

SI no	Name of the test	Result
1	Specific gravity	2.65
2	Particle size distribution	Zone 3, Fineness modulus 2.76, Uniformity coefficient 2.5
3	Bulking of sand	Max bulking 35.2%, Water content at max bulking 7%
4	Water absorption	1.25%

**3.Coarse aggregate :**coarse aggregate chosen was in the size range upto 20 mm.

TABLE 3: Test on coarse aggregate

SI no	Name of the test	Result
1	Specific gravity	2.65
2	Grain size analysis	Fineness modulus 5 Uniformity coefficient 1.28
3	Water absorption	1.55%

**4.Water:** drinkable water is used for the blending and conditioning of concrete.

**5.Polypropylene fibers:** polypropylene fibers from the personal protective equipment are used for this study. We collected the polypropylene fibers and then cutted into 1cm in both length and width.



Figure 1: Polypropylene fibres or PPE's

#### IV CONCRETE MIX DESIGN

Concrete mix design involve the process of finding the right proportion of cement, sand and aggregate to achieved the desired strength . it is done as per the Indian standard.

The obtained mix proportion is 1:1.3:1.91

Adopted water cement ratio is 0.38

TABLE 4:Mix specification

Proportion of polypropylene fibers	Mix specification
0%	Conventional mix
0.5%	S1
1%	S2
1.5%	S3
2%	S4
2.5%	S5



**V METHODOLOGY**

Ordinary Portland cement OPC of 53 grade fine aggregate, coarse aggregate, water and polypropylene fibers are utilized for the study. As per the Indian standard the properties of cement, fine aggregate and coarse aggregate are obtained and the obtained value are considered for the study. The polypropylene fibers are collected and cutted into required size of 1cm in both length and width. M35 mix with mix proportion 1:1.3:1.91 is adopted for the study. Nominal concrete were casted for determining the compressive strength, tensional strength and flexural strength at 7 and 28 days. concrete cubes cylinder Made by reusing the polypropylene fibers with varying percentage of 1%, 1.5%, 2% and 2.5% are casted and placed for curing and compression strength, flexural strength and tensional strength of same was determined.



Figure 2: Casting of specimens

**VI. RESULT AND DISCUSSION**

- Compression strength test

Compression strength test is carried out to determine the strength of concrete cube, cylinder and beam with varying proportion of addition of polypropylene fibers at 7 and 28 days. The concrete specimen with mould of cylinder, cube and beam with size of 300 mm height

diameter 150mm, 150\*150\*150, 500 \*150\*150\* respectively are casted for testing.

TABLE 5: Compressive strength after 7 days

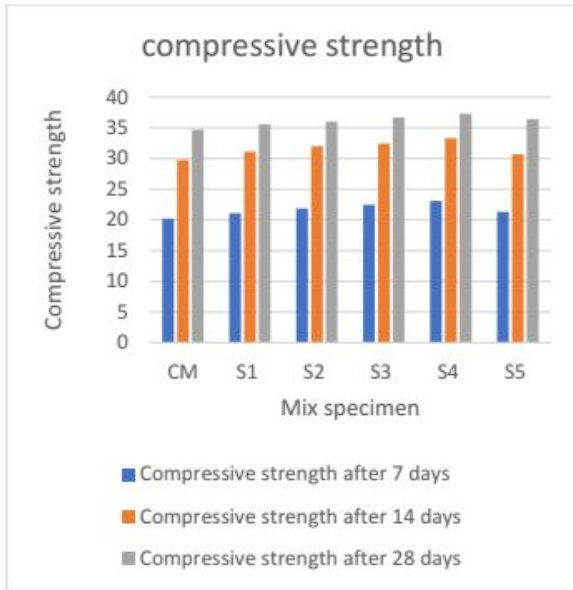
SI no	Mix Specimen	Load (kN)	Compressive strength (MPa)
1	Conventional mix	455	20.22
2	S1	475	21.11
3	S2	492	21.87
4	S3	505	22.44
5	S4	520	23.11
6	S5	480	21.33

TABLE 6: Compressive strength after 14 days

SI no	Mix specimen	Load (kN)	Compressive strength (MPa)
1	Conventional mix	670	29.78
2	S1	700	31.11
3	S2	720	32
4	S3	730	32.44
5	S4	750	33.33
6	S5	690	30.67

TABLE 7 : Compressive strength after 28 days

SI no	Mix specimen	Load (kN)	Compressive strength (MPa)
1	Conventional mix	280	34.67
2	S1	800	35.56
3	S2	810	36
4	S3	825	36.67
5	S4	840	37.33
6	S5	820	36.44



• Split tensile strength test

Split tensile strength is used to determine the tensile strength of the concrete to determine the load at which the concrete member may crack

Table 9: Split tensile strength after 28 days

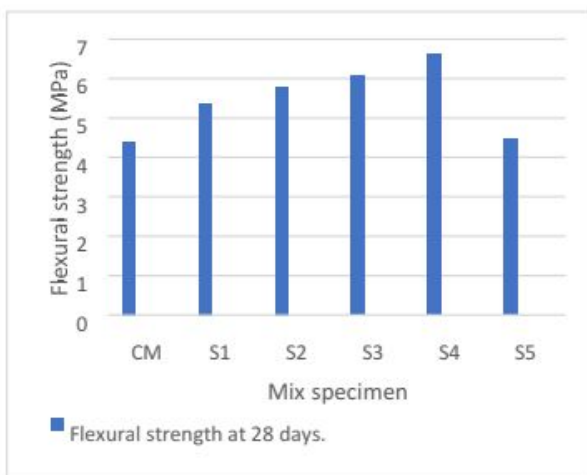
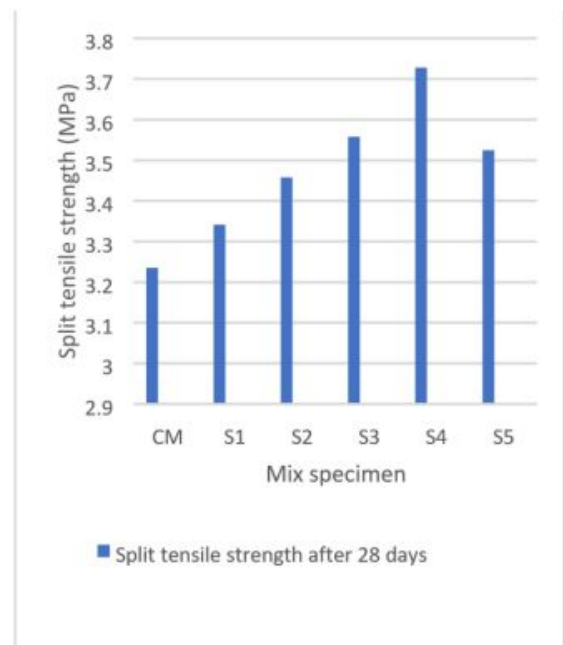
SI no	Mix specimen	Split tensile strength Mpa
1	Conventional mix	3.235
2	S1	3.341
3	S2	3.458
4	S3	3.558
5	S4	3.728
6	S5	3.525

• Flexural strength test

Flexural strength test is carried out to assess the tensile strength and the feasibility of the mix to applied load and the load at which it's the member subjected to crack .

TABLE 8: Flexural strength after 28 days

SI no	Mix specimen	Flexural strength (Mpa)
1	Conventional mix	4.405
2	S1	5.358
3	S2	5.796
4	S3	6.072
5	S4	6.610
6	S5	4.470



VII CONCLUSION

The impact caused by the single usage of the plastic o environment is very much hazardous and it generates the economic and social costs . The aim of the study is to better usage of polypropylene as a constituent in the construction material on how to act in a coordinated way to tackle this issue and promoting a sustainable approach. The usage of polypropylene fibres in the concrete mix improve the mechanical characteristics and resulting in the improvement in the compression , tensile and flexural strength test . the study contribute to the development of solid waste management and sustainable plastic reusing especially alarming the necessity to consider the environmental conservation .

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