e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

EXPERIMENTAL INVESTIGATION ON PROPERTIES OF CEMENT CONCRETE AND SELF COMPACTING CONCRETE BY USING DIFFERENT PLASTIC WASTE

Borlakunta Maneesh (18u61d2003)*1, Ms. Gollapalli Sandhya Rani*2

*1M.Tech Student, Department Of Civil Engineering, Global Institute Of Engineering & Technology, Moinabad, Telangana, India.

*2Asst. Professor, Department Of Civil Engineering, Global Institute Of Engineering & Technology, Moinabad, Telangana, India.

ABSTRACT

The disposal of solid waste is a important and main problem in populated countries. Plastic is one of the most common waste which are coming by many way and non degradable materials which produce many environmental issues/problems on the basis of physical property plastics are classified into different categories. Plastic waste should be recycled or reused because there are non- bio degradable. The main objective is to study the behavior and certain properties of the concrete which is made of the plastic materials. In the present study, attempts were made to use the plastic waste as partially replacement of fine aggregate for CM (1:3) in different proportions (2%,4%,6%) and for that replacements optimum value of percentage taken to check out the Strength properties of self-compacting concrete and conventional concrete.

I. INTRODUCTION

Self- compacting concrete is a self -consolidating concrete defined as a Concrete which is able to flow under its self-weight and to fill the formwork in complete, even in the presence of dense reinforcement, without using any vibration actions, whilst maintaining homogeneity. It was originally first developed in Japan, to overcome the problems caused by lack of complete and uniform compaction through vibrators. Self-compacting concrete is not affected by the shape and quantum of reinforcing bars or the enactment of a structure and, due to its high-property of flowing it easily a changeable quality and resistance to segregation it can be long distances (Bartos, 2000).

At initial stage and the hardened state, Inclusion of plastic fibers slightly improves the properties of this special concrete. Considering it, researchers have focused on studied the strength & durability aspects of self-compacting concrete with plastic wastes which are.

1. PVC (polyvinyl chloride)
2. ABS (Acrylonitrile Butadiene Styrene)
3. PP (Polypropylene)
4. PET (Polyethylene tetraphalate)
5. PS (Polystyrene)

First Stage Investigation Cement mortar mix cases:

Normal or control cement mortar mix case Cement Mortar mix case with PP Cement Mortar mix case with ABS The above mix cases have considered for both normal cement mortar and bacterial cement mortar. The mix proportion is adopted as 1:3 proportions.

Method of curing adopted: Laboratory method or submerged curing.

Ages of curing: To monitor the development of compressive strength of Normal and Bacterial cement mortar specimens, the curing of specimens up to 7 daysand 28 days have been considered.

Strength properties of cement mortar specimens: Compressive strength.

Specimens moulded: Cube Specimens.

Cube size: cube moulds of 70.7 X 70.7 X 70.7 mm size

Number of cubes: 3 for normal + 3 for each concentration of bacterial sample for each age of curing.

Total numbers of cubes cast: 24

Plastics used in this investigation are PVC, ABS, and PP a brief report of these plastics is given below.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

II. LITRETURE REVIEW

Ahana K Reji et.al.,(2018)

Author established In this study M30 cement concrete is considered in which the polypropylene is used as the partially replacement of fine and coarse aggregate in the concrete. Concrete cube & cylinder were casted taking 1 to 7% and 2.5- 10% weight of polypropylene as partial replacement of fine aggregate & coarse aggregate respectively. This project also covers Experimental study for the possibility of effective replacement of cement with metakaolin with optimal polypropylene (0%, 5%, 10%, 15%, 20% and 25%).The compressive strength of concrete increased by 0.72% by replacing polypropylene as fine aggregate. The split tensile strength of concrete increased by 2.23% by replacing polypropylene as fine aggregate.

Abdul Sami Kohistaniet al.,(2018)

Author established that the utilization of plastic waste and Alccofine for enhancing the durability and workability of self-compacting concrete, Alccofine as a partial replacement of cement and Plastic waste from PET fibers as a partial replacement of sand, in this investigation it's found to be very useful in the modification properties of self- compacting concrete and it enhance the durability and workability of self-compacting concrete As from results it observed

A.Muthadhi et al.,(2017)

Author established that the Experimental investigations on concrete with e-plastic waste" As coarse aggregate in concrete with partial replacement from 0% to 20 %on strength criteria of M20 concrete. Compressive strength of concrete at 7 and 28 days, and split tensile strength of concrete at 28 days were determined. The results implies that replacing natural coarse-aggregates with e-plastic waste doesn't affect workability significantly and compressive strength & split tensile strength of concrete was found to be marginally increased upto 10% partial replacement with natural aggregate.

III. METHODOLOGY

Introduction:

This chapter is dealing with the mix design M30 conventional concrete and M30 Self- compacting concrete. The concrete mix for M30 grade as per IS 10262-2009 and IS 456-200 has been used. The specified concrete grade includes the economical selection of relative proportions of cement, fine aggregate, coarse aggrgate and water. Although compliance with respect to characteristics strength is the main criteria for acceptance, it is implicit that concrete must also have desired workability in the fresh state and impermeability and durability in hardened state.

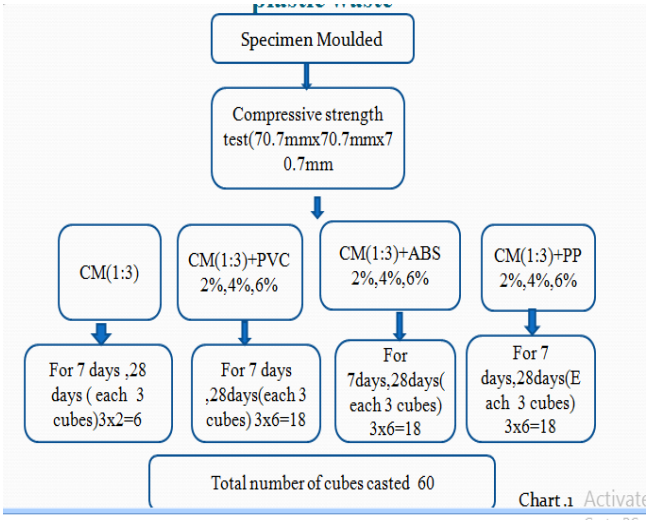
Table 1: physical properties of 53 grade cement

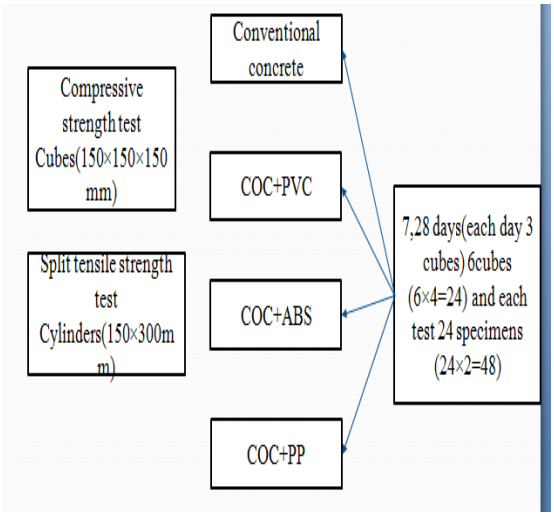
Sl.No	Description	Values
1	Specific gravity	3.15
2	Standard consistency	32%
3	Initial setting time	40min
4	Final setting time	350min.

Methodology

- To know the workability aspects of the concrete with and without plastic waste as compared with the normal concrete.
- To know the workability aspects of the scc with & without plastic wastesas compared with normal concrete as well as plastic concrete.
- To study the compressive strength of cement mortar with & without plastic waste.
- To study the mechanical properties of concrete with optimum Plastic waste percentage.
- To Study the mechanical Properties of self compacted concrete with optimum Plastic waste percentage.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com





Mix Design

Mix design of concrete suggests proportions of cement, fine aggregate, coarse aggregate and water based on the quality of the material used & their moisture content. Based on the experiments made in laboratory and revision in mix design the final mix - proportions are suggested. With the help of mix design we can provide concrete ranging strength from M10 to M100 for various workability requirements from no slump to 150 mm slump value.

Some admixtures are also required to enhance some properties of concrete such as setting time, workability etc. These admixtures are also needed to be considered during the mix-design calculations for their optimum use. Because their overdose can affect the properties of concrete and cause harm to strength of concrete

Mix Design For CM(1:3)

Cement =200 grams Sand =600 grams Water =83 ml

Mix Design for M30 Grade concrete

The mix design for M30 grade concrete has calculated by invesrigation was designed as per the guidelines specified in IS10262-2009 and IS456-2000.The mix proportions were calculated & presented below.

Maximum size of coarse aggregate = 20mm
Specific gravity of coarse aggregate = 2.6
Specific gravity of fine aggregate = 2.52
Cement = 438.13kg per cubic meter.
Water = 197.16 kg per cubic meter
Fine aggregate = 704.128 kg per cubic meter
Coarse aggregate = 986.918kg per cubic meter
w/c ratio = 0.45
Final mix proportion for M30 grade concrete 1 : 1.607 : 2.25

Mix design for M30 grade self-compacting concrete: The mix design for M30 grade self-compacting concrete has calculated by invesrigation was designed as per the guidelines specified in IS10262-2009 and IS456-2000.

The mix proportions were calculated & presented below.

Max.size of aggregate= 20mm
Cement =395 kg per cubic meter
Water =158 kg per cubic meter (water reduces 20% by adding superplasticizer)
Fine aggregate = 754.639 kg per cubic meter
Coarse aggregate =1067.78 kg per cubic meter

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

W/c ratio =0.4

Super plasticizer = 100ml per 1 litre of water

Final mix proportions for SCC 1:1.9: 2.7

Methodology-plastic waste for CM (1:3)

Step-1: preparation of modules

a) collection of materials

b) Mix design for the work-plastic wastes c) Fine aggregate without replacement

d) Fine aggregate replaced with 2%,4%,6%

Step-2: Work planned

a) Casting of 3 cubes for every mix b) Coarse and fine aggregate ratios c) Water-cement ratio

Step-3: Specimens and testing

a) Specimens casted for every mix

b) Compressive test are done at 7 days ,28 days under normal curing condition- 3 samples each

Step 4: Results

Results are noted after curing under accelerated curing tank, the curing follows according to the code rules, conditions. And average results are determined for compressive strength of cubes and tensile strength of cylinders. comparative results are analyzed between cement mortar and different plastic wastes with different proportions. Finally the optimum % taken to check out results for conventional concrete and self-compacting concrete.

Methodology –conventional and Self-compacting concrete for M30 grade

Step-1: preparation of modules

a) Collection of materials

b) Mix design for the work-plastic wastes

c) Fine aggregate without replacement of plastic waste d)Fine aggregate replaced with 4%, for PVC, ABS, and PP

Step-2: Work planned

a) Casting of 3 cubes for every mix b) Coarse and fine aggregate ratios c) Water-cement ratio

Step-3: Specimens and testing

a) Specimens casted for every mix

b) Compressive test & split tensile tests are done at 7 days ,28 days under normal curing condition- 3 samples each

Step 4: Results

Results are noted after curing under accelerated curing tank, the curing follows according to the code rules, conditions. And average results are determined for compressive strength of cubes and tensile strength of cylinders. comparative results are analyzed between conventional of concrete and conventional of concrete with different plastic wastes with 4% replacement.

IV. EXPERIMENTAL WORK

This chapter represents experimental study on the behaviour of cubes with plastic waste concrete. The chapter gives a brief overview of the casting of specimens, test set-up and testing procedures. Experimental studies were conducted out on specimens to ascertain the strength of plastic waste concrete. The compressive strength of cement mortar mixes using 2%,4%,6% replacement of fine aggregate with different plastic wastes and the compressive & split tensile strength of the conventional concrete and self-compacting concrete mixes using 4% replacement of fine aggregate with PVC, ABS, and PP mix under accelerated curing at 7 days, 28 days are done. Total 156 specimen of cubes were tested. The Cement mortar of 60 specimens of cubes were tested and conventional of concrete for compressive & split tensile strengths 48 specimens were casted and for self-compacting concrete 24 cubes and 24 cylinders. The compressive & tensile strength of the concrete determined for 7days and 28days.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

1. Ordinary Portland cement, 53Grade conforming to: IS 456-2000.
2. Locally available quarried & crushed blue granite stones conforming to graded aggregate of nominal size 20mm as per IS 383-1970.
3. Local available river sand conforming to grading zone II of IS 383-1970.
4. plastic collected from Recycling plant
5. Polycarboxylic ether is the super plasticizer used in this project.
6. Water : Normal ground water for concreting & curing

Experimental study on materials

Following are the various test performed on materials like cement, fine aggregates, plastic wastes such as polyvinyl chloride (PVC), ABS (Acrylonitrile Butadiene Styrene) and PP (polypropylene), coarse aggregate and water.

Tests on cement

- Specific gravity
- Standard consistency
- Initial setting time
- Final setting time
- Fineness

Specific gravity test

The device used to this experiment is pycnometer. This test helps to find out the specific gravity of cement. The specific gravity of cement find in laboratory

$$Sg = \frac{W2-W1}{(W2-W1)-(W3-W4)}$$

Table 2: Specific gravity of cement

S.NO	Description	Weight (grams)
1	Empty weight of empty bottle(W1)	45
2	Empty weight +water (W2)	76.2
3	Empty weight +kerosene(W3)	108
4	Empty weight+keroscene+cement(W4)	87
5	Weight of cement	0.050
	Specific gravity of cement	3.06

Test results

- Specific gravity of cement 3.06
- Standard consistency 32%
- Initial setting time 40min
- Final setting time 350 min

Fine aggregate.

Fine Aggregates used as natural sand obtained from local market. The Physical properties of fine aggregates like specific gravity & fineness modulus were found to be 2.65 and 2.47 respectively. The details of specific gravity results are in Table 3.2.

Calculations:

Specific gravity of fine aggregates(IS 2720 part 3)

Sample taken is 500 gm

Trial one

Weight of empty pan (W1) = 643gm

Empty + sand (W2) = 1143gm

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

Empty + sand + water (W3) = 1860gm

Empty + water (W4) = 1548gm

Specific gravity of fine aggregate = W2-W1.

(W4-W1)-(W3-W2)

= 1143-643.

(1548-643)-(1862-1142)

= 500

185

= 2.702

Table 3: Sieve Analysis of Fine Aggregate

	Trial 1	Trial 2	Trial 3
Weight of empty bottle W1	643	638	648
Weight of bottle+ sand W2	1143	1148	1148
Weight of bottle+ sand + water	1860	1841	1858
Weight of bottle+ water	1548	1539	1542
Specific gravity (W2 – W1)/(W4 – W1) – (W3 – W1)	2.702	2.717	2.521

Average of specific gravity = 2.65

Sample take is 1000 grams

Table 4: Sieve Analysis of Fine Aggregate

Sl. No.	**Sieve Size**	**Weight retained in gm**	**% weight Retained**	**Cumulative % weight retained**	**% of Passing in each sieve**	**Remarks**
1	4.75 mm	4	4/1000x100 = 0.40	0.40	99.60	Fine Aggregate is Pertaining to Zone-III as Per Table-4 Of IS:383,1970
2	2.36 mm	10	1.00	1.40	98.60	
3	1.18 mm	144	14.40	15.80	84.20	
4	600 micron	200	20.00	35.80	64.20	
5	300 micron	582	58.20	94.00	6.00	
6	150 micron	56	5.60	99.60	0.40	
7	Tray	4	0.40	100.00	0.00	

Total = 247.00

Fineness Modulus= 2.47

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

Table 5: Properties of Fine Aggregate

Sl. No.	Property	Value
1.	Specific gravity of Fine Aggregate	2.65
2.	Fineness Modules	2.47

Coarse aggregate.

Coarse Aggregate used was with maximum size aggregate of 20 mm obtained from local market. The physical properties of coarse aggregates like specific gravity & fineness modulus were found to be 2.63 and 7.30 respectively. The specific gravity is calculated from code IS The details of sieve analysis are given in Table 3.4

Specific gravity of course aggregate:

Sample taken is 1000gms

D = weight of oven dry sample = 982gm

C = weight of saturated surface dry sample = 990 gm

A = Weight of Sample + weight of vessel + water = 3372 gm

B = weight of vessel with water = 2754

Specific gravity = D C – (A - B)

= 982/372

= 2.639

Table 6: Sieve Analysis of Coarse Aggregate

SI. No.	Sieve Size	Weight retained in gm	% weight retained	Cumulative % weight Retained	% of passing in each sieve	Remark
1	80 mm	0	0	0	100	Reference Code is IS:383, 1970
2	40 mm	0	0	0	100	
3	20 mm	1598	31.96	31.96	84.20	
4	10 mm	3310	66.20	98.16	64.20	
5	4.75 mm	92	1.84	100.00	6.00	
6	2.36 mm	0	0	100.00	0.40	
7	1.18 mm	0	0	100.00	0.00	
8	0.60 mm	0	0	100.00	0.00	
9	0.30 mm	0	0	100.00	0.00	
10	0.15 mm	0	0	100.00	0.00	

Total= 730.12

Fineness Modulus=7.30

Water

The minimum expensive but the very important ingredient of concrete is water. The water which is used for mixing concrete must be clean & free from the harmful impurities such as oil, alkali, acid etc. Potable water have being used for the mixing & curing work in the project

V. RESULTS AND DISCUSSION

STRENGTH CHARACTERESTICS

Preliminary remarks

This chapter deals in the experimental observation of tests conducted on hardened mortar specimens,

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

and concrete specimens, after attaining the desired ages of curing with respect to its compressive strength and split tensile properties. The results have been precisely and systematically compiled and presented. They are also represented in Bar charts for its critical analysis and interpretations.

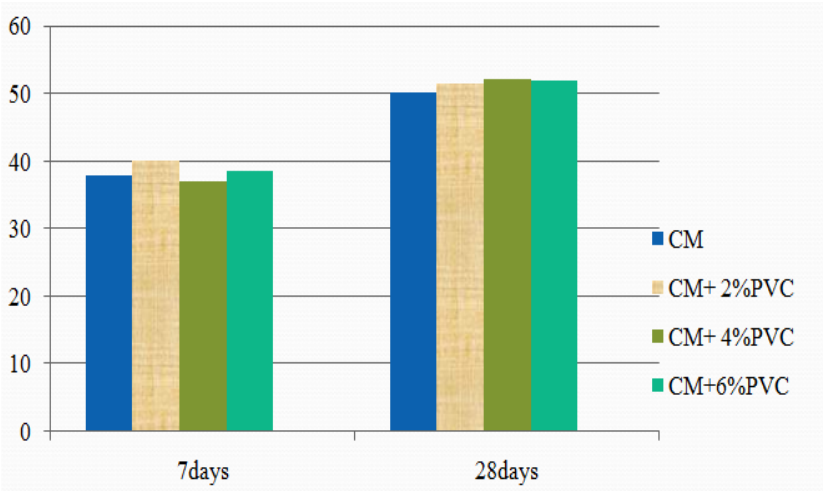
Properties of Mortar

Compressive strength.

The most common of all the parameters is the compressive strength because it is a desirable characteristic of concrete and also quantitatively related to compressive strength.

Table 7: Compressive strength of mortar having different proportions of plastic waste

Sl.No	Mortar type	Mortar proportion	Plastic waste	compressive strength (MPa)		% variation
1	CM	(1:3)	0%	37.80	50.20	
2	CM+PVC	(1:3)	2%	40.20	51.53	2.58
3	CM+PVC	(1:3)	4%	36.93	52.10	3.46
4	CM+PVC	(1:3)	6%	38.44	51.42	2.37



Graph 1: Compressive Strength of Cement Mortar

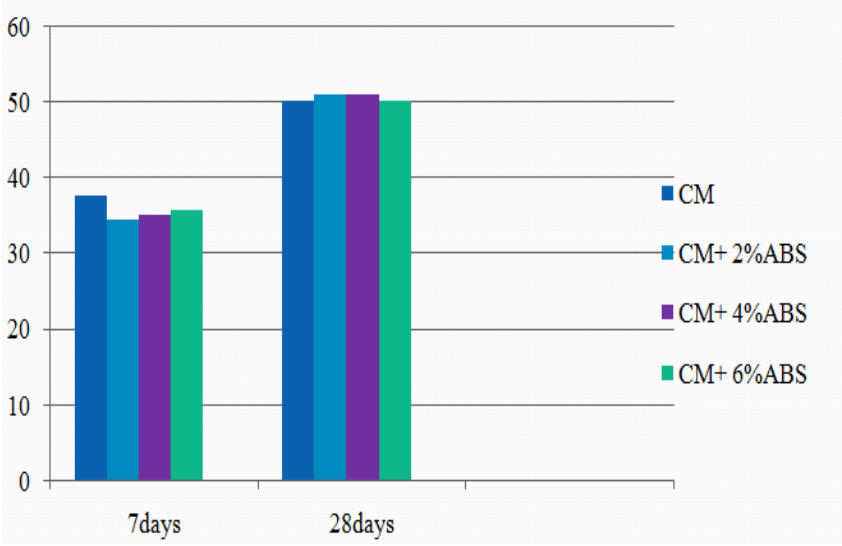
Table 8: Compressive Strength of Cement Mortar (1:3) Containing Plastic waste (PP) for Different Ages of Curing

Sl No	Mortar Type	Mortar Proportion	Plastic Waste	Compressive Strength (MPA)		%Variation
				7 Days	28 Days	28Days Strength
1	CM+PP	(1:3)	2%	38.80	50.32	0.23
2	CM+PP	(1:3)	4%	34.52	51.20	1.95
3	CM+PP	(1:3)	6%	34.42	50.42	0.43

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

Table 9: Compressive Strength of Cement Mortar (1:3) Containing Plastic waste (ABS) for Different Ages of Curing

Sl No	Mortar Type	Mortar Proportion	Plastic Waste	Compressive Strength (MPA)		%Variation
				7 Days	28 Days	28Days Strength
1	CM+PP	(1:3)	2%	34.52	51.12	1.79
2	CM+PP	(1:3)	4%	35.20	51.20	1.95
3	CM+PP	(1:3)	6%	35.92	50.32	0.23



Graph 2: Compressive Strength of Cement Mortar

- Optimum value taken from above results for conventional and self compacting concrete is at 4%
- Super plasticizer (polycarboxylic ether) added for conventional concrete to produce SCC

Table 10: Fresh Properties of conventional concrete with and without plastic waste

Sl No	Type of Concrete	Slump in(mm)	Compaction factor
1	Conventional Concrete	94	0.84
2	COC+4%PVC	95	0.89
3	COC+4%ABS	93	0.88
4	COC+4%PP	94	0.89

Table 11: Fresh Properties of SCC with and without plastic waste

Sl No	Type of Concrete	Slump in(mm)	Compaction factor
1	SCC	95.5	0.90
2	COC+4%PVC	96	0.91
3	COC+4%ABS	96	0.90
4	COC+4%PP	96	0.91

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

Table 12: Compressive strength of conventional concrete with and without plastic proportion

Sl No	Mortar Type	Proportion	Compressive Strength (MPA)		%Variation
			7 Days	28 Days	28Days Strength
1	Conventional Concrete	-	24.16	36.48	-
2	COC+PVC	4%	24.62	36.87	1.06
3	COC+ABS	4%	24.02	36.12	-0.98
4	COC+PP	4%	24.82	36.84	0.93

VI. CONCLUSION

- Addition of Plastic waste increased the workability aspects of concrete when compared with respect to normal concrete
- Addition of Plastic waste increased the workability aspects of self compacting concrete.
- Cement mortar strength was increased to 2% to 3.6% by replacement of plastic waste while compared with normal cement mortar
- Compressive strength of conventional concrete increased to 1% for PVC waste
- Compressive strength of concrete increased to 0.9% for Polypropylene plastic waste
- Compressive strength of concrete decreased to 0.98% for Electronic waste(ABS) due to poor bonding
- Split Tensile strength of conventional concrete increased to 4.97% by replacing polypropylene plastic than ABS and PVC
- Compressive strength of self compacting concrete increased to 0.66% for polypropylene plastic waste
- Compressive strength of self compacting concrete increased to 0.46% for PVC waste
- Split tensile strength of self compacting concrete increased to 7% by replacing plastic waste
- Addition of plasticizers increases compressive strength than the conventional concrete
- There will not be much changes by using the plastic in construction but we can use less volume of plastic waste .
- At least we the civil engineers can decrease the plastic materials by using them in construction works.
- Compressive strengths with different plastics are conducted and we can use any type of plastics in construction in low volumes

VII. FUTURE SCOPE OF THE PROJECT

Based on established properties determined in this study, mix designs could be researched to achieve increased compressive strength. Plastics have low bonding properties which results in low improvement of compressive , tensile strengths so the effect of decrease in the plastic aggregates size and the use of admixtures, among other alterations should also be studied for increasing strength.

VIII. REFERENCES

[1] **Ahana K Reji,Ameer Suhail(2018)** "Effect of Waste Polypropylene on Strength of Concrete"Vol. 7 Issue 04, April-2018.

[2] **Abdul Sami Kohistani(2010)** "Utilization of Plastic waste and Alccofine on Self-Compacting Concrete" Volume: 05 Issue: 04 ,Apr-2018.

[3] **Dr.Vaishali ,G.Vijaya G.S, Ghorpade (2016),** in his research on "strength characteristics of SCC with various percentage of waste plastic fibers and GGBS".

[4] **A.Muthadhi A. Mohamed Basid (2017)** "Experimental investigations on concrete with e-plastic waste" Volume 8, Issue 6, June-2017.

[5] **Balamurugan,V.Goutham(2017),** In his research on "effective utilization of PET bottles in self compacting concrete" Volume No.5, Issue Special 1 pp : 304-307.

[6] **HemnU.Boiny ,Younis M. alshkane(2016)** In his reaserch on "Mechanical properties of cement mortar by using polyethylene terephthalate fibers'' Issued october 2016.

[7] **Amani Yaseen,Ayah Al-ES(2016)** in this research "The addition of plastic waste in self compacting concrete" Vol. 8, Issue, 06,pp.33240-33244, June, 2016.

[8] **Dr.H.Sudarashana Rao(2016)** In his research on "The behavior of self compacting concrete with plastic waste fibers when subjected TO chloride Attack" July 29th 1501- 1508 2016.

[9] **MB Hossain, P Bhowmik, KM Shaad(2016)** In his research on "Use of waste plastic aggregation in concrete as a constituent material".

[10] **Iliana Rodriguez Viacava, Antonio AguadoDeaCea**,"Self Compacting Concrete Of Medium Concrete Characteristics Strength." Construction and Building Materials 30(2012) 776-782.

[11] **M. Sulyman, J. Haponiuk, and K. Formela(2016)** **"**Utilization of recycle polythene terephthalate(PET)" in engineering Materials Vol No2, February 2016.

[12] **Saikia, Brito(2014) ,** "Use of plastic waste as aggregate in cement mortar and concrete preparation", Construction and Building Materials 34(2014) 385-481.