IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 11, November 2020

DOI 10.17148/IARJSET.2020.71110

Partial Replacement of Natural Sand with Plastic Waste and Artificial Sand in a Concrete Mix

Dakhore N.A.[1], Dr.Mohd.Zameeruddin[2]

PG Student, Department of Civil Engineering, MGMs College of Engineering ,Nanded, India [1]

Associate professor, Department of Civil Engineering, MGMs College of Engineering, Nanded, India [2]

Abstract: In India, most of plastics waste is abandoned and not recycled. This situation causes serious problems such as wastage of natural resources and environmental pollution. Solid waste management is one of the major environmental concerns in the world. In fact, a wide variety of waste materials can be utilized as inert in a cement matrix. In this study, plastic waste in the form of water-pouch (distilled water industry) and artificial sand both materials were used as a partial replacement of fine aggregates in a concrete mix. The aim of this study is to investigate the fresh and hardened concrete properties of the newly defined concrete mix. The mix was obtained for a varying percentage of plastic waste and artificial sand by 5, 10, 15 and 20 percent by weight of natural sand requirement. Result showed there was considerable improvement in compressive strength and workability up to 10 percent of replacement. The use of such concrete mixes in light weight concrete will considerably reduce the solid waste produced by plastics.

Keywords: Plastic waste, artificial sand, fresh concrete test and hardened concrete test

I. INTRODUCTION

The productive use of plastic waste material represents a means of alleviating some of the problems of solid waste management. The reuse of plastic wastes is important from environmental aspects (as shown in figure 1). The use of plastic as an alternative material in concrete mix will help to save and sustain natural resources that are not replenished, it decreases the pollution of the environment and it also helps to save and recycle energy production processes. Wastes and industrial by-products should be considered as potentially valuable resources merely waiting for the appropriate treatment and application. Plastic water pouch wastes are among these wastes; which found a common place in daily needs and produces huge source of solid waste, especially in urban areas of India. There are various ways of disposing of this waste, but carries harmful effects on the environment and therefore one of the logical methods for reduction of their negative effects is the application of these materials in construction industries. In present days, sources of natural sands are limiting or overwhelmed, demanding new sources of artificial sand. In this study, we have proposed such an alternate source of natural sand by hand cutting of water pouches in fine size and also in the form granules produced from mechanized process. Figure 2, illustrates the artificial sand obtained from water-pouch. In this study the efficacy of concrete produce by this replacement was investigated.

Fig. 1. Plastic waste and pollution caused by it.

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 11, November 2020

DOI 10.17148/IARJSET.2020.71110

(a) Granules of Plastic pouch (b) Hand-cut Plastic pouch grains

Fig 2: Artificial sand produced from plastic water pouch

II. LITERATURE REVIEW

In the recent past, many researchers have conducted an experimental investigation on concrete by varying various ingredients of concrete. Plastic plastics were used as coarse aggregate and the effects on strength, material properties were investigated [Praveen Mathew et al., 2013; Subramani and Pugal, 2015; Charudatta Thosar and D. M. Husain, 2017]. The results demonstrate that significant improvement in compressive strength was obtained at 20 percent replacement of the natural coarse aggregates. Plastic waste was also used as fine aggregates [Rajendra Mogre et al., 2013; Chien Chung Chen et al., 2015; Dhaarani et al., 2018]. This replacement revealed that there was significant improvement in strength for 30 percent replacement of natural fine aggregates.

Later, the replacement of sand and cement was also investigated [Harini B. and Ramana K.V., 2015; Amalu. R. G. et al., 2016]. The fine aggregate was replaced by recycling plastic waste and the binding material by silica fume, the result shows that significant losses in strength of mix of higher percentage of recycled plastic waste. Following the same trends in the present study, we have prepared a mix as partial replacement of hand-crushed plastic pouch waste and machined granules of plastic pouch taking care of the volumetric content of coarse aggregate in concrete mix. The study aims to study the effects on both fresh and hardened state of the concrete.

III. EXPERIMENTAL PROGRAMME

The purpose of this study was to systematically investigate the effect of partial replacement of hand-crushed plastic pouch waste and machined granules of plastic pouch on compressive strength of concrete. For these purposes ten samples were prepared with varying ratios of hand-crushed plastic pouch waste and machined granules of plastic pouch. Table 1 shows the details of the percentage replacement of natural sand. The concrete mix is of grade M20 prepared following the guidelines given in IS 10262:2007 for moderate exposure condition. The material used to prepare the mixes is a natural coarse aggregate (locally available) of 20 mm size and the fine aggregate (from river bed) confirming to Zone I of IS 383. The cement used in the mix is of 53 grade Portland pozzolanic cement. The details of material properties are given in Table 2.

Table 1: The percentage replacement of natural sand in a mix

Sample Number	Percentage of natural sand in concrete	Percentage of artificial sand in concrete	Percentage of plastic waste in concrete
1	75	25	0
2	75	20	5
3	70	20	10
4	60	35	05
5	60	30	10
6	60	40	0
7	50	40	10
8	50	35	15
9	50	40	10
10	40	60	0

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 11, November 2020

DOI 10.17148/IARJSET.2020.71110

Table 2: Preliminary material properties

r. No	Material	Tests and Properties	Obtained results	Reference code
1	Cement	Fineness of cement	3.4 %	IS: 269
		Standard consistency	34 %	
		Initial setting time	68	
		Final setting time	384	
2	Aggregates	Fineness modulus of C.A	7.58	IS 12669
		Specific gravity of C.A	2.71	
		Fineness modulus of F.A	3.11	
		Specific gravity of F.A	2.65	
		Water absorption of F.A	0.61%	
		Water absorption of C.A	0.57%	
3	Water	Potable Water		

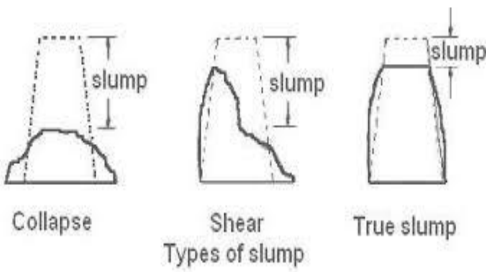
IV. EXPERIMENTAL RESULT

The mix proportion adopted for the preparation of concrete mix is 1:1.84:3.28. The volume of various ingredient are cement 372 kg/m^3, fine aggregates 686.44 kg/m^3, coarse aggregates 1220.34 kg/m^3 and water 186 kg/m^3. The various test performed on concrete in fresh and hardened state are summarized below.

A. Slump Cone Test:

The slump cone test is most commonly used method of measuring workability of a concrete. It is not a suitable method of mix with lower water-cement ratio or lean concrete. Workability is measured in terms of fall in height, known as a slump. The test mould is conical in shape, having bottom diameter of 30 cm and top diameter of 20 cm, made of metal not thinner than number 16 gauges. Height of cone is 600 mm. The Table 3 shows that the slump values for various samples. It was observed that with the increase in plastic waste and the artificial sand proportion concrete losses it's workability.

Table 3: Result of slump cone test

Sample Number	Slump observed	Typical behaviour
1	106 mm	
2	120 mm	
3	70 mm	
4	100 mm	
5	75 mm Shear slump	
6	100 mm(Collapsed slump)	
7	65 mm (Shear slump)	
8	00 mm (Zero slump)	
9	00 mm(Zero slump)	
10	00 mm (Zero slump)	

B. Compressive Strength

The major strength of concrete is its compressive force carrying ability hence compressive strength test is prime focused among the test conducted on hardened concrete. In India the compressive strength test is carried out on specimen cubical in shape. The cube specimen is of the size 15 x 15 x 15cm. A set of three cubes are crushed under compression at various ages, the average result is said to be representative value of the required characteristic strength Table 4 shows that as the 28 days compressive strength of sample of varying percentage of plastic and artificial sand added in concrete.

The average compressive strength of concrete was 28.46 N/mm^2, when 60 percent natural sand, 35 percent of the artificial sand and 5 percent plastic waste were used in concrete. It therefore concludes that 5 percent plastic waste and 35 percent artificial sand replacement is possible good proportion in concrete without affecting the strength of mix. Therefore it can be useful for concrete reinforced cement concrete as well as plain cement concrete.

The average compressive strength 24.23 N /mm^2 were obtained for 50 percent of the natural sand, 40 percent of the artificial sand and 10 percent plastic waste in concrete. In this case the compressed strength of concrete has not been achieved for the target strength of Mix.

DOI 10.17148/IARJSET.2020.71110

Table 4: Compressive Strength Of Cubes With Various Percentage Of Artificial Sand And Plastic Waste

Sample Number	Cube number	Compressive strength for 28 days (N/mm^2)	Average compressive strength (N/mm^2)
1	A	34.4	33.63
	B	35.0	
	C	31.5	
2	A	22.2	24.63
	B	28.8	
	C	22.9	
3	A	20.1	20.53
	B	22.7	
	C	18.8	
5	A	25.7	28.46
	B	29.9	
	C	29.8	
6	A	19.2	23.44
	B	23.8	
	C	27.4	
7	A	39.3	37.03
	B	38.5	
	C	33.3	
8	A	24.8	24.23
	B	23.5	
	C	24.4	
9	A	13.9	12.93
	B	13.1	
	C	11.8	
10	A	26.0	24.63
	B	23.9	
	C	24.0	
11	A	23.9	30.44
	B	35.4	
	C	32.1	

V. CONCLUSION

The test conducted on materials used in a concrete mix that is cement, sand, aggregate found to bear the values within permissible limits as per relevant IS codes. The concrete which were prepared with higher percentage of plastic waste and artificial sand produces lean concrete. The 5 percent of plastic waste and 35 percent of artificial sand prepares a mix without affecting compressive strength, whereas higher values plastic waste and artificial sand results in concrete of lower strength. The flexural strength at this stage is not communicated; has been kept as future scope. Main benefit of this study is to effective reduction of the pollution of environment, scarcity of fine aggregate and also reduces the cost of material.

VI. FUTURE SCOPE

As a part of future scope the study, the flexural strength, split strength for different percentage of plastic waste and artificial sand of concrete mix will be investigated. Also the efficacy of the mix so prepared in different loading condition will be worked out.

REFERENCES

[1]. Amalu.R.G, Azeef Ashraf, Muhammad Hashim, Rejith.K.U. and Vijitha.V.(2016), "Use Of Waste Plastic As Fine Aggregate Substitute In Concrete".International Journal of Scientific & Engineering Research, Vol.7, Issue 4,pp.172-177.
[2]. Charudatta P. Thosar and Dr.M.Husain (2017)," Reuse of Plastic Waste as Replacement of Sand in Concrete ". International Journal of Innovative Research in Science, Engineering and Technology,Vol. 6, Special Issue 1,pp.789-794 .
[3]. Chien-Chung Chen, Nathan Jaffe, Matt Koppitz, Wesley Weimer and Albert Polocoser (2015), "Concrete Mixture With Plastic As Fine Aggregate Replacement ". International Journal of Advances in Mechanical and Civil Engineering, Vol. 2, Issue-4, pp.49-53.

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 11, November 2020

DOI 10.17148/IARJSET.2020.71110

[4]. Dhaarani D., Shanmuganathan N. ,Gokila M., Akalya A, Abirami D. and Dhilshath begam J.(2018) , "Crushed Plastic Waste In Concrete Feasibility Of Artificial Sand In Concrete". International Research Journal of Engineering and Technology (IRJET) , Vol.05, Issue 03 ,pp.3638-3640.

[5]. Harini B. and Ramana K.V.(2015),"Use of Recycled Plastic Waste as Partial Replacement for Fine Aggregate in Concrete".International Journal of Innovative Research in Science, Engineering and Technology , Vol. 4, Issue 9,pp.8596-8602.

[6]. Praveen Mathew , Shibi Varghese , Thomas Paul and Eldho Varghese (2013) "Recycled Plastics as Coarse Aggregate for Structural Concrete". International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 3, pp.687-690.

[7]. Rajendra P. Mogre , Dr. Dhananjay K. Parbat and Dr. Sudhir P. Bajad (2013), "Feasibility Of Artificial Sand In Concrete".International Journal of Engineering Research & Technology (IJERT),Vol. 2 ,Issue 7,pp.1606-1610.

[8]. Subramani T. and Pugal V.K. (2015), "Experimental Study On Plastic Waste As A Coarse Aggregate For Structural Concrete".International Journal of Application or Innovation in Engineering & Management (IJAIEM), Vol. 4, Issue 5,pp.144-152.