Replacement of Sand by the Mixture of M-Sand and Plastic Pellets (PP) as Fine Aggregate in Concrete

Insamam Ul Huq S
Assistant Professor
Department of Civil Engineering
Dhaanish Ahmed College of Engineering

Ajith C
Student
Department of Civil Engineering
Dhaanish Ahmed College of Engineering

Balaji A
Student
Department of Civil Engineering
Dhaanish Ahmed College of Engineering

Mohamed Hassan Mohideen U
Student
Department of Civil Engineering
Dhaanish Ahmed College of Engineering

Mohamed Navas M A
Student
Department of Civil Engineering
Dhaanish Ahmed College of Engineering

Abstract

Now-a-days usage of plastic and generation of plastic refuse increases day by day, so necessary steps should be taken to reduce pollution due to plastic waste. In this paper, plastic refuse was used as a fine aggregate in some percentage with Manufactured sand (M-sand) instead of river sand to reduce the impact of pollution caused by plastic refuse. Since the demand for natural sand has increased drastically. The replacement of river sand by plastic refuse should not affect the strength as well. In this way, it is easy to manage the demand of natural sand and pollution due to improper disposal of plastic refuse. In previous studies, there was a strength reduction in the concrete as the addition of plastic refuse increases. The addition of plastic refuse in the form of pellets has increased the strength of concrete as plastic pellets are having more density than raw plastic refuse. The addition of plastic pellets of 4% has achieved a maximum compressive strength, tensile strength and flexural strength of 28 N/mm^2, 1.96 N/mm^2 and 2.75 N/mm^2 respectively at the end of 28 days curing.

Keywords- Replacement, Manufactured Sand, Plastic, Minimum Percentage, Disposal of Plastic

I. INTRODUCTION

Generation of plastic waste in residential, industrial and commercial places has always been an arduous problem. There are number of conventional ways to dispose plastic such as Landfilling, Recycling and Reusing, Incineration & Waste to energy, Gasification, Pyrolysis, Thermal De-polymerization. Landfill will not be efficient disposal process due to non-bio-degradable nature of plastic. The Recycle and Reuse of plastic is also not an efficient method as it is an expensive method and reuse makes plastic into single use throwaway items. Incinerating plastic which means burning it which results in global warming and in worst case it releases dioxins carcinogens.

To overcome this problem Plastic can be used in concrete instead of natural sand in some minimum percentage. In this project High Density Polyethylene (HDPE) have been used, a form of Plastic which is an excellent chemical resistant and has a melting point of range 120 to 180 °C. By partial replacement of plastic as fine aggregate in concrete it can reduce considerable amount of plastic waste dumped into the environment.

II. OBJECTIVE

The principle in this method is to find an alternative for natural sand in concrete in an environment friendly way without any loss in strength attained by normal cement concrete. Since Plastic are non-biodegradable substance and there are no efficient methods available to dispose them so it is necessary to choose plastic as alternative material for Natural Sand in concrete. On considering previous studies and analysis on plastic High Density Polyethylene (HDPE) have been used because of its high density (0.93 to 0.97 g/cm^3) which would be a perfect alternative for Natural sand in M-Sand.

III. METHODOLOGY

Replacement of Sand by the Mixture of M-Sand and Plastic Refuse as Fine Aggregate in Concrete mixture composite of Cement, Water, Coarse Aggregate and Fine Aggregate. Fine Aggregate is a mixture of M sand and HDPE pellets. HDPE pellets are added in percentage 0%, 2%, 4%, 6%, 8% and 10% to analyze strengths of concrete. Then replacement concrete mixer is prepared, casted (cube, cylinder and beam) and cured for testing it on compressive strength, tensile strength and flexural strength. From the compressive, tensile and flexural strength results a suitable percentage of High Density Polyethylene (HDPE) materials to be added will be finalized.

IV. RESULT & DISCUSSION

Mix Design of the concrete has been Designed based on the IS CODE 10262:1982 for M20 grade of concrete (F_{ck}=20Mpa).Water cement ratio calculated is 0.47 the mix ratio for M20 is (1:1.44:3.33) which contains mixture M Sand and HDPE as fine aggregate.

Fig. 1: High Density Polyethylene

Fig. 2: HDPE & Cement Mixture

Fresh Concrete Test: The workability tests were taken as per IS CODE 456:2000. The tests conducted are slump cone test and flow table test. The test results satisfied the water cement ratio 0.47 which was calculated from Mix design using IS CODE 10262:1982. Hardened Concrete Test: As per IS CODE 456:2000 the hardened concrete test for compressive strength, tensile strength and flexural strength were taken. Results are given below.

Table 1: Compressive Strength of concrete

Percentage of Materials Added	*Specimen*	*7days*	*14 Days*	*28 Days*
		Strength (N/Mm2)	*Strength (N/Mm2)*	*Strength (N/Mm2)*
0%	*Cube*	*18.32*	*21.55*	*26.55*
2%	*Cube*	*19.60*	*23.29*	*26.77*
4%	*Cube*	*19.78*	*23.65*	*28.00*
6%	*Cube*	*17.75*	*21.46*	*24.19*
8%	*Cube*	*15.35*	*18.55*	*21.55*
10%	*Cube*	*9.55*	*12.89*	*15.33*

The above Table 1 shows the test result of conventional and replaced concrete. Where 0% replacement Yields only 26.5 N/mm2 of strength, 2% replacement yields 26.77 N/mm2 and 4% replacement give higher strength of 28.00 N/mm2 and gradually the Strength decreases for the 6%, 8%and 10%

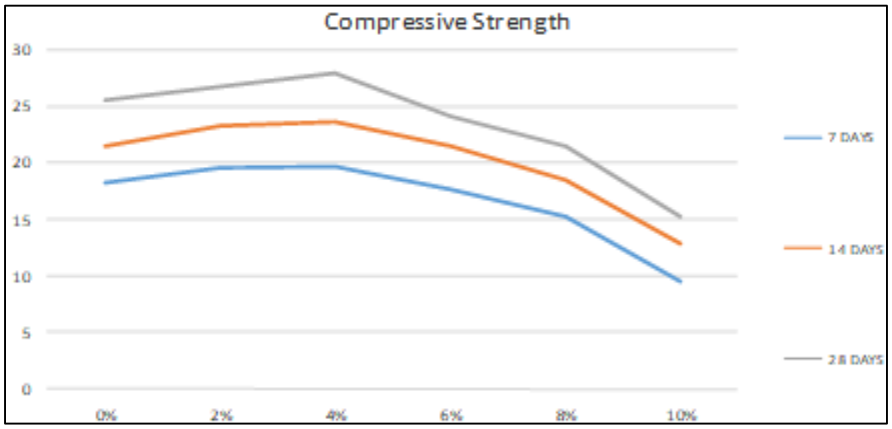

Fig. 3: Compressive strength of concrete specimens

The compressive strength is calculated from concrete cubes. The above fig 3 shows the percentage of plastic present in concrete and the strength attained from 7, 14 and 28 days. Strength in 4% of replaced concrete is higher than the conventional concrete after 28 days of curing.

Fig. 4: compression testing on cube specimen

The above image shows the test for compressive strength by Universal testing machine for concrete cubes.

Table 2: Tensile strength of replaced concrete

S:no	*Percentage of Materials Added*	*Specimen*	*7days Strength (N/Mm^2)*	*14 Days Strength (N/Mm^2)*	*28 Days Strength (N/Mm^2)*
1.	*0%*	*Cylinder*	*1.05*	*1.45*	*1.82*
2.	*2%*	*Cylinder*	*1.08*	*1.46*	*1.89*
3.	*4%*	*Cylinder*	*1.15*	*1.55*	*1.96*
4.	*6%*	*Cylinder*	*1.08*	*1.39*	*1.79*
5.	*8%*	*Cylinder*	*1.05*	*1.34*	*1.63*
6.	*10%*	*Cylinder*	*0.99*	*1.19*	*1.39*

The table 2 shows the test result of conventional concrete and normal concrete. Where 0% replacement yields 1.82 N/mm2 of strength, 2% yields 1.89% of strength and 4% yields 1.96% of strength for the next replacement of 6%, 8% and 10% the strength gradually decreases. Both compressive and tensile strength yields higher strength in 4% replacement.

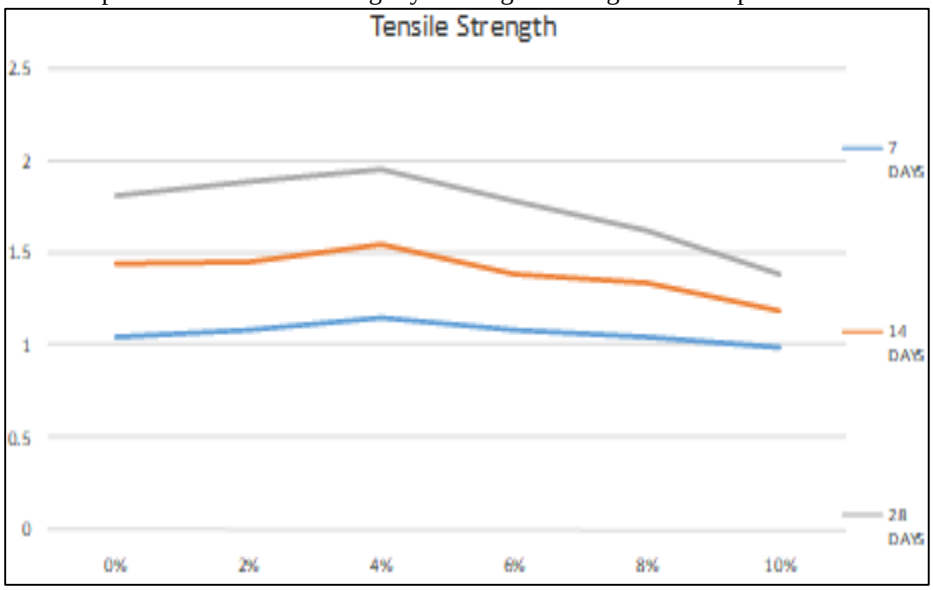

Fig. 5: Tensile strength of replaced concrete specimens

The Tensile strength is calculated from concrete cylinders. The above fig shows the percentage of plastic present in concrete and the strength attained from 7, 14 and 28 days. Strength in 4% of replaced concrete is higher than the conventional concrete after 28 days result.

Fig. 6: Tensile testing on cylinder specimen

From the above test results the percentage of materials to be added is finalized for casting of beam to find flexural strength in replaced concrete.

Table 3: Flexural Strength

Percentage of Materials Added	*Specimen*	*7days*	*14 Days*	*28 Days*
		Strength (N/Mm^2)	*Strength (N/Mm^2)*	*Strength (N/Mm^2)*
4%	*Beam*	*1.57*	*1.89*	*2.75*

The above table 3 shows the flexural strength of the concrete for 4% replacement. The 4% replacement is done with respect to the compressive and tensile strength test results

Fig. 7: Beam Mould

Fig. 8: Laying of beam for flexural strength

The above image shows the beam mould and laying of beam mould for flexural strength

V. PROPERTIES

Replaced concrete is known for its environment value and fulfilment of demand for natural sand by the mixture of M-Sand and High Density Polyethylene (HDPE). HDPE is harder and more opaque and can withstand somewhat higher temperature. Even at high temperature below boiling point would end in fusing of HDPE with concrete.

Table 3: Replacement concrete properties

Properties	*Value*
Compressive Strength	*28.00*
Tensile Strength	*1.96*
Flexural Strength	*2.75*

Table 4: High Density Polyethylene

Properties	*Value*
Compressive Strength	*0.97 g/cm3*
Tensile Strength	*120 to 180 °C*

VI. CONCLUSION

Replaced concrete which yields some good amount of strength as conventional concrete it can be used in construction purposes and structures made up of concrete. The addition of plastic pellets of 4% has achieved a maximum compressive strength, tensile strength and flexural strength of 28 N/mm2, 1.96 N/mm2 and 2.75 N/mm2 respectively at the end of 28 days curing. It also helps us in protecting environment by preventing the dumping of plastic waste as landfill etc. This replacement concrete will bring wide changes in the field of Civil Engineering.

REFERENCES

[1] Boskey Bahoriaa , Dr D K Parbatb , Dr. P. B. Nagarnaikc , Dr.U.P.Waghe “Effect of Replacement of Natural Sand By Quarry Dust And Waste Plastic On Compressive & Split Tensile Strength Of M20 Concrete”
[2] Pramod S. Patil1, J.R.Mali2, Ganesh V.Tapkire3, H. R. Kumavat4 “Innovative Techniques of Waste Plastic Used In Concrete Mixture"
[3] Bahoria B.V.*1, Parbat D.K.2 and Naganaik P.B.3 “Replacement of Natural Sand in Concrete by Waste Products: A State Of Art”
[4] Manhal A Jibrael1 and Farah Peter2* “Strength and Behavior of Concrete Contains Waste Plastic” All
[5] Vinayak R.Supekar1 Popat D “Properties of Concrete by Replacement of Natural Sand with Artificial Sand”.
[6] Zainab Z. Ismail *, Enas A. Al-Hashmi “Use of Waste Plastic in Concrete Mixture as Aggregate Replacement”
[7] Arivalagan.S “Experimental Investigation on Partial Replacement of Waste Plastic in Concrete”
[8] Kshiteesh Gaur1, Jyotsana2, Anil Kumar Arya3, Neelesh Kumar Singh4 “Use Of Plastic as Partial Replacement of Fine Aggregate in Fibre Reinforced Concrete”.
[9] Gaurav Verma1, Mohd. Afaque Khan2 Mr Abhishek Kumar3 “Effect of Waste Plastic as Partial Replacement of Aggregate in Concrete Mixture: A Review”
[10] B.Harini1 & K.V.Ramana2 “Use Of Recycled Plastic Waste as Partial Replacement for Fine Aggregate in Concrete”
[11] B Jaivignesh* And A Sofi “Study On Mechanical Properties of Concrete Using Plastic Waste as an Aggregate”
[12] Raghatate Atul M “Use Of Plastic in a Concrete to Improve Its Properties”