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GREEN CONCRETE WITH GRAPHENE OXIDE

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Abstract - The rapidly growing volume of construction and demolition (C&D) waste produced by the construction industry has led to tremendous pressure on environmental protection. Research by concrete engineers has suggested the possibility of appropriately treating and reusing such waste as aggregates in new concrete, especially for lower-level applications. This study discusses recycled aggregates (RA) produced from C&D waste and their use in Green concrete (GC). Recycled aggregates are treated with a polycarboxylate super plasticizer to reduce the water absorption and adding graphene oxide powder to improve compressive strength. This study shows that the recycled aggregates that are obtained from demolition waste of the building in our Annai Velankanni Polytechnic college campus. The influence of the replacement of 25% of recycled aggregates in GC on the compressive strength is presented in this paper.

Key Words: Construction and demolition (C&D) waste, Normal aggregate (NA), Recycled aggregate (RA), Manufacturing Sand (M Sand), Green concrete (GC), Polycarboxylate super plasticizer (PC), Graphene oxide (GO), Ultra high-performance concrete (UHPC).

1. INTRODUCTION

Due to the increase in the economic growth after development and redevelopment projects in the country and subsequent increase in the urbanization in the cities has made construction sector increase drastically, but also environmental impacts from construction and demolition (C & D) waste are increasingly becoming a major issue in urban solid waste management. [(1)] Rapid construction has led to serious construction and demolition waste disposal. Meanwhile, natural aggregates are swiftly depleting. An alternate way to solve this problem is to use waste concrete as aggregates. [(2)]Thus, Recycled Aggregate (RA) could come from the demolition of buildings, bridge supports, airport runways, and concrete roadbeds. Concrete made using such aggregates is referred to as Green concrete (GC). [(3)] Meanwhile, the USA is also a major producer of C&D waste, producing more than 0.5 billion tons of C&D waste per year. Therefore, increased attention has been paid to how to dispose of this type of waste. Currently, the use of recycled aggregate (RA) from C&D waste to manufacture Green concrete (GC) has been considered as one of the most effective ways for recycling C&D waste. Consequently, it is necessary to attempt to produce ultra-high performance concrete (UHPC) with RA, considering relieving the shortage of natural river sand and recycling C&D waste and thus form denser pore structures in cement-based composites.[(4)] In recent years, nanomaterials have been applied in the concrete industry to improve the mechanical performances of cement composites. Among the various investigated nanomaterials, graphene oxide is a unique two-dimensional (2D) material that creates large surface areas and thus forms close contact with the host material. The pore structure was refined in cement paste containing GO due to its filling effect. It was found that hydration products, which form closer connections between micro-cracks, could be accelerated by GO addition. From these results, it can be concluded that GO can fill pores, accelerate the hydration process, and thus form denser pore structures in cement-based composites.[(5)] The main objective of this investigation is to study the performance of concrete with recycled coarse aggregate.

2. MATERIALS

2.1 Construction and Demolition (C&D) Concrete Waste as Coarse Aggregate

Construction and demolition of concrete waste (C&D) from the college campus is initially collected and broken into pieces with a hammer. The required recycled aggregate (RA) maximum size is 20mm. Recycled aggregates are sharp and angular in shape which resembles that of the normal aggregate.

2.2 Graphene oxide(GO)

Modifier of graphene oxide by Graphene oxide powder (0.8-2)nm is used obtaining from graphene supermarket Co were used.

2.3 Other Concrete Mix Components

Ordinary Portland cement (OPC) confirming to IS:8112-1976, Manufacturing Sand(M Sand) as fine aggregate and Normal aggregate conforming to IS:383-1970 from Tindivanam, Polycarboxylate powder (PC) used as water reducing agent in this work supplied by Perry Impex Limited.

3. EXPERIMENTAL PROGRAM

3.1 Test on aggregate

To understand the effects of recycled aggregate from C&D waste a series of tests on physical characteristics such as specific gravity, fineness modulus and water absorption and mechanical properties like impact value, crushing value were conducted according to Bureau of Indian standard specification given in IS:2836-1963 and these values are compared with normal aggregate. These test results are tabulated in Table: 1.Grading of aggregates are given in Table: 2.

Table-1: Physical properties of NA and RA

Physical characteristics	NA	RA
Specific gravity	2.72	2.41
Fineness modulus	3.18	3.42
Water absorption	0.6	3.65
Crushing value	12.22	22.47
Impact value	10.61	22.62

Table- 2: Gradation of aggregates

BIS.Sieve size	Cumulative percentage of passing		
	NA	RA	M Sand
40mm	100.00	100.00	0.00
20mm	81.10	55.45	0.00
10mm	0.50	1.70	0.00
4.75mm	0.25	0.50	100.00
2.36mm	0.00	0.00	98.50
1.18mm	0.00	0.00	81.80
600micron	0.00	0.00	66.80
300micron	0.00	0.00	39.70
150micron	0.00	0.00	25.50

BIS-Bureau of Indian Standard
NA-Normal Aggregate
RA-Recycled Aggregate
M Sand- Manufacturing Sand

3.2 Tests on Green concrete

The experimental programme involved in this investigation is to study the compressive strength behaviour of green concrete and controlled concrete having equal cement, fine aggregate and water with convention recycled aggregate, polycarboxylate super plasticizer and graphene oxide. In this work design mix concrete (M30) cube samples (150mmX150mmX150mm) are prepared by adding 0.1%, 0.2% and 0.3% of the weight of cement of Polycarboxylate super plasticizer for normal concrete with 0.5 w/c ratio and also0.1% of Polycarboxylate super plasticizer with Graphene oxide powder of 0.02%, 0.04% and 0.06% of the weight of cement was added in 25% replacement of RA in Green concrete with 0.5 w/c ratio.Table:3 gives two mix prportions.M_1 mix is used in Normal concrete and M_2 mix in Green concrete. A compression testing machine is used to determine the compressive strength of concrete cubes. Load at cracking is noted and area of the concrete cube also is taken to find compressive strength for 7days and 28 days of curing. These test results are tabulated in Table: 4 and 5.

Table- 3: Controlled Concrete mix Proportion

Material	M_1 mix	M_2 mix
NA(Kg/m^3)	1106.5	830.00
RA(Kg/m^3)	0.00	276.50
M Sand(Kg/m^3)	756.50	756.50
Cement(Kg/m^3)	394.00	394.00
Water (lit/m^3)	197	197

Table- 4: Results of Compressive Strengths Test

Mix designation & Suggested mix proportion of concrete(1.33:2.55:3.74)	Aggregate Maximum size(mm)	Water Cement Ratio	Cement content Kg/m^3	Dosage of Super Plasticizer (%)	Average Compressive Strength of Normal concrete(N/mm^2)	
					7 days	28 days
M30	20	0.5	394	0	16.96	26.52
M30	20	0.5	394	0.1	24.88	37.77
M30	20	0.5	394	0.2	23.63	34.37
M30	20	0.5	394	0.3	28.59	28.59

Table- 5: Results of Compressive Strengths Test

Mix designation & Suggested mix proportion of concrete(1.33:2.55:3.74)	Aggregate Maximum Size (mm)	Water Cement Ratio	Cement Content Kg/m^3	Dosage of Super Plasticizer (0%)	Percentage of Replacement of RA (%)	Dosage of Graphene Oxide (%)	Average Compressive Strength of Green Concrete(N/mm^2)	
							7 days	28 days
M30	20	0.5	394	0	25	0	17.78	34.82
M30	20	0.5	394	0.1	25	0	22.78	27.77
M30	20	0.5	394	0.1	25	0.02	27.11	41.03
M30	20	0.5	394	0.1	25	0.04	17.31	15.55
M30	20	0.5	394	0.1	25	0.06	22.88	30.89
M30	20	0.5	394	0.1	25	0.08	22.21	33.55

4. CONCLUSION

The following conclusions are drawn from the study on Green concrete and they are applicable for the range of parameters and materials used in this study. Construction and demolition(C&D) waste can be transformed into useful coarse aggregate.

Specific gravity of recycled aggregate is almost equal to normal aggregate. Crushing and impact value of recycled aggregate is higher than normal aggregate. They decreases compressive strength of Green concrete.

Water absorption of recycled aggregate also is higher than normal aggregate. Due to the increased amount of free water in the mixture, the density of fresh and hardened concrete becomes significantly lower in Green concrete. Therefore adding admixtures was helpful to improve compressive strength and reducing the water-cement ratio. The same W/C ratio was used in the preparation of Normal concrete and Green concrete.

The compressive strength of Green concrete is higher by 6 N/mm^2 respectively when compared to conventional concrete in 28 days of curing without adding super plasticizer and graphene oxide but adding 0.1% of polycarboxylate super plasticizer and 0.02% graphene oxide the compressive strength 9.33N/mm^2 and 6.21N/mm^2 in 7 days and 28 days of curing is higher in Green concrete. This research work is the basis for further experiments on Green concrete with the use of C&D waste coarse aggregate.

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REFERENCES

1. Harish. P. Gayakwad and Neha B. Sasane “Construction and Demolition Waste Management in India”; IRJET, vol.2, 2015

2. Shahiron Shahidan, Mohamad Azim Mohammad Azmi, Kumanan Kupusamy,
Sharifah Salwa Mohd Zuki and Noorwirdawati Ali “Utilizing Construction and Demolition (C&D) Waste as Recycled Aggregates (RA) in Concrete” Elsevier, Procedia Engineering 2017,174:1028 – 1035

3.Akash Rao, Kumar N. Jha and Sudhir Misra “Akash Rao, Kumar N. Jha and Sudhir Misra “Use of aggregates from recycled construction and demolition waste in concrete”, Elsevier, Resources, Conservation and Recycling 2007,50: 71–81

4. Lanzhen Yu and Rongxing Wu “Using graphene oxide to improve the properties of
Ultra-high-performance concrete with fine recycled aggregate”, Elsevier, 2020

5. Wu-Jian Long, Dan Zheng, Hua-bo Duan, Ningxu Han and Feng Xing, “Performance enhancement and environmental impact of cement composites containing graphene oxide with recycled fine aggregates”, Cleaner production, 2018

6. Li Zhao , Xinli Guo , Chuang Ge , Qi Li , Liping Guo , Xin Shu and Jiaping Liu , “Mechanical behavior and toughening mechanism of polycarboxylate super plasticizer modified graphene oxide reinforced cement composites”,Elseveir,2017

7. Ali Akhtar and Ajit K. Sarmah, “Construction and demolition waste generation and properties of recycled aggregate concrete”, Cleaner production, 2018