International Journal of Innovative Research in Computer Science and Technology (IJIRCST)
ISSN (online): 2347-5552, Volume-11, Issue-3, May 2023
https://doi.org/10.55524/ijircst.2023.11.3.13
Article ID IJIRD-1251, Pages 72- 75
www.ijircst.org

Analyzing the Performance of Environmental Friendly Concrete That Contains Acid-Treated (H_2SO_4, H_3PO_4) Recycled Aggregate

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ABSTRACT- Its poor quality was one of the key problems preventing recycled course aggregate (RCA) from being used in concrete mixes. The quality of recycled aggregate may be impacted by cement mortar on the surface of the material. The examination of recycled aggregate in various test results employing acid soaking treatment procedures utilizing sulfuric acid and phosphoric acid is the subject of this research. Natural aggregate, recycled aggregate, recycled aggregate with H2SO4 and recycled aggregate with H3PO4 are the four types of concrete mixtures that are made. Using these cleaned recycled aggregates in concrete has been proven to be beneficial. The strength and durability of concrete were also evaluated, and aggregate attributes were computed. The test findings showed. The behavior of recycled aggregate has changed according to the test results after being treated with acid. Out of these two acids, sulphuric acid treatment of recycled aggregates produced the best results, followed by phosphoric acid doing only marginally better. According to the overall research, employing treated recycled aggregate in concrete can significantly increase the strength and durability properties of concrete made using recycled aggregate.

KEYWORDS- Recycled, Brobdingnag Ian.

I. INTRODUCTION

Around 6 billion tons of concrete are manufactured worldwide each year and are utilized as one of the most flexible building materials. After water, it is the material that is most commonly utilized worldwide. Concrete is a durable, moldable building material. Before the initial setting begins, we are capable of changing into any shape. Aggregate, cement, water, and at the moment, various admixtures, are the basic components of concrete. Aggregates, such as fine and coarse aggregate, make up between 60 and 75 percent of the total concrete volume and add bulk to the mix, but they are not engaged in the chemical reactions that cement uses to bind the elements together. The simplicity with which the structure. Concrete structural elements can be easily shaped into various shapes and sizes because freshly mixed concrete has a plastic nature that allows it to flow into made-to-measure formwork. Concrete is typically the most readily available and least priced material.

II. LITERATURE REVIEWS

2.1 R Ashraf et al. (2012) discussed the potential for substituting recycled aggregate for natural aggregate in structural concrete cubes. The findings indicate that replacing portions of NCA with RCA in the range of 25% to 50% will improve the performance of concrete mixes. The performance of structural concrete is not significantly adversely affected when 25% of NCA is replaced with RCA. Compressive strength decreased by 7% to 13% when the replacement ratio reached 50%. 2.2
JianZhuang et al. (2012) aims to describe how concrete containing recycled coarse aggregates reacts to carbonation (RCAs). The results led the author to the conclusion that the carbonation behaviour of RAC was influenced by both the properties of RCA and the calibre of new mortar.
2.3 Khaldoun (2005) compared some of the mechanical properties of recycled aggregate concrete (RAC) to those of natural aggregate concrete in a test study (NAC). With the exception of the 40 and 50 Mpa RAC mixes, the author claimed that all of his taken mixes met the 28-day target compressive strength. when the target length was reached but the observed strength wasa little lower.

III. METHODOLOGY & EXPERIMENTAL INVESTIGATION

A. Material Used

- Cement, Water, Aggregate
- Acids like H2SO4 and H3PO4

Cement, water, aggregates, and other readily accessible elements are mixed to create concrete. The work makes use of IS 8112. The clean river sand, with a maximum size of 4.75 mm, and complying to grading zone II, was the fine aggregate used in this experiment. As coarse aggregate, blue granite stone is machine crushed. One coarse size (16 mm) passes through 12.5 mm of retained material, and the second coarse size (25 mm) passes through 20 mm of retained material. The following characteristics of coarse aggregates were established in accordance with IS: 2486 - 1964 recommendations.

B. ACIDS

Sulphuric acid (H2SO4) and phosphoric acid (H3PO4) with 0.1M were used to treat the recycled coarse aggregate are shown in fig.4.3

The table 1 and 2 lists the physical, chemical, and chemical composition information.

Table 1: Physical Property of aggregates

mix	Specific gravity	Crushing value	Impact value
NCA	2.65	21.47	17.19
RCA	2.36	32.75	22.42
RCA_{H2S04}	2.678	25.43	19.54
RCA_{H3PO4}	2.6	26.38	20.14

Table 2: Chemical Property of cement

Description	Composition
Physical Properties	
Colour	Grey
Specific gravity	3.1
Specific surface area (cm2/g)	3550
Chemical Composition	
MgO	8.0%
SO3	3.0%
S	1.5%
LOI	5.0%
IR	4.0%

C. *Methodology*

Many civil engineering criteria, such as high durability or impact load resistance, are met by cementations composites. Around 15 specimens were cast and put through a compressive test in order to evaluate the behaviour of reinforced concrete with various volume ratios

1) Tests on Cement

- Fines test
- Normal consistency test

2) Tests on Aggregate

- Specific gravity test.
- Water Absorption test.
- Density test. 3.3.3.Mix Proportion

Grade designation: M40
Type of cement: PSC 53 grade Maximum nominal size of aggregate: 20mm Minimum cement content: 320 kg/m3 Maximum water-cement ratio 0.4(As per Table 4 & 5 of IS 456-2000) Exposure condition: Severe Maximum cement content: 450kg/m3 Slump value: 100mm Sp. gravity of cement: 3.10 Sp. gravity of coarse aggregate: 2.75 Sp. gravity of Fine aggregate:2.65 Sp. gravity of admixture: 1.145 Earthquake Zone: Zone II
Assume Air content: 2%.

D. *Experimental Investigation*

1) Test On Final Product

- Compression test
- Split test
- Flexural test

2) Compressive Strength Test

For compression test, cube specimens of size Compressive strength of natural aggregate concrete, recycled aggregate concrete, recycled aggregate concrete treated with acid solutions like sulphuric acid, and phosphoric acid are tested in compressive testing machine(CTM) which is shown in table 5.1. Compressive strength results are tested are in the age of 7 and 28 days are shown in chart 5.1. The test results in compressive strength that sulphuric acid treated recycled aggregates improved 27.182% compared to RCA and phosphoric acid is 16.82% improved after 28 days curing. And moreover untreated recycled aggregate give poor performance.

E. *Test Result a Discussion*

Compression test

Aggregates	Compressive strength test after		Average Compressive strength test after	
	7 days(N/mm^2)	28 days(N/mm^2)	7 days(N/mm^2)	28 days(N/mm^2)
NCA	26.01	48.24	26.43	48.45
	26.9	48.16		
	26.4	48.96		
RCA	17.15	31.25	17.56	31.45
	17.28	32.1		
	18.26	31.01		
RCA H_2SO_4	21.53	43.25	21.38	43.19
	21.98	43.98		
	20.65	42.35		
RCA H_3PO_4	20.65	37.19	20.73	37.81
	21.36	38.23		
	20.19	38.02		

Table 3: compressive strength test results after 7 days and 28 days

Figure 1: Compressive strength for M40 grade concrete

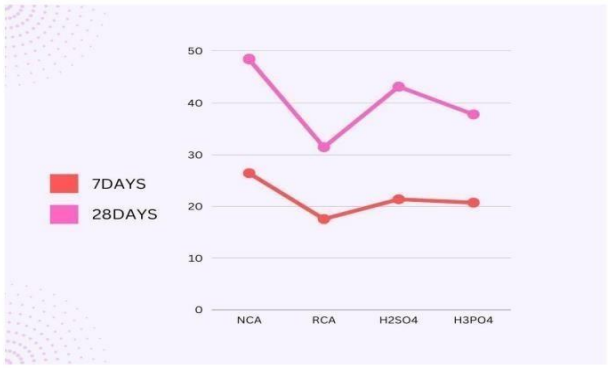

Figure 2: Line diagram Compressive strength for M40 grade concrete

F. Compressive test result

Recycled aggregate concrete treated with acid solutions like sulphuric acid, and phosphoric acid are tested in compressive testing machine (CTM) which is shown in table 5.1. Compressive strength results are tested are in the age of 7 and 28 days are shown in chart
5.1. The test results in compressive strength that sulphuric acid treated recycled aggregates improved 27.182% compared to RCA and phosphoric acid is 16.82% improved after 28 days curing. And moreover untreated recycled aggregate give poor performance.

G. Split Tensile Test

In this study, cylinders are tested for tension having specimen size 150mm in diameter and 300mm height. At least 3 specimens are required to cast for testing at least an age of 7 and 28 days. As per the requirements of IS 516-1959 the tests are conducted. The mean values are reported as strength of the specimen. Split tensile test is conducted on cylinders in Compressive Testing Machine(CTM) with a capacity 200tn

H. Flexural Strength

For flexural strength all the concrete mixes like natural aggregate concrete, recycled aggregate concrete, and treated recycled aggregate concrete are tested and the flexural strength results are at the age of 7 days and 28 days can be shown in table
and chart 5.3. In Flexural strength test performance of sulphuric acid treated recycled aggregates improved 16.64% compared to RCA and phosphoric acid is 11.24% improved after 28 days curing
Here the tested results show that the compressive strength, split tensile strength and flexural strength of the recycled aggregate is found to be lower than the natural aggregate. However, the recycled aggregate concrete strength can be improved by acid treatment.

Table 4: Flexural Strength

Aggregates	Split tensile strength test results		Average Split tensile strength test results	
	7 days(N/mm²)	28 days(N/mm²)	7 days(N/mm²)	28 days(N/mm²)
NCA	2.47	2.952	2.45	2.91
	2.41	3.08		
	2.48	2.71		
RCA	2.06	2.26	2.06	2.36
	2	2.89		
	2.12	1.95		
$RCA_{H_2SO_4}$	2.44	2.89	2.44	2.9
	2.42	3.08		
	2.46	2.75		
$RCA_{H_3PO_4}$	2.27	2.87	2.36	2.862
	2.14	2.92		
	2.69	2.79		

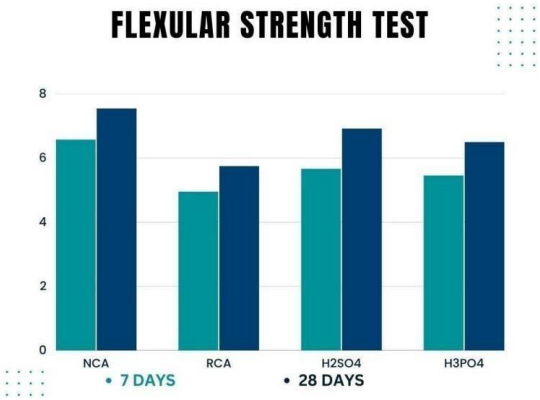

Figure 3: Flexural strength test results after 7 days and 28 days

Figure 4: Line diagram flexural strength for M40 grade concrete

IV. CONCLUSION

From overall study by using acid treatment The strength and durability characteristics of concrete by recycled aggregate can be improved in good way Hence this method can be considered and employed in the application on large scale RAC projects
out of this two acids first recycled aggregates treated with sulphuric acid has given best results and second phosphoric acid has given the better results.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

[1] Amnon Katz. 2004. Treatments for the Improvement of Recycled Aggregate. Journal of materials in civil engineering, 16(6), 597–603.

[2] Ashraf M. Wagih., Hossam Z., El-Karmoty., Magda Ebid., Samir H., Okba. 2013. Recycled construction and demolition concrete waste as aggregate for structural concrete. Housing and Building National Research Center, 9, 193–200.

[3] ASTM C494 / C494M-05. 2005. Standard Specification for Chemical Admixtures for Concrete, ASTM International, West Conshohocken, PA, www.astm.org

[4] ASTM C642-13. 2013. Standard Test Method for Density, Absorption, and Voids in Hardened Concrete, ASTM International, West Conshohocken, PA, www.astm.org

[5] BS:5075–3. 1985. Concrete admixtures. Specification for superplasicizing admixtures, British Standard Institution, London.

[6] Dhir RK., Henderson NA., Limbachiya MC. 1998. Use of recycled concrete aggregate. Proceedings of International Symposium Sustainable Construction. London (UK): Thomas.

[7] D. K. Gandhi, A. Gudadhe., M. T. Ramteke., N. Thakur., C. R. Deshpande. V2014. Environmental Sustainability by Use of Recycled Aggregates – An Overview. International Journal of Engineering Research and Applications, 4(5), 09-