Experimental Investigation of Concrete with Construction Waste Caste in Magnetized Water

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Abstract

This research investigates the use of magnetized water in concrete casting using demolition waste as an aggregate. Many studies have observed that demolition waste can be used as aggregate for manufacturing of concrete which can be used for various purposes like pavement blocks, benches, shear walls etc. because the expected compressive strength was not able to achieve using this type of concrete hence, we focused on increasing the compressive strength of this demolished concrete without replacing the demolished aggregate. We studied magnetized water and used in casting concrete to further study and investigate the effect of magnetized water on properties of concrete like compressive strength etc.

1 INTRODUCTION

1.1 History:

The environmental protection and promotion have been among the cross-cutting issues to be tackled by many countries, and it was included in different Sustainable Development Goals. Every country has put a lot of efforts, enforcing measures and strategies, and allocate large budgets on environmental management programs. However, environmental degradation is still one of obstacles to green economy. One of causes for those issues is the increased growth of construction works countrywide which resulted in the consumption of a vast number of natural aggregates used as components for bricks, concrete blocks asphalt and other construction materials.

1.2 Introduction:

There is a huge amount of solid waste is being generated as development countries requires a large amount of construction materials, land sites etc. The waste which is being generated from different activities like agricultural, domestic, industrial are causing major problems to the environment as they are not disposed in a right way. As the construction industry is growing the old buildings and structures are demolished and new buildings are constructed or the existing buildings are retrofitted. The construction activity requires several materials such as concrete, steel, brick, glass, wood etc. out of which concrete is considered as the most important construction material. Concrete is made of coarse aggregate, fine aggregate, cement and Water in specific mix proportions.

1.3 Need for study

Buildings have long lifespan and their impacts affect the lives of many generations of our ancestors and stretch into the future of unknown resources, pollution and unstable climatic conditions. Several investigations have shown that the consequences on the environment instigated by building activities are severe and require to be inhibited. Building sector contributes majorly in the development of the society. While acknowledging this fact, it is also being professed as a key contributor to environment deterioration. Some of its negative effects on the society are land depletion, energy requirement and use, solid waste production, discharge of dust and gas, noise pollution, and utilization of natural resources including non-renewable resources.

1.4 Objectives of study

- To Study of effect of magnetized water on compressive strength of concrete.
- To enhance quality of water used for concreting.
- To recycle and reuse demolition waste.
- To minimize cost of construction by using waste material instead of natural aggregate.

2 LITRATURE REVIEW

Sr. No.	Title of Paper	Conference/Journal	Remark	Pg no.
1	Experimental Investigation of ceramic waste concrete using magnetized water	International Research journal of Engineering and technology 10 October 2017	Volume 4 Issue 10 e-ISSN23950056 p-ISSN23950072	196-200
2	Performance evaluation of magnetic field treated water on convectional concrete containing fly ash	International journal of science technology and management	International paper	69-74
3	Effect of Magnetic Water on Properties of Concrete	Research gate May 2017	International paper	11864-11866
4	Experimental Investigation of Concrete with Recycled Aggregates for Suitability in Concrete Structures	Appl. Sci. 2019, 9(23), 5010	International paper	35-41
5	Recycled Concrete Aggregates	International Research Journal of Engineering and Technology	International paper	125-128
6	Utilization of Demolished Waste as Coarse Aggregate in Concrete	Civil Engineering Journal Vol. 5, No. 3, March, 2019	International paper	541-551

3 METHODOLOGY

3.1 Methodology steps:

To achieve the intended objective, in addition to the literature review conducted with purpose for Background information on the study field, this study followed the below mentioned methodology.

3.2 Resource input:

The resource input includes materials such that concrete and masonry rubble, natural aggregates water and cement. Other inputs are labor, energy and information. Labor and energy are mostly labor-based (i.e. manual). Information includes structural requirement, age at which strength is required, concrete block specifications, standards and codes of practice. This study, concrete blocks with load bearing capacity that produced from recycled C&D waste using magnetized water.

3.3 Production process:

i. Water-cement ratio. According to IS codes referred, the water-cement ratio which is normally used for stiff concrete (i.e., concrete blocks) ranges from 23% to 30% (by weight). Concrete blocks are one of the stiff concrete materials. In this study, the water/cement ratio of 0.35 (by weight) was used.

ii. In this study, the cement/ aggregates ratio of 1:9 by volume suggested by Schoner et al, (1987) was used. By applying an analytical method of combining aggregates (Raju, 2002; Schoner and Mwita, 1987), the fine and coarse aggregates fractions were estimated. Out of nine parts of aggregates, the fine/coarse aggregates ratios were in the ratio of 5:4. This shows that the cement-aggregates ratio used was 1:5:4 (cement: fine (sand): gravel parts in volume).

This ratio is equivalent to 1:4:3.3 parts in weight, respectively. The weights of water, fine, and coarse aggregate in a batch were obtained as the product of 50 kg (1 bag) of cement.

3.4 The crushing and sieve processes:

The crushing of C&D concrete wastes was done manually at production site by use of heavy hammers. After the crushing, the sieve was conducted in order to get a uniform sample that would maintain the uniformity of manufactured new concrete block.

3.5 The used water-cement ratio:

According to Rwandan building code, which is also in line with international practice, the water/cement ratio was taken as 0.35 (by weight). The manufacturing of recycled concrete block: according to practice of professional concrete block producers in Rwanda, the whole mixture was subjected to the mechanical compaction machine in order to provide a later higher load bearing capacity and aesthetics to the new block. from the machine. After 24 hours, the concrete blocks were cured in water (immersed) for 26 days. Then they were taken out of the water for surface drying for one day before the laboratory testing. The manufacturing process of the new block is presented.

3.6 Constituent material

Cement: The binding material of Ordinary Portland cement (OPC) of 53 grade were used in the present study for concrete mix. It was used in the examination for physical and chemical properties as per IS: 12269-2013.

Aggregates. Aggregate is a term for any particulate material. The aggregates such as gavel, crushed stones, sand etc. The two main elements in the concrete is fine aggregate and course aggregate. Fine aggregate and coarse aggregates used in this study are free from impurities and the specific gravity of fine aggregate was found to be 2.6 by conducting experiment as per IS 2386 (Part III) – 1963. Coarse aggregate was obtained by crushing the demolition waste collected from construction sites and passing through 20 mm and it is angular and graded coarse aggregate as per IS 383 -1970, the specific gravity was found to be 2.7 by conducting experiment as per IS 2386 (Part III) – 1963. The test result of crushing value was 21, impact value was 19 and Los Angeles abrasion value was 24, and the test results confirmed that the aggregate was good quality and the same was used for project work.

Normal Water (Tap water). One the most important element in the concrete is water. For mixing and curing of concrete water is essential. For this study tap water were used for conventional concrete block casting and the chemical properties confirming to IS: 3025-1986 and IS: 456-2000.

Magnetized water. The two magnets are to be place below the glass beaker and replete with normal water for 24 hours magnetization. In the time of magnetization, the magnetic flux penetrates through the glass beaker into the water, thus water alters to magnetized water. In this study, the magnetized water was used in demolition waste concrete block to examining the strength properties of concrete.

3.7 Casting of concrete blocks

In this project the process followed to cast the concrete is same as the conventional concrete only the difference is we replaced fine and coarse aggregate with natural and demolished aggregate by crushing it into 4 to 20mm. After manufacturing concrete blocks of 150x150x150mm size are casted and followed the procedure as mentioned in IS code.

3.8 Cost estimation of new and natural concrete blocks:

This was done with purpose to check the new block affordability. It is clear that the main difference in cost would be experienced in the purchasing of cement, natural sand and coarse aggregates and the cost of crushing and transporting C&D concrete wastes, for ordinary concrete block and recycled concrete block, respectively. The cost estimation for one block was calculated using the quantities estimation, where the unit cost of each component was considered. From the local literature and survey in local construction industries, it was established that C&D Concrete wastes were estimated at around 34% of total construction wastes. This was considered as a good quantity as it was exceeded only by bricks and blocks demolished wastes which were generated at around 49%. As mentioned, until today most of the generated concrete wastes at the rate of around 65% were taken to land fill and therefore that was contributing to environmental degradation. Regarding other potential uses, the research established that 32% of experts suggested that C&D wastes should use for preparation of new concrete blocks while 38% confirmed that these wastes should be used as wall filling materials.

4 FINDINGS

4.1 Material properties: -

Crushed aggregates usually cannot be used directly to produce a new concrete structure since it has a porous structure. This is due to the high-water absorptions rate compare to normal aggregates. Therefore, recycled aggregates have to be treated using epoxy resin to reduce the water absorption inside the aggregate. Firstly, the epoxy resins have to mix together before placing the aggregate inside the container. Then the aggregates were immersing into the epoxy resin and dry it. The process of treating recycled aggregates using epoxy resin.

4.2 Analysis of model: -

Sample preparation was done for both fresh and hardened concrete. Meanwhile, about 18 samples were be made for the tests involving hardened concrete. These samples are used for compression test. The formworks used to prepare the samples was cubical size 150mm x 150mm x 150mm. The size of aggregates was used during the experimental works are 5mm, 10mm, 14mm, 20mm and 37.5mm. All the specimens were conducted for 7- and 28-days curing time.

The direct produce of recycling of C&D waste are:

I. Different sizes (5-10 mm, 10-20 mm, 20-40 mm or as required)
II. Recycled Aggregates (RA) of different sizes (5-10 mm, 10-20 mm, 20-40 mm or as required) Results for Replacement of Natural Coarse Aggregate with Recycled Coarse Aggregate in Concrete,

Sr. No.	Replacement %	Compressive Strength as per IS-516 (MPa)			
		07 days	28 days	56 days	90 days
1.	0	25.93	38.98	46.14	52.00
2.	25	26.28	44.48	51.59	55.29
3.	50	25.36	38.56	45.05	51.31
4.	75	22.80	36.42	41.54	45.50
5.	100	21.60	32.29	37.18	41.62

Table 1. Compressive strength with respect to replacement of percentage of recycled aggregate.

Results for Replacement of Natural Fine Aggregate with Recycled Coarse Aggregate in Concrete,

5 RESULT AND DISCUSSION

The analysis results were presented in the form of tables and graphs in this part. The recycled aggregates were treated with 25% epoxy resin and the remaining 75% constitutes recycled aggregates.

5.1 Fresh Concrete

For fresh concrete, the slump test was used to determine the flow of concrete mixing. The values of the slump test fall within the range of 30mm – 60mm. The highest value recorded approximately 50mm for aggregate size of 5 mm and 10 mm and the lowest slump value was 40mm for size of 20mm and 37.5mm. The small-scale sizes of aggregates were absorbed less water compared to the larger size of aggregates. This happened because of the less surface area for small scale size aggregates will be less water absorption in the aggregates. Furthermore, the large-scale size of aggregates has harsher surfaces that able to withstand the better grip compared to other aggregates during the slump test.

5.2 Compressive Strength

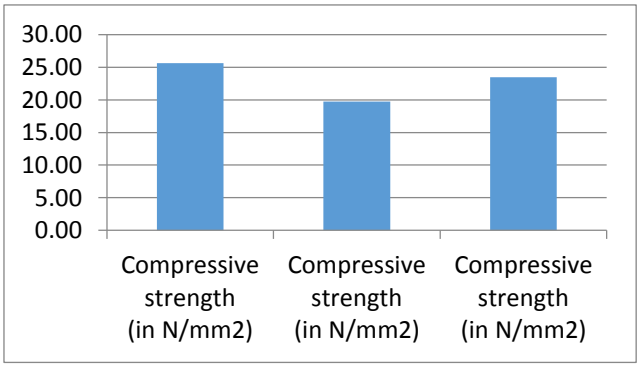
The results for compressive strength in 7 days increased dramatically from 14 MPa (5mm) up to 29.6 Mpa (10 mm). The size of 20mm aggregate was recorded the highest strength at 33.1 MPa, followed by the second highest strength achieved approximately 32.5 MPa for size of 37.5 mm. The aggregate size of 14mm was also among the highest ranks in the category at 31.3 MPa. For the specimens cured for 28 days, the compressive strength sharply changed from size of 5 mm (13.8 MPa)

up to aggregates size 10 mm (41.1 MPa). Then, the graph shown fluctuate between the 14mm aggregates at 37.8 MPa, 20mm aggregates at 38.8 Mpa and 37.5 mm aggregates at 37.7 MPa.

Table 3: Results Table

Compressive strength of concrete blocks									
	Type 1		Type 2		Type 3		4	5	6
Sr. No	Crushing strength of Concrete Block with normal aggregate using Normal Tap Water (in KN)	Compressive strength in N/mm^2	Crushing strength of Concrete block With Demolition waste Using normal Water (kN)	Compressive strength in N/mm^2	Crushing strength of Cocnrete block With Demolition waste Using Magnetized water (kN)	Compressive strength in N/mm^2	Percentage decrease between Type 1 & Type 2	Percentage increase between Type 2 & Type 3	Percentage decrease between Type 3 & Type 1
1	580	25.78	471.2	20.94	624.3	27.75	23.09	32.49	-7.10
2	495	22.00	415.6	18.47	536.5	23.84	19.10	29.09	-7.74
3	630	28.00	421	18.71	550.4	24.46	49.64	30.74	14.46
4	650	28.89	414	18.40	599.01	26.62	57.00	44.69	8.51
5	505	22.00	457.2	20.32	457.3	20.32	8.27	0.02	8.24
6	610	27.11	432	19.20	551	24.49	41.20	27.55	10.71
7			539.4	23.97	418.01	18.58		-22.50	
8			418.9	18.62	343.8	15.28		-17.93	
9			433.8	19.28	490.9	21.82		13.16	
10			437.6	19.45	590.2	26.23		34.87	
11					636.4	28.28			
12					524.8	23.32			
13					624.8	27.77			
14					449	19.96			
15					369	16.40			
16					684	30.40			
17					559.8	24.88			
18					509.2	22.63			
19					609.4	27.08			
20					424	18.84			
Average	578.333	25.630	444.070	19.736	527.591	23.448	33.05	27.43	4.52

Table 2. Comparison of compressive strength conventional of concrete and demolition concrete and demolition concrete using magnetized water



Graph 1. Graphical representation of compressive strength comparison between concrete with different material

- In table type 1 column is of concrete with natural aggregate and normal water.
- Type 2 is of concrete with demolition aggregate with normal water.
- Type 3 is of concrete with demolition waste and using magnetized water.
- Comparison between conventional concrete and concrete with demolition aggregate and normal water is shown in column 4 which indicates that the strength of demolition aggregate concrete has decreased than the strength of conventional concrete.

- Comparison between demolition aggregate concrete and concrete with demolition aggregate and magnetized water is shown in column 5 which indicates that the strength of demolition aggregate concrete has increased than the strength of demolition aggregate concrete.
- Comparison between conventional concrete and concrete with demolition aggregate and magnetized water is shown in column 6 which indicates that the strength of demolition aggregate concrete with magnetized water has little bit less strength than the strength of conventional concrete.

6 CONCLUSION

- Strength of conventional concrete reduces by **33.05%** when, demolished aggregate is used for casting of concrete.
- Strength of concrete increases by **27.43%** when magnetized water is used along with demolished aggregate in concrete casting.
- Though strength of concrete increases when magnetized water is used along with the demolished aggregate still, the strength of this concrete is less than the strength of conventional concrete by **4.52%.**
- From the above points it can be concluded that concrete blocks can be manufactured using building demolition waste. Natural aggregate can be 100% replaced by demolished aggregate without much loss in strength and durability parameters when used along with magnetized water, However M-sand can be replaced up to 20% by RFA without much compromise in strength and durability parameters.
- Demolished concrete can be used for less useful purposes for example, pothole and foundation backfilling. By this replacement and reuse of recycled aggregates, the aim is not only to reduce down-cycling but also to solve the rising problem of material shortages. In this research, the recycled aggregates for both fine and coarse replace natural aggregates by 100% in the concrete blocks production.

1. The strength study shows that magnetized water showed strength development compared with normal tap water. The compressive, Split Tensile and Flexural strength of magnetized water enhanced as the maturity of the concrete increases by virtue of continues hydration mechanism which reduces the porosity of the concrete.

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