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EXPERIMENTAL STUDY ON RE-UTILIZATION OF WASTE CONCRETE AGGREGATE AFTER TREATMENT

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Abstract: The recycling of Construction and Demolition Wastes has long been accepted to have the possible to conserve natural resources and to decrease energy used in production. In some nations it is a standard substitute for both construction and maintenance, particularly where there is a scarcity of construction aggregate. The use of recycled aggregate weakens the quality of recycled aggregate concrete which limits its application. For improving the quality of recycled coarse aggregate, various surface treatment methods such as removing the attached mortar by ultrasonic cleaning method , ball milling , heating, and then rubbing or pre soaking RCAs with HCl, H_2SO_4, and H_3PO_4 ,improving the quality of attached paste, such as surface coating with water glass pozzolanic materials , or polyvinyl alcohol emulsion. However, the addition of acidic solvents can lead to new pollution, use of water glass increases the risk of alkali aggregate reaction, and the other methods require extra energy thus carbonation process is more adequate to be used .Strength properties of the treated and untreated coarse aggregate were compared. The results indicated that the compressive, flexure and split tensile strength of recycle aggregate is found to be less than the natural aggregate if used without treatment.

Keywords: Recycled concrete aggregate, Carbonation treatment ,Mechanical properties.

1. INTRODUCTION

To achieve sustainable development in the construction industry, there is a need to recycle and reuse construction waste derived from demolition of old concrete structures as secondary aggregates for producing new building materials. However, due to the adhered old cement mortar, the quality of recycled concrete aggregate (RCA) has been widely reported to be of inferior to that of natural aggregates. In consideration of the constituent of the old cement mortar adhering to the surface of RCA,
improving the low quality of RCA through accelerated carbonation is possible to some extent because the calcium hydroxide, which is one of the main cement hydration products in the old cement mortar adhering to the surface of RCA, can react with carbon dioxide accompanied by an increase in solid volume which is formulated by the following reaction:

$Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$

The other hydration products, such as calcium silicate gel, may also be carbonated and decalcified to generate the $CaCO_3$. During the carbonation process, the precipitation of calcite ($CaCO_3$) in pore space can decrease the porosity of the matrix, thus strengthen the weak surface and lower the water absorption of the porous cement mortar (Lange, Hills & Poole 1995)(Walton et al. 1997). This study presents an innovative pretreatment method to enhance the properties of RA by using a CO_2 curing process. Different from the conventional pretreatment methods for recycled aggregates, which normally try to remove the attached cement mortar, the CO2 curing pretreatment aims to densify the old cement mortar and then strengthen the RA through a well known carbonation reaction between CO_2 and cement hydration products. The accumulation of waste. Therefore,recycling construction waste is vital, both in order to reduce the amount of open land needed for landfilling and to preserve environment through resource conservation. Also from the viewpoint of sustainable and green building technologies, the use of recycled aggregate (RA) in new concrete production has enlarged globally.

2.RESEARCH SCOPE:

To study the strength properties of concrete made with recycled aggregate after incorporating water washing and CO_2 curing of aggregate.

Materials Used

Cement

The ordinary Portland Cement conforming was used for the preparation of test specimens.

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Fine Aggregate

The fine aggregate used in this experimental investigation was natural river sand confirming to zone II

Natural Coarse Aggregate

Crushed granite aggregates particles passing through 25 mm and retained on 10 mm I.S sieve was used as natural aggregates which met the grading requirement.

Recycled Coarse Aggregate

Crushed concrete aggregate waste passing through 20 mm and retained on 10 mm I.S sieve were used as recycled coarse aggregate and they met the grading requirements.

Water

Portable water available in laboratory was used for mixing and curing the concrete specimens.

Table 1. Specimen details:

Sr. No	Notations	Cube (Nos)	Cylinder (Nos)	Beam (Nos)
1	C1(Natural Aggregate)	6	3	3
2	C2(Recycled Aggregate with 10%)	6	3	3
3	C3(Recycled Aggregate with 20%)	6	3	3
4	C4(Recycled Aggregate with 30%)	6	3	3
5	C5(Recycled Aggregate with 40%)	6	3	3

Figure 1:

Table2. Average test results:

Notations	Compressive Strength (N/mm^2)	Split Tensile Strength (N/mm^2)	Flexural Strength (N/mm^2)
C1	25.68	2.56	3.51
C2	22.47	2.59	2.47
C3	23.49	2.80	2.83
C4	23.97	2.69	3.25
C5	26.58	2.81	3.46

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Methods for Treatment of Recycled Aggregates

In order to boost the quality of RA, several techniques have been developed in literature. However, these methods can be broadly categorized into two categories. The first category removes the loose mortar particle on the exterior and the second category modifies the aggregate surface. The loose mortar particle adhered to the surface can be removed by ultrasonic modify method, ball milling, or by heating at first and then rubbing. The laboratory CO_2 curing setup. An air-tight cylindrical vessel was used as the curing chamber, which was vacuumed to -0.5 bar before the pure CO_2 gas injection. The CO_2 pressure in chamber was controlled by a regulator and kept at $+0.1$bar. Considering the adverse impact of high humidity on carbonation, anhydrous silica gel was put inside the chamber to remove the evaporated water from the specimens during the carbonation process. After 24 hours of CO_2 curing.

3.CONCLUSION

The result concludes that the direct use of recycled aggregates in concrete reduces the strength of concrete thus treatment is required to improve the property of concrete.

The main factor that reduces the strength of recycled aggregate concrete is the mortar that has been stuck around fine as well as coarse aggregates that leads to the poor bonding between cement and aggregate.

There is increase in water absorption of the recycled aggregate as compared to natural aggregate.

The drying shrinkage also increase in the recycled coarse aggregate as compared to natural aggregate.

There are many surface treatment for the aggregate such as removing the attached mortar by ultrasonic cleaning method , ball milling , heating, and then rubbing or pre soaking RCAs with HCl, H_2SO_4, and H_3PO_4 ,improving the quality of attached paste, such as surface coating with water glass pozzolanic materials , or polyvinyl alcohol emulsion. However, the addition of acidic solvents can lead to new pollution, use of water glass increases the risk of alkali aggregate reaction, and the other methods require extra energy thus carbonation process is more adequate to be used.

Use of recycle aggregate reduces the cost of construction and also it saves the valuable land used for the dumping, although it reduces the carbon used in production of natural coarse aggregates hence this process is environmental friendly.

The use of recycled aggregate is the structure does not have any standard specification or coddle provision.

4. REFERENCES

[1]. Experimental Study on CO2 Curing for Enhancement of Recycled Aggregate Properties Baojian Zhan1,*Chi Sun Poon, Qiong Liu, and Shicong Kou Department of Civil and Environmental Engineering The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong.

[2]. Johannesson, B. & Utgenannt, P. 2001, "Microstructural changes caused by carbonation of cement mortar", Cement and Concrete Research, vol. 31, no. 6, pp. 925-931.

[3]. Lange, L.C., Hills, C.D. & Poole, A.B. 1995, "Preliminary Investigation into the Effects of Carbonation on Cement-Solidified Hazardous Wastes", Environmental science & technology, vol. 30, no. 1, pp. 25-30.

[4]. Liu, Q., Xiao, J. & Sun, Z. 2011, "Experimental study on the failure mechanism of recycled concrete", Cement and Concrete Research, vol. 41, no. 10, pp. 1050-1057.

[5]. Poon, C.S. & Chan, D. 2007, "The use of recycled aggregate in concrete in Hong Kong", Resources, Conservation and Recycling, vol. 50, no. 3, pp. 293-305.

[6]. Steinour, H.H. 1959, "Some effects of carbon dioxide on mortars and concrete-discussion",Journal of American Concrete Institute, vol. 30, pp. 905.

[7]. Walton, J.C., Bin-Shafique, S., Smith, R.W., Gutierrez, N. & Tarquin, A. 1997, "Role of carbonation in transient leaching of cementitious wasteforms", Environmental Science and Technology, vol. 31, no. 8, pp. 2345-2349.

[8]. Yousuf, M., Mollah, A., Hess, T.R., Tsai, Y.-. & Cocke, D.L. 1993, "An FTIR and XPS investigations of the effects of carbonation on the solidification/stabilization of cementbased systems-Portland type V with zinc", Cement and Concrete Research, vol. 23, no. 4, pp. 773-784.

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