ISSN: 2248-9622 www.ijera.com
Vol. 2, Issue 2, Mar-Apr 2012, pp.407 -410

EXPERIMENTAL STUDY ON RECYCLED AGGREGATE CONCRETE

G. Murali[1], C.M. Vivek Vardhan[1], Gabriela Rajan[2], G.J. Janani[2], N. Shifu Jajan[2] and R. Ramya sri[2]

[1] Assistant Professor, [2] B.E Third Year Civil engineering Students
Vel Tech High Tech Dr. Rangarajan Dr. Sakunthala Engineering College, Avadi, Chennai.

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 washing the recycled aggregates with water and diluted acid were investigated. 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.

Keywords: Construction and Demolition Wastes, Recycling, Acid

INTRODUCTION
The recycling of Construction and Demolition Wastes has long been recognized to have the potential to conserve natural resources and to reduce energy used in production. In some countries it is a standard alternative for both construction and maintenance, particularly where there is a shortage of construction aggregate. The benefits and weaknesses of using recycled aggregate in concrete have been broadly studied [1]. The use of recycled aggregate generally increases the drying shrinkage and creep and decreases the compressive strength and modulus of elasticity of concrete compared to those of natural aggregate concrete [2-5]. The undesirable effects of recycled aggregate on concrete quality limit the use of this material in structural concrete. However, the weaknesses of using recycled aggregate can be mitigated by incorporating a certain amount of fly ash into the concrete mixture since fly ash is known to be able to reduce the creep and drying shrinkage of concrete [6-8].

Experimental program:

Research Scope
To study the strength properties of concrete made with recycled aggregate after incorporating water washing and presoaking treatments using nitric, hydrochloric and sulphuric acid.

Materials Used
Cement
The Portland Pozzolana Cement conforming was used for the preparation of test specimens.
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 20mm and retained on 4.75mm I.S sieve was used as natural aggregates which met the grading requirement of
Recycled Coarse Aggregate
Crushed concrete aggregate waste passing through 20mm and retained on 4.75mm 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.
Pre Soaking Treatments
The recycled aggregates were crushed and soaked in water for 24 hours for water treatment then kept for drying. Similarly the recycled aggregate soaked with diluted sulphuric, hydrochloric and nitric acids separately and then those aggregates were used for casting of concrete cubes, prisms and cylinders.

Acid Properties

The acid which was bought was highly concentrated so 0.1ml of concentrated acid was mixed with 150 ml of water and diluted the laboratory under expert supervision.

Table1. Properties of acid:

Molecular formula	**Nitric Acid (HNO_3)**	**Sulphuric Acid (H_2SO_4)**	**Hydrochloric Acid (HCl)**
Appearance	Colourless, mobile liquid	Colourless, clear, odorless	Highly corrosive, strong mineral acid
Density	1.512 g/cm^3	1.84 g/cm^3	1.490 g/L
Solubility in water	Miscible with water	Fully Miscible with water	Soluble in water and other polar solvents
Acidity	-1.64	-3	-1.1
Viscosity	2.6 at 68 F	26.7cP at20° C	2.8cP at 68 F
Molecular weight	63.01g/mol	98.078 g/mol	*36.46* g mol−1

Table 2. Specimen details:

S.No	**Notations**	**Cube (Nos)**	**Cylinder (Nos)**	**Prism (Nos)**
1.	N.A(Natural Aggregate)	3	3	3
2.	R.A(Recycled Aggregate)	3	3	3
3.	R1(Recycled Aggregate with water treatment)	3	3	3
4.	R2(Recycled aggregate with Nitric Acid treatment)	3	3	3
5.	R3(Recycled Aggregate with Sulphuric Acid Treatment)	3	3	3
6.	R4(Recycled Aggregate with Hydrochloric Acid Treatment)	3	3	3

Table 3. Average test results:

Notations	**Compressive Strength (N/mm^2)**	**Split Tensile Strength (N/mm^2)**	**Flexural Strength (N/mm^2)**
NA (Natural Aggregate)	27.45	2.72	3.45
RA (Recycled Aggregate)	22.3	2.46	2.85
R1 (Recycled Aggregate with Water Treatment)	23.4	2.54	2.9
R2 (Recycled Aggregate Treated with Nitric Acid)	24.95	2.6	3.1
R3 (Recycled Aggregate Treated with Sulphuric Acid)	23.50	2.55	2.95
R4 (Recycled Aggregate Treated with Hydrochloric Acid)	23.90	2.56	2.95

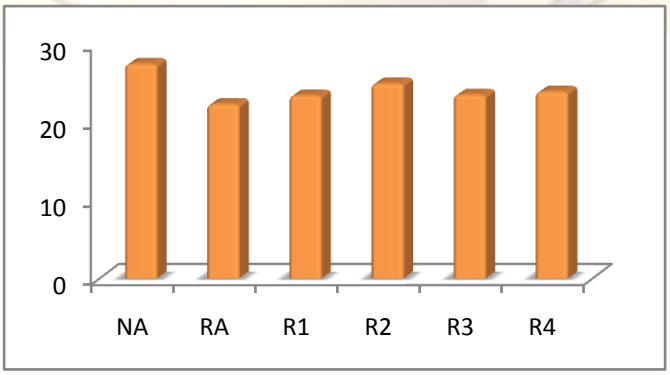

Fig 1: Compressive strength of concrete (N/mm^2) Vs Type of aggregate

Fig 2: Typical Failure Patterns

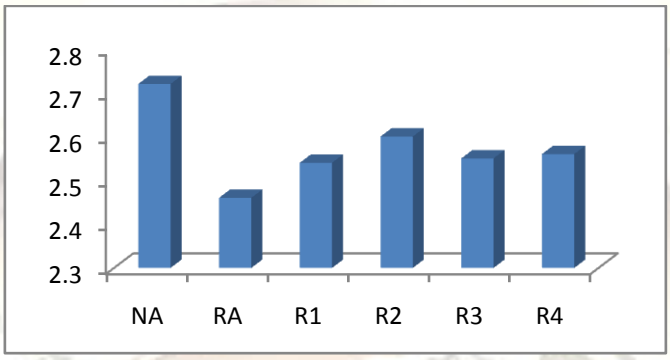

Fig 3: Split tensile strength of concrete (N/mm^2) Vs Type of aggregate

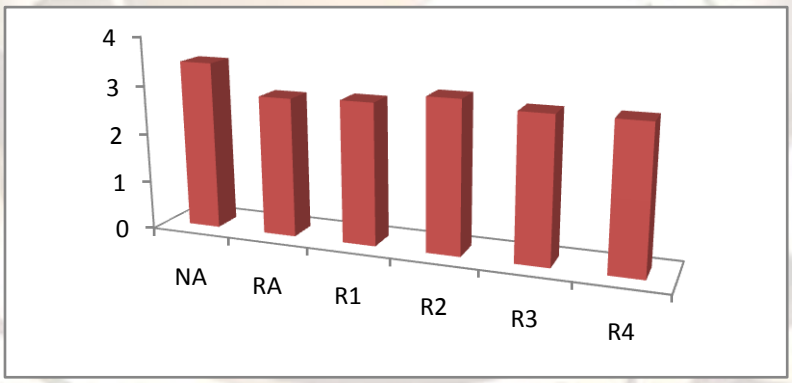

Fig 4: Flexural strength of concrete (N/mm^2) Vs Type of aggregate

RESULTS AND DISCUSSIONS:

It is observed from the Fig 1. Compared to natural aggregate concrete the compressive strength of recycled aggregate was decreased by 18.76%. The recycled aggragate treated with water has increased 4.93%, nitric acid by 11.88%, sulphuric acid increased by 5.38% and hydrochloric acid increased by 7.17% than the recycled aggregate. Fig 3 shows that the split tensile strength of recycled aggregate was decreased by 9.55% than the natural aggregate. The strength of water treated recycled aggregate was increased 3.25%, strength of nitric acid treated recycled aggregate is increased by 5.69% , sulphuric acid treated recycled aggregate increased by 3.66%, and hydrochloric acid treated recycled aggregate increased by 7.17% than the recycled aggregate. It can be seen from the Fig 4. the flexural strength of recycled aggregate was decreased by 17.39% compared to natural aggregate, and the strength of water treated recycled aggregate was increased by1.75%, the strength of nitric acid treated recycled aggregate increased by 8.77%,sulphuric acid treated recycled aggregate increased by 3.51% and hydrochloric acid treated recycled aggregate increased by 3.51% than the natural aggregate.

CONCLUSION

Based on the results obtained from the experiment the following conclusions are drawn

The test results showed that the flexural, compressive and split tensile strength of the recycled aggregate concrete is found to be lower than the natural aggregate. However the strength of recycled aggregate concrete can be improved by the water and acid treatments. Furthermore Recycled aggregate treated with nitric acid displayed the decent result compared to the hydrochloric and sulphuric acid and from economical point of view; water and acid treated recycled aggregates can be used in place of natural aggregates for temporary structures.

REFERENCE:

[1] Dhir, R.K., Henderson, N.A. AND Limbachiya, M.C (edit), Proceedings of the International Conference on the Use of Recycled Concrete Aggregates, Thomas Telford, UK. 1998.
[2] Hansen, T. C. AND BØegh, E., 'Elasticity and drying shrinkage of recycled aggregate concrete', Journal of American Concrete Institute, 82 (5), pp. 648-652, 1985
[3] Hasaba, S., Kawamura, M., KazuyukI,T. AND Kunio,T., 'Drying shrinkage and durability of concrete made from recycled concrete aggregates', Transactions of Japan Concrete Institute, Tokyo, Vol 3, 1981, pp.55-60.
[4] Olorunsogo, F.T. AND Padayachee. N., 'Performance of recycled aggregate concrete monitored by durability indexes', Cement and Concrete Research, 32 (2002)179-185.
[5] Dhir, R. K. Limbachiya, M. Leelawat, C. T., 'Suitability of recycled concrete aggregate for use BS 5328 designated mixes', Proc. Inst. Civ. Engrs & Bldgs, 1999, 134, Aug., 257-274.
[6] Haque, M. N., Langan, B. W. AND Ward, M. A., 'High fly ash concrete', ACI Material. J., 81 (1), 54-60.
[7] Delagrave, A., Marchand, J., Pigeon, M., AND Boisvert, J., 'Deicer salt scaling resistance of roller compacted concrete pavements', ACI Material. J., 96 (2), 164-169.
[8] Pittman, D. W., AND Ragan, S. A., 'Drying shrinkage of roller compacted concrete for pavement applications', ACI Material. J., 95 (1), 19-25.