Study of Influence of RC Aggregate on Bond Behaviour & Chloride Conductivity

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Abstract: ***Aggregates are inert granular materials such as sand, gravel, or crushed stone that, along with water and Portland cement, are an essential ingredient in concrete.Natural sand, graveland crushed stone exist most abundantly in the natural world, thus these materials are most frequentlyused for infrastructure development. Although the aggregate situation varies by country and region, thereplacement of natural aggregate with crushed stone aggregate has progressed in recent years due to environmental restrictions. It is believed that this has also led to changes in the quality of aggregate, which greatly affects the quality and durability of concrete.On the other hand, the waste generated from the demolition of old structure and construction activity is a matter of concern all over the world. Thus, recycling and reuse of these wastes may reduce the usage of natural resources and it can also serve towards the demand of environment. The present paper gives a brief status of recycled aggregate concrete made out of recycled aggregate, summarizes and critically analyses some of the most important research findings over the past few years regarding the material aspects. It also attempts to elucidate the approaches for the better performances, identifies the gaps in the existing knowledge and underlines the reasons why this promising technology has not become widely accepted by the construction industry. The practical problems with application of recycled aggregate in concrete are also discussed.***

Keywords: Aggregates, durability, aggregate, recycled aggregate

1. Introduction

Construction aggregate, or simply "aggregate", is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. Aggregates are the most mined materials in the world. Aggregates are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material. Due to the relatively high hydraulic conductivity value as compared to most soils, aggregates are widely used in drainage applications such as foundation and French drains, septic drain fields, retaining wall drains, and road side edge drains. Aggregates are also used as base material under foundations, roads, and railroads. In other words, aggregates are used as a stable foundation or road/rail base with predictable, uniform properties (e.g. to help prevent differential settling under the road or building), or as a low-cost extender that binds with more expensive cement or asphalt to form concrete.Most composites are filled with particles whose aspect ratio lies somewhere between oriented filaments and spherical aggregates. A good compromise is chopped fiber, where the performance of filament or cloth is traded off in favor of more aggregate-like processing techniques. Ellipsoid and plate-shaped aggregates are also used.

In most cases, the ideal finished piece would be 100% aggregate. A given application's most desirable quality (be it high strength, low cost, high dielectric constant, or low density) is usually most prominent in the aggregate itself; all the aggregate lacks is the ability to flow on a small scale, and form attachments between particles. The matrix is specifically chosen to serve this role, but its abilities should not be abused.

Objective

- To Study of properties of recycle aggregate.
- To determine the effect of recycling method on using the RCA in structural concrete based on its strength, stiffness, dimensional stability and durability.

2. Review of Literature

Wengui *et al.* (2012) studied the mechanical property, durability and the structural performance of recycled aggregate concrete for around 10 years (1996-2011). The author compared the obtained results with the results of conventional concrete. The observations revealed that the aggregates – cement matrix interfacial zone of recycled aggregate concrete consisted of loose and porous hydrates. The mix design procedure used was same as conventional concrete's. The mechanical properties such as compressive strength, tensile strength, and shear strength are lower than conventional concrete. With reference to the durability properties the carbonation resistance, chloride penetration resistance was lower when compared with the conventional concrete. The factors such as shrinkage and creep showed an increased amount with respect to the conventional concrete. The structural behaviour of recycled aggregate concrete was slightly weaker in comparison to that of the structural elements made with natural aggregates.

Xiao *et al.* (2012) tested physical and mechanical properties of microwave modifiedrecycled coarse concrete aggregates and recycle coarse concrete. This microwave modification was compared with traditional pure mortar beneficiation and mechanical beneficiation; results showed that microwave modification results in more ideal performance of recycled concrete aggregates.

Behiry (2013) studied the feasibility of using recycled concrete aggregate (RCA) mixed with traditional limestone aggregate (LSA) which is currently being used in base or sub-base applications in Egypt. The results show that the adding of RCA improves the mechanical properties of the mixture where the unconfined compressive strength (UCS) is taken as an important quality indicator. Variables influencing the UCS such as cement content, curing time, dry density play important roles to determine the performance of cement treated recycled aggregate (CTRA).

Spaeth *et al.* (2013) experimentally studied about the improvement of recycled concrete aggregate properties by polymer treatments. The performance achieved was characterized in order to show the relevance of such polymer treatment. The physical properties of recycled aggregates were depended both on adhered mortar quality and the amount of adhered mortar. Some investigation lead to the chemical treatment developed which can improve the properties of RCA without removing the mortar based matrix. Without further purification soluble sodium silicate was used as an industrial grade product. These results showed that the positive effect was induced by polymer treatments of water absorption capacity of RCA. The final results were very encouraging and confirmed the interest of this kind of appropriate treatment as a result, the polymer treatments appeared to be an appropriate treatment on RCA.

Kou *et al.* (2013) studied a long term experimental results of the use of fly ash as a cement replacement in proportion to the recycled aggregate concrete. In this study the test were made cured in water or outdoor exposure conditions for about 10 years. The concrete mixture with 100% recycled concrete aggregate had the highest strength gain of more than 60% between 28 days and 5 years. The tensile strength of concrete mixes with 100% recycled aggregate was higher than conventional concrete. In terms of carbonation coefficient the recycled aggregates content and fly ash content were increased. The results suggested that the optimal mix proportions for recycled aggregate concrete mixtures were 50% recycled aggregate as a replacement of natural aggregates and 25% fly ash as a replacement of ordinary Portland cement

3. Methodology

Chloride conductivity test

Concrete durability depends to a large extent on the diffusion characteristics of concrete. Chloride ion diffusion is one of the main mechanisms affecting the durability of reinforced concrete structures. Depending upon the concrete quality, the diffusion test duration will vary.

Generally, high grade concrete will have longer test duration when compared to that of lower grade concrete. This is because the coefficient is based on steady state permeation, which may take longer to reach in dense concrete

Sample Preparation

All test specimens were prepared following the guidelines given in AASHTO R 39, "Making and Curing Concrete Test Specimens in the Laboratory". For each batch of concrete, 14 compression cylinders, 3 CTE cylinders, 5 flexure beams, and 3 shrinkage beams were created. All cylindrical test specimens were filled and tamped with a rod using the specified procedures, while the beams were filled and vibrated on a shake table. The tops of the test specimens were then smoothed with a trowel. The cylinders were capped with plastic caps, and the beams were covered with a moist towel followed by a plastic sheet to help keep the moisture in. The test specimens then sat for 24 hours, after which they were de-molded and placed in lime-saturated water for curing.

4. Result and Discussion

Chloride Conductivity

The average value of five specimens and Figures 4.14 and 4.15 show the individual response of each specimen in a chloride conductivity test for both CEM I 42.5 and CEM II 32.5. A higher value is found for CEM I 42.5 and the reason for this higher value is unknown. Note that the four measurements do not represent a sufficient statistical base, so more tests are recommended to reduce uncertainty of this outcome. However, from these results it may be concluded that CEM II 32.5 shows relative good durability performance and fulfils the durability requirement for this ingress mechanism.

Table 1: Chloride conductivity of the concrete with recycle aggregate

Sr. no.	Recycled aggregates (%)	Voltage (volts)		Conductivity (mS/cm)	
		CEM I 42.5	CEM II 32.5	CEM I 42.5	CEM II 32.5
1	0	10.42	10.45	1.47	1.45
2	25	10.47	10.49	1.40	1.38
3	50	10.54	10.56	1.32	1.30
4	75	10.62	10.64	1.24	1.21
5	100	10.71	10.73	1.16	1.15

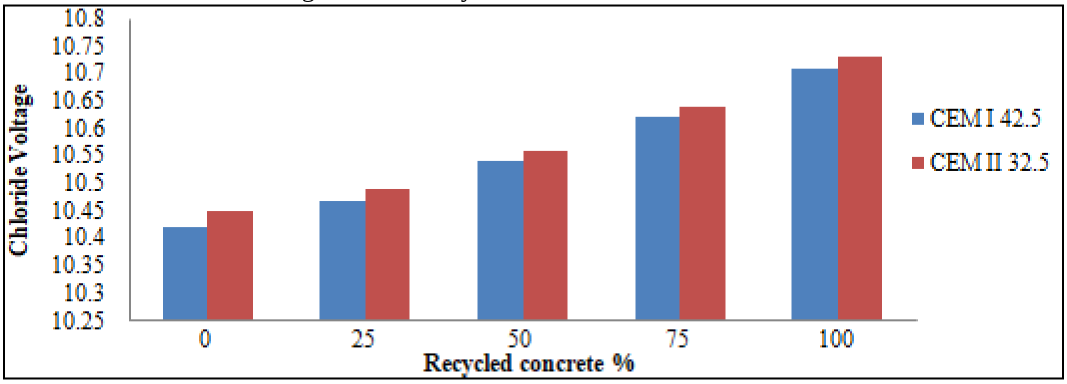

Figure 1: Chloride voltage of the concrete with recycle aggregate

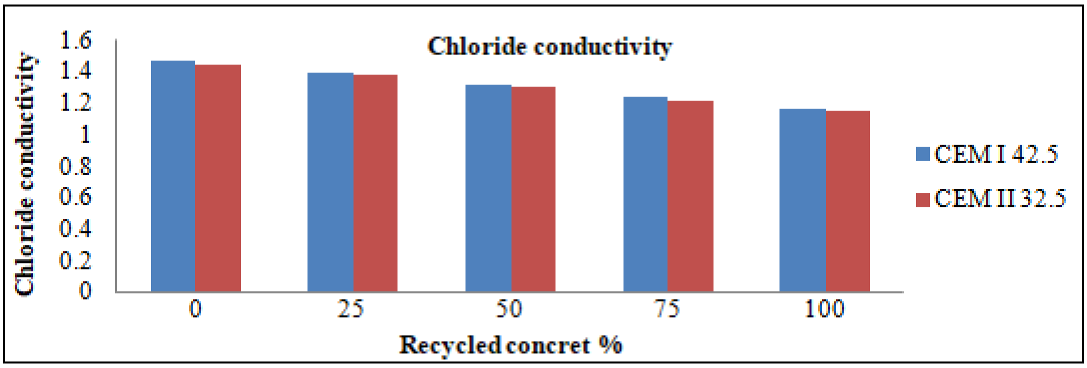

Figure 2: Chloride conductivity of the concrete with recycle aggregate

5. Summary and Conclusion

Rates of diffusion are dependent on temperature, on the internal moisture content of concrete, the type of diffusant and the inherent diffusibility of the material. Diffusion into concrete may be complicated by chemical interactions, by partially saturated conditions, by defects such as cracks and voids diffusion of chloride ions is of particular importance due to the depassivating effects of chlorides on embedded steel, which ultimately may lead to corrosion and by electrochemical effects due to steel corrosion and stray currents. In marine environments

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