Ecofriendly recycled aggregate concrete and bioreceptivity

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Abstract

Nowadays, it becomes essential to limit environmental impact of building materials and to consider the life cycle of materials used. Recycling of materials from demolition has the dual objective of preserving natural resources and limiting the number of storage sites. The study presented here aims to develop the use of recycled aggregate issued of concrete in total replacement of natural materials (sand and gravel). This work has to be done upstream the studies on bio-corrosion or bio-receptivity of these concrete composed of recycled aggregates.
Following an experimental analysis of physical, mechanical and mineralogical properties of recycled aggregates, the influence of these characteristics on choosing formulation parameters of concrete and mortar was studied. It was shown that the use of superplasticizers is necessary to reach satisfactory properties of concrete.
The next step of this work will be to analyse the bio-receptivity of these concrete and compatibility with bio-admixture used to decrease bio-receptivity and bio-corrosion; and to develop bio-superplasticizers to replace chemical ones.

Keywords

recycled aggregates, absorption, concrete, superplasticizers, bio-receptivity.

Introduction

Most research on corrosion in concrete refers to traditional concrete. In order to combine concrete durability and sustainable development, it seems interesting to extend field of study to ecofriendly concrete such as recycled aggregate concrete (RAC). Prior to studies on bio-corrosion or bio-receptivity, an accurate definite characterization of RAC properties needs to be done.

In regards to natural aggregates, recycled concrete aggregates (RCA) contain mortar that influences theirs properties and those of concrete in which they are used (RCA), [1-7]. The objective of this work is to analyze the characteristics of concrete with 100 % of RCA. [8]

Main properties of RCA (Recycled Concrete Aggregate)

Due to mortar content included in (Figure 1) RCA present higher water absorption (Figure 2), lower mechanical strength, a spreader granular distribution (Figure 3) and a different shape compared to natural aggregates. [9-10]

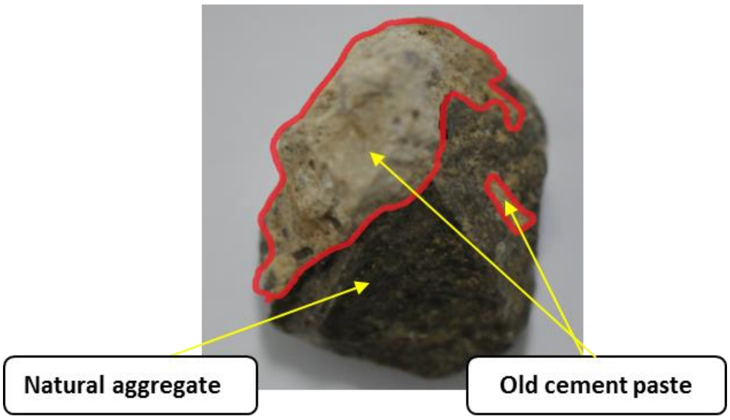

Figure 1 Constitution of RCA

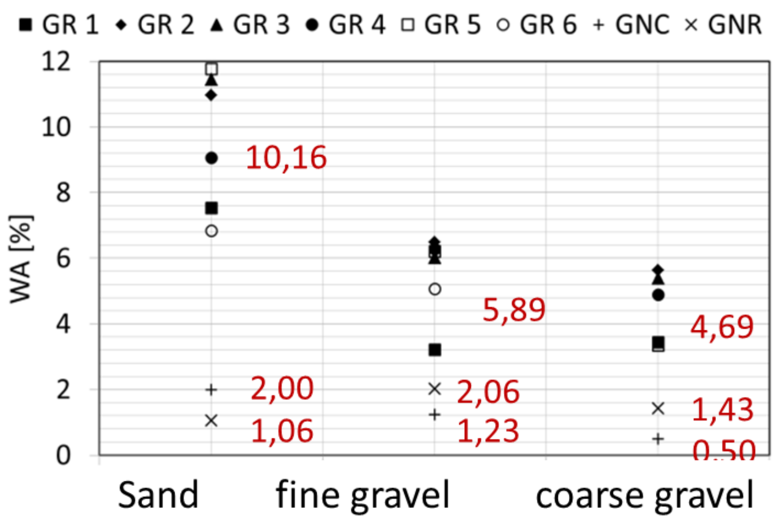

Figure 2 Water absorption (WA_{24}) of RCA compared to Natural aggregate NA
GR1-GR5 : Recycled Concrete Aggregate
GNC : Natural Crushed Aggregate

GNR : Natural Rolled Aggregate

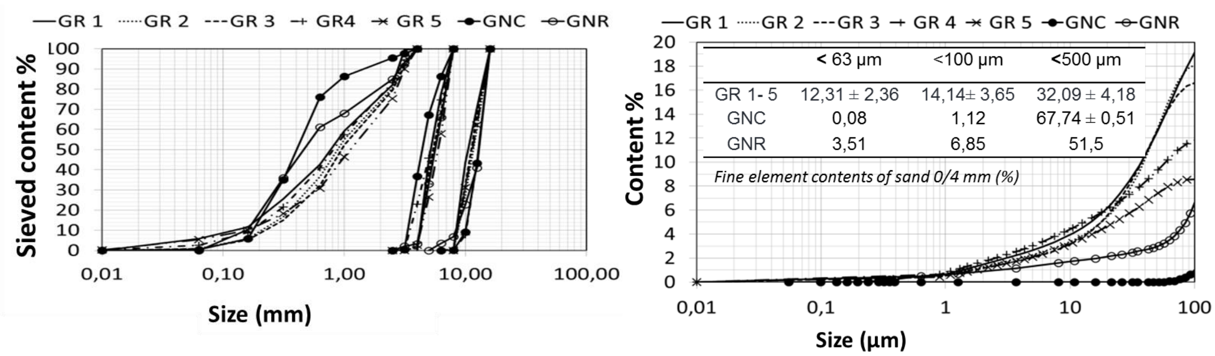

Figure 3 Granular Distribution of RCA compared to NA

<u>**Concrete including RCA (Recycled Concrete Aggregate)**</u>

In order to balance the loss of workability and mechanical strength of concrete containing recycled aggregate, several superplasticizers and formulations were tested. Some polycarboxylates were identified as appropriate superplasticizers for RAC [11].

Thus, admixtures enhance the immediate workability (rheology measurement illustrated by Figure 4) of fresh concrete made of natural or recycled aggregate but retention of this property over time is not obtained for concrete with RCA (Figure 5 and Figure 6). Moreover, some superplasticizers admixtures allow enhancing mechanical strength, due to a better manufacturing.

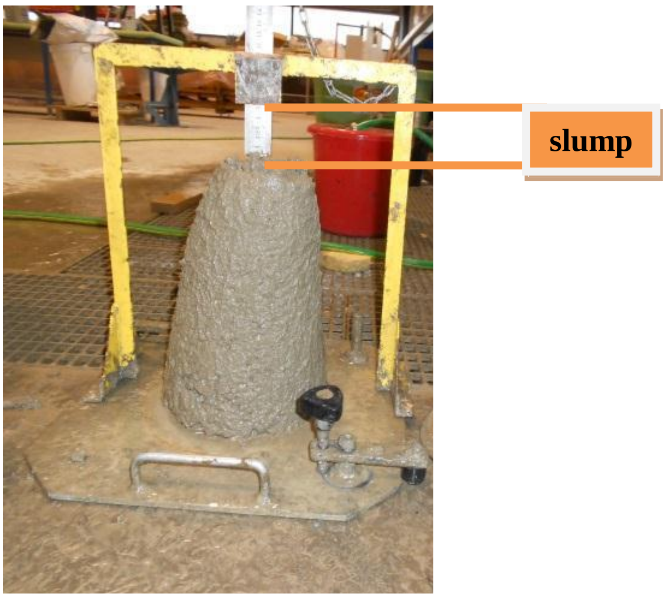

Figure 4 Slump test

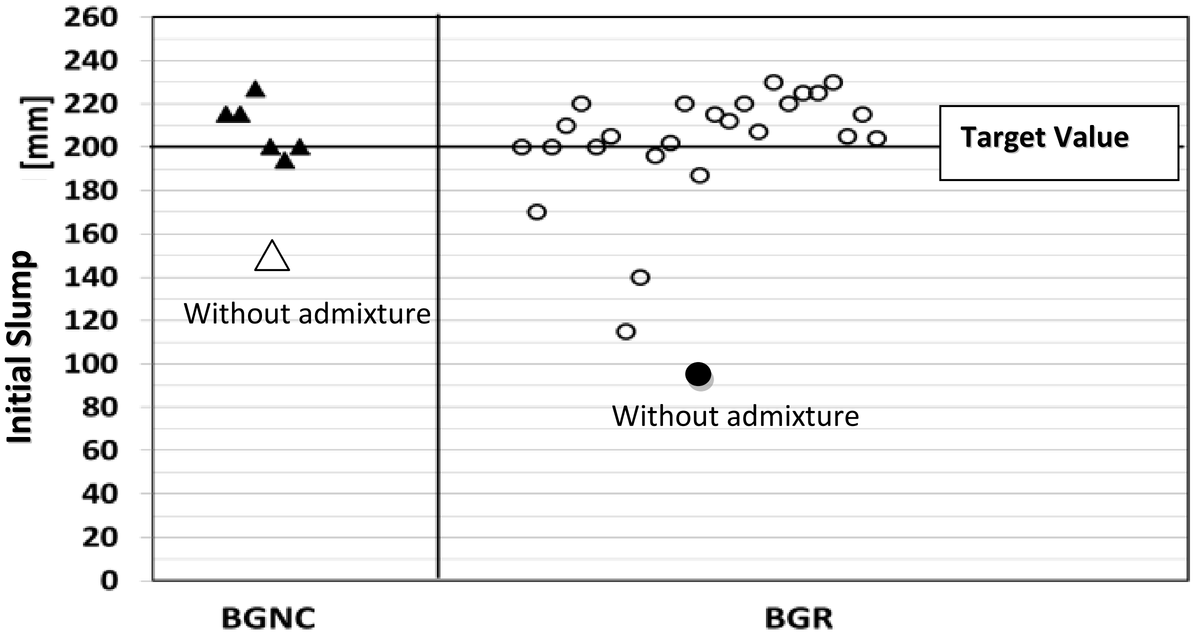

Figure 5. Initial slump of Recycled Aggregate Concrete (BGR) and Natural Aggregate Concrete (BGNC)

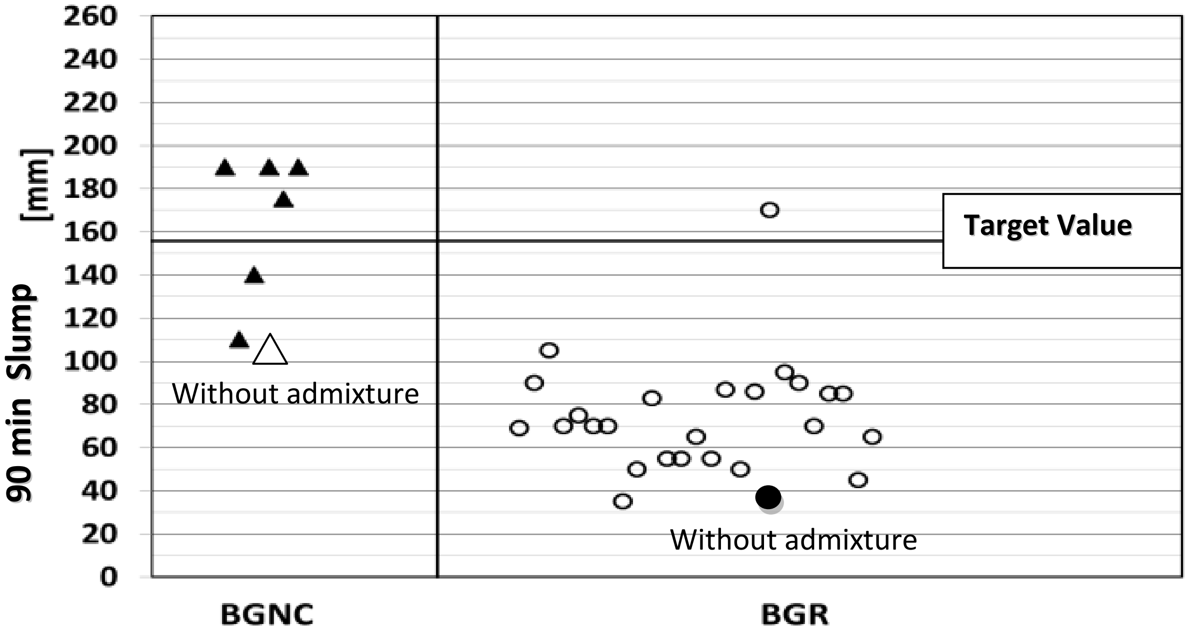

Figure 6. Final slump (90 min) of Recycled Aggregate Concrete (BGR) and Natural Aggregate Concrete (BGNC)

Conclusions and perspectives

Analysis of properties of RCA allowed the optimization of concrete formulation methods with use of superplasticizers. Moreover, studies on environmental impacts of RAC confirm that they are eco-friendly.[12] Indeed, Life Cycle Assessment of these concrete made with RCA induce less environmental damage than ones made with natural aggregates.

The next step of this work will be the analyze of bio-receptivity (ability to be colonized by microorganisms) of RAC and compatibility with bio-admixture (from extracellular substances) used to decrease bio-receptivity and bio-corrosion and to develop bio-superplasticizers to replace chemical ones. Then concrete durability and environmental impacts could be both satisfactory.

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