9th International Congress on Civil Engineering, May 8-10, 2012
Isfahan University of Technology (IUT), Isfahan, Iran

Effect of Size and Amount of Glass Aggregate on Alkali Silica Reaction

Reza Saleh Ahari[1] , Cihat Yuksel[1] , Babak Abbaspoursani Ahari[2] , Kambiz Ramyar[3]

1- PhD student Civil Engineering Department Ege University, Izmir, Turkey
2- MS student Civil Engineering Department Ege University, Izmir, Turkey
3- Professor Civil Engineering Department Ege University, Izmir, Turkey

rsalehahari@yahoo.com
cihat.yuksel@ege.edu.tr
babak_asa@yahoo.com
kambiz.ramyar@ege.edu.tr

Abstract

In this study, the potential alkali reactivity of glass aggregate was investigated in accordance with RILEM A.TC 106-2 standard. For this purpose two series of mortar mixtures were prepared. In the first series five different size fraction of non-reactive crushed limestone aggregate including 2-4 mm, 1-2 mm, 0.5-1 mm, 0.25-0.5 mm, and 0.125-0.25 mm were replaced with the corresponding particle size of flint glass. In the second series 25, 50, 75, and 100 % of the non-reactive aggregate was replaced with glass particles having the same gradation with that of the non-reactive aggregate. Regardless of the size and amount of the glass particles used in the mortar, it was observed that no considerable expansions were recorded within 14 days of exposure to 80 °C 1 N Na OH solution as prescribed by the standard. However, beyond this period a great amount of expansion was recorded in the mortar bars containing 2-4 mm and 1-2 mm glass size fractions. Although the 48-day expansion values of the glass-bearing mixtures in second series are well below 0.1% standard limit, the expansion figures of mixtures have still increasing trends. It seems that the RILEM A.TC 106-2 accelerated mortar bar method is conventionally used for rapid ASR assessment, but there is doubt about its suitability for determining the reactivity of glass aggregates.
Keywords: Glass aggregate, Alkali-silica-reaction, RILEM A.TC 106-2, Expansion, Aggregate Replacement.

1. INTRODUCTION

Glass is a recyclable material and many countries show efforts in order to obtain new glass from waste glass. Glass recycling has many benefits from both environmental and economic respects. However, in most cases, glass recycling programs cannot achieve great success. According to the statistics reported by Environmental Protection Agency (EPA), in 2009, Americans recycled only 26% of the glass produced. This resulted in 8 million tons of waste glass to be discarded to landfill [1]. The presence of impurities and mixed-color glass particles in the waste glass stream make the recycling operation to be too difficult or costly. Therefore, it is urgent to develop alternative markets for non-recyclable glass particles. Many studies have been made to utilize waste glass cullet in the construction industry, such as use of washed glass sand as aggregate in concrete products [2]. A major concern regarding the use of waste glass as aggregate is the alkali-silica reaction (ASR) that may take place between the alkali in the pore solution and reactive silica in the amorphous glass [3]. This reaction causes the formation of alkali-silica gel which can imbibe water unlimitedly, thus cracking and disruption in hardened concrete.

The degree of expansion caused by the reactive glass particles depends on many parameters including particle size, color and amount of glass in the mix [4]. Zhu et al. [5] found that flint glass reacts more than amber and green glass, besides, increasing particle size up to 12 mm led to greater amount of expansion. On the contrary, work by Jin et al. [6] monitored different results from particle size point of view; the authors indicated a pessimum size (1.18 mm) for flint soda-lime glass. Corinaldesi et al. [7] stated that with particle size up to 100 µm, glass particles improved the micro-structural properties and no detrimental effect was observed due to ASR. As discussed by many researchers, the expected ASR expansion due to the