



Evaluation of ASR potential of quartz-rich rocks by alkaline etching of polished rock sections

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Damaging effect of alkali-silica reaction (ASR) on concrete structures has been observed in various countries all over the World. Civil engineers and real state owners are demanding reliable methods in the assessment of ASR potential of aggregates before they are used in constructions. Time feasible methods are expected, as well as methods which enable prediction of long-term behaviour of aggregates in concrete. The most frequently employed accelerated mortar bar test (AMBT) quantifies ASR potential of aggregates according to the expansion values of mortar bars measured after fourteen days testing period.

Current study aimed to develop a new methodical approach facilitating identification and quantification of ASR potential of aggregates. Polished rock sections of quartz and amorphous SiO_2 (coming from orthoquartzite, quartz meta-greywacke, pegmatite, phyllite, chert, and flint) were subjected to experimental leaching in 1M NaOH solution at 80°C . After 14 days of alkaline etching, the rock sections were analyzed employing scanning electron microscope combined with energy dispersive spectrometer. Representative areas were documented in back scattered electron (BSE) images and measured using fully-automatic petrographic image analysis (PIA).

Several features connected to alkaline etching were observed on the surface of polished rock sections: deep alkaline etching, partial leach-out of quartz and amorphous particles, alkaline etching connected to quartz grain boundaries, and alkaline etching without any connection to grain boundaries. All features mentioned above had significant influence on grey-scale spectrum of BSE images. A specific part of the grey-scale spectrum (i.e. grey-shade 0-70) was characteristic of areas affected by alkaline etching (ASR area). By measuring such areas we quantified the extent of alkaline etching in studied samples. Very good correlation was found between the ASR area and ASR potential of investigated rocks measured according to the standard AMBT (following ASTM C1260).

The etching experiment is regarded to be feasible method to quantify ASR potential of quartz- (resp. SiO_2 -) rich rocks. Employment of the method: (1) decreases potential error from less experienced operator; (2) minimizes the volume of the rock need to be analyzed; (3) enables to visualize microscopic features where ASR originates; and (4) enables to identify alkali-reactive components in the rocks. The main disadvantage of the method is regarded in the restriction to quartz- (resp. SiO_2 -) rich rocks. If other minerals are included in the rocks their role in ASR should be considered. These minerals can be excluded from the analysis in case they are not reactive and if their content is very low (e.g. accessory minerals). If the minerals contribute to ASR (e.g. albite, micas), these mineral phases should be included in the analysis. Then the application of PIA needs to be modified in respect to different grey shades of individual minerals.