

Australian Standard®

Methods for sampling and testing aggregates

Method 65: Alkali aggregate reactivity— Qualitative petrological screening for potential alkali-silica reaction

1 SCOPE

This Standard sets out the method for the petrographic examination of concrete aggregates or source rock that will identify those minerals and rock types that may react with alkali hydroxides in concrete pore solutions.

The method recognizes that most routine examinations are performed as an initial screening of materials and that all that is required is a qualitative indication of potential reaction. In limited instances, a more precise measure of the sample mineralogy may be warranted.

The method does not address the procedures for mineral or rock identification. It is assumed that the method will be used by a person who is trained and experienced in geology and petrography, with experience of materials used for concrete and with a good knowledge of alkali reactive aggregates and minerals.

The method is not applicable to alkali-carbonate reactive materials.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1141 Methods for sampling and testing aggregates

1141.1 Method 1: Definitions

1141.2 Method 2: Basic testing equipment

2758 Aggregates and rock for engineering purposes

2758.1 Method 1: Concrete aggregates

3 DEFINITIONS

For the purpose of this Standard, the definitions in AS 1141.1 and those below apply:

3.1 Alkali-aggregate reaction (AAR)

Chemical/physical expansive reaction in mortar or concrete between reactive mineral phases in aggregates and alkali hydroxide in the pore solution of the cement paste or from external sources. The reaction is divided in two types—

- (a) alkali-silica reaction (ASR); and
- (b) alkali-carbonate reaction (ACR).

NOTE: Worldwide, the occurrence of ASR is much more common than the occurrence of ACR.

3.2 Alkali-reactive aggregates

Aggregates that have been shown to react with alkali hydroxides derived from the cement paste pore solution of concrete or from external alkali sources such as sea water. Reactive aggregates are grouped into—

- (a) fast-acting reactive siliceous aggregates;
- (b) slower or late reactive siliceous aggregates; and
- (c) alkali-reactive carbonate aggregates.

3.3 Alteration

Changes to the primary mineralogy occurring under heat and/or pressure and caused by percolating fluids from the late stages of igneous activity or by metamorphic activity, leading to the formation of new minerals.

3.4 Grain/crystal size

The size of a crystal or grain in a particular rock particle or minerals:

- (a) *Microcrystalline* Texture so fine-grained that a petrographic microscope is needed to resolve individual crystals (0.004 mm–0.062 mm or 4 µm–62 µm).
- (b) *Cryptocrystalline* Rock texture too small to be resolvable under the petrographic microscope (<0.004 mm or 4 µm).

3.5 Monomictic

Aggregate comprising particles of one rock or mineral type.

3.6 Petrography

The systematic description of rock, mainly with the unaided eye and by means of microscopical methods. The petrographic examination of aggregates describes the structure, texture and mineral composition of the rocks and minerals forming the various particles.

3.7 Polymictic

Aggregate comprising particles of more than one rock or mineral type.

3.8 Qualitative examination

An examination in which some or all of the constituents of a sample are identified and described, and the approximate relative proportions of those various constituents are estimated.

3.9 Weathering

The process by which rocks are broken down and decomposed by exposure to oxygen and the actions of external agencies such as moisture, heat, chemical agents, wind, plants and bacteria.

NOTE: In petrographic examination 'weathering' should be distinguished from alteration.

4 APPARATUS

The following apparatus shall be required for this method:

- (a) *Stereoscopic microscope*—capable of examining aggregate and sand-sized particles in obliquely reflected light. Zoom capability is desirable.
- (b) *Apparatus and machinery suitable for the manufacture of 30 µm thick petrographical thin sections*—sand-sized samples and some coarse aggregates will also require materials and apparatus suitable for resin consolidation prior to the manufacture of the thin sections. Alternatively, a commercial slide manufacturer may be used.

- (c) *Petrographic (i.e., polarizing) microscope*—capable of high resolution at magnifications up to $\times 500$.
- (d) *Point counting apparatus for use with the petrographic microscope* (optional).

5 SAMPLING

Sampling should be conducted by a person suitably trained and experienced in geology or by a person familiar with the rock type variations within the source.

NOTE: Normally a sample for a petrographic analysis for ASR will consist of a small section of core or small spalls of each rock type represented in a deposit. Other options may include a small grab sample of aggregate particles from a prepared stockpile (200 g of 10 mm aggregate has been found suitable) or a grab sample of about 200 g of fine aggregate.

6 PROCEDURE

6.1 Sample description

Examine the sample and describe the general character of the material (drill core, spalls, processed or unprocessed gravel or hard rock aggregate, natural or processed sand, or artificial rock). Describe whether the sample is monomictic or polymictic. Record maximum particle size and whether the sample is graded or single sized. Finally, describe the relationship between the sample supplied and the source or resource from which the sample was derived. If this relationship is not clear or known, include a statement to this effect in the report.

6.2 Particle description

Describe the general character of particles in the sample. In particular, for those particles selected for petrography and/or for preparation of sections, describe particle size and shape, appearance in terms of surface texture, colour, crystallinity, and degree of weathering. Make note of any particle coatings or encrustations.

6.3 Petrography

Identify and record the rock types present in the sample, where possible using the descriptions given in AS 2758.1, Appendix B. Where these descriptions are insufficiently precise, the description shall include an indication of the closest description in addition to a more precise definition. In polymictic samples, provide an estimate of the sample composition by percentage of rock type present. Consider the sample composition in relation to particle size and identify if there is a petrographic differentiation according to particle size.

6.4 Microscopic examination and point counting

Select sufficient particles to prepare petrographic slides.

For monomictic samples, prepare slides that will allow approximately 600 points to be counted when the point counter traverse interval is set to approximately the average grain size of the rock. Identify and count the minerals falling under the cross-hairs. Record the percentage mineral composition of the rock. Determine the approximate grain size of the mineral components, especially those components considered potentially reactive and record any textural features of importance.

For polymictic samples, select particles that represent the rock types present in the sample. With reference to data on rock types that may cause ASR ensure that potentially reactive rock types are selected (see Note). Prepare sufficient slides to count at least 100 points on each rock type. Identify and count the minerals falling under the cross-hairs. Record the percentage mineral composition for each rock type. From this data determine the percentage composition of reactive components for the total sample.

NOTE: Information on alkali-silica reactivity for some rock types is given in Appendix