TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 16349

April 2012

ICS 91.100.30

English Version

Framework for a specification on the avoidance of a damaging Alkali-Silica Reaction (ASR) in concrete

Cadre d'une spécification destinée à prévenir les dégradations causées au béton par l'alcali-réaction

Anwendung von Qualitätsregelkarten bei der Herstellung von Beton

This Technical Report was approved by CEN on 14 February 2012. It has been drawn up by the Technical Committee CEN/TC 104.

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Ref. No. CEN/TR 16349:2012: E

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Foreword

This document (CEN/TR 16349:2012) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This Technical Report is partly based on the recommendation of RILEM TC ACS (Part 1 of AAR-7) [6].

Introduction

This Technical Report has been prepared by the Joint Working Group (JWG) on Alkali-Silica Reaction (ASR) that was set up by the chairmen of CEN/TC 51, CEN/TC 104 and CEN/TC 154 and composed of representatives from CEN/TC 51, CEN/TC 104, CEN/TC 154 and RILEM TC ACS.

The following is a list of the members of the JWG on ASR:

Name	Represents
Michel Delort	CEN/TC 51
Christer Ljungkrantz	CEN/TC 51
Tom Harrison	CEN/TC 104
Christoph Müller	CEN/TC 104
Philip Nixon (until 2009)	CEN/TC 154
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In CEN member countries, ASR has been recognised as a problem in concrete structures since the 1970s.Consequently, a number of countries have established provisions to avoid a damaging ASR. These provisions are currently set out in national guidance documents and specifications.

Provisions vary in the different CEN member countries and depend on local experiences; some member countries have not yet found the need to set up specifications.

The JWG was established to review the situation and to see whether it is possible to go further in providing pragmatic and unified economic European specifications for the avoidance of a damaging ASR in concrete.

The JWG concluded that, unless there is any sound scientific explanation of a damaging ASR which can be used uniformly all over Europe, it is premature to have harmonised classes for alkali-reactivity of aggregates and provisions for avoiding a damaging ASR on a European level. Additionally, safety margins are determined at national level and are related to the reliability at which a damaging ASR will not occur. Nevertheless, a framework for the specification of the avoidance of a damaging ASR in concrete can be given.

1 Scope

This Technical Report gives guidance for avoiding a damaging Alkali-Silica Reaction (ASR) in concrete.

2 Alkali-Silica Reaction (ASR)

Alkali-Silica Reactions in concrete are a result of reaction between the alkaline pore solution in concrete and reactive mineral species (as reactive silica and silicates) in the aggregate. The reaction leads to the formation of a gel that can absorb water and exert an expansive force on the concrete. In certain conditions, these reactions can lead to damaging expansions and cracking in the concrete. For such damaging expansion to occur, all of the following conditions must be present simultaneously:

— a critical amount of reactive mineral species;

— a sufficiently high alkali hydroxide concentration in the pore solution;

— a sufficient supply of water.

Effective specifications to avoid damage from the reaction are based on ensuring that at least one of these conditions is absent.

NOTE Another type of reaction between reactive mineral species in the aggregates and the alkaline pore solution, which has been reported (e.g. from Canada and China), is the alkali-carbonate reaction. As alkali-carbonate reaction has not been recognised as a significant problem in Europe, it is not covered by this Technical Report.

3 Elements of specifications

In order to promote the sustainable use of locally available materials, it is important to tailor the precautions to the environment that the structure is exposed to as well as to local experience in building practice. Based on these principles, specifications for avoiding a damaging ASR in concrete are given within the following structure:

a) characterisation of the environment (environmental category):

   1) degree of saturation of the concrete with water;

   2) alkali supply;

   3) further aggravating factors.

b) undertaking recommendations for precautionary measures appropriate to concrete, depending on the environmental category.

4 Characterisation of environment

When all the necessary compositional factors are present, the likelihood and extent of damaging alkali-silica reaction is dependent on the environment. Three levels of categorisation of environment are therefore appropriate:

— E1: the concrete is essentially protected from extraneous moisture;

— E2: the concrete is exposed to extraneous moisture;

— E3: the concrete is exposed to extraneous moisture and additionally to aggravating factors, such as de-icing agents, freezing and thawing (or wetting and drying in a marine environment) or fluctuating loads.