TECHNICAL SPECIFICATION

ISO/TS 16774-2

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Test methods for repair materials for water-leakage cracks in underground concrete structures —

Part 2: Test method for chemical resistance

Méthodes d'essai pour matériaux de réparation pour fissures dues à l'eau dans les structures en béton souterraines —

Partie 2: Méthode d'essai de la résistance chimique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 7, *Maintenance and repair of concrete structures*.

ISO/TS 16774 consist of the following parts, under the general title *Test methods for repair materials for water-leakage cracks in underground concrete structures*:

— *Part 2: Test method for chemical resistance*

— *Part 3: Test method for water (wash out) resistance*

— *Part 4: Test method for adhesion on wet concrete surface*

The following parts are under preparation:

— *Part 1: Test method for thermal stability*

— *Part 5: Test method for watertightness*

— *Part 6: Test method for response to the substrate movement*

Introduction

This Technical Specification is linked to ISO/TR 16475. ISO/TR 16475 outlines 6 basic properties and the required performance levels of water leakage repair materials, and ISO/TS 16774 proposes a tentative, sample testing methods that are capable of evaluating the respective properties of the repair materials.

The test methods in this Technical Specification are intended to serve as a reference for nations that have not yet developed a test method on the 6 required performance properties of water leakage repair materials. If other forms of test methods that are simpler, more accurate or more organized are available, such methods are recommended for use instead. Many of the dependent variables outlined in the reference test methods of this Technical Specification are subject to change in accordance to the environmental conditions (temperature and humidity, chemical solution and concentration, width of movement activity, water pressure or water flow velocity, etc.) outlined in the standards used in respective countries.

For ISO/TS 16774-1, ISO/TS 16774-5 and ISO/TS 16774-6, for the purpose of objectively comparing the performance of injected repair materials, artificial cracks of same width, height, and volume were used to control the usage of repair materials for each testing cycle and enable repetition of the same test methods under the same conditions.

Test methods for repair materials for water-leakage cracks in underground concrete structures —

Part 2:
Test method for chemical resistance

1 Scope

This part of ISO/TS 16774 specifies a laboratory test method for the qualitative determination of the retention level of chemical resistance of repair materials in repaired cracks of concrete structures in conditions where the material is either underwater or in contact with water that may have various chemical components present.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TR 16475, *Guidelines for the repair of water-leakage cracks in concrete structures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 16475 and the following apply.

3.1
repair material for water-leakage cracks
grouting materials used to prevent water-leakages in concrete cracks

Note 1 to entry: In this Technical Specification, target ingredients are limited to injection materials outlined in ISO/TR 16475.

4 Principle

A repair material's resistance to chemical attacks is one of the fundamental properties that water-leakage repair materials should possess. While repair materials can undergo chemical property changes due to chemical attack, and moreover, harmful chemical substances can also corrode the repair materials and reduce their repair performance in water-leakage cracks. This test method evaluates a water-leakage repair material's chemical resistance performance by determining if the tested material can maintain as closely as possible its original mass after being exposed to various types of chemical substances as a means to evaluate the material's resistance against chemical corrosion. In this method, comparing the mass difference of water leakage repair materials before and after chemical exposure can be used to determine the repair material's chemical resistance level. An example test method is provided in Annex A.

The tested repair material sample prepared in a Petri dish is placed in a container and completely immersed in chemical solutions for predetermined number of hours or days (values subject to change in accordance to different national standards). The concentration of the tested chemical solution follows the condition of the applied environment belonging to different national standards, meaning test chemical substances that represent common chemical substances that are exposed to concrete

material and repair materials, as well as exposure time and chemical concentration range values should reflect the applicable environmental conditions.

Test specimens are treated so that they remain in a stable state prior to immersion in chemical substance so that physical factors such as swelling, pore-filling, or bubbling do not affect the principles of this test method. The mass of the test specimen after immersion in chemical substance is measured using an electronic scale and the mass difference is recorded. Tested types of repair materials in this part of ISO/TS 16774 are limited to injection type water-leakage repair materials.

5 Apparatus

5.1 Container.

Any size of plastic or glass type of container used to contain the chemical solution and immerse the test specimens (quality of the material of container, bowl, or dish being used should be made with materials that are non-reactive to chemical substance).

5.2 Others.

5.2.1 **Glass testing dishes (Petri dish)** and **plate** (used to keep the height of specimen).

5.2.2 **Electronic scale** (measurable up to two decimal places in unit grams).

5.2.3 **Stirring rod** and **trowel** used for specimen placement into Petri dish.

5.2.4 Other types of injecting apparatus (optional).

6 Preparation

6.1 Test specimens

Prepare the glass testing dish filled with the repair materials.

Repair material surface should be treated with a trowel or other surface treating tools to make certain the surface of the material is flat (tolerance for uneven surface allowed). Should there be a specific instruction provided by the manufacturer's end on how to prepare/inject material, such method should be used instead.

6.2 Chemical substance

Prepare the chemical substances. Example chemical substances can be used such as acid (HCl, H_2SO_4 and HNO_3, etc.), alkali (NaOH, etc.), and NaCl which are commonly found in underground water. At this time, the concentration and mixture ratio of the chemical solution should be determined in accordance with the required environmental conditions. Other types of common harmful chemical substances can be used as well for this test method such as nitrate, carbonate, acetate, sulfate, etc.

6.3 Ambient conditions

Keep the test room at temperature (20 ± 3) °C and humidity at (65 ± 5) % during the experiment unless specifically required otherwise.

NOTE Temperature values are subject to change according to different national standards.

Examples may include warmer countries with ranges that can reach up to (27 ± 2) °C and colder countries at (16 ± 3) °C, etc. The same applied to humidity conditions.

7 Procedure

a) Measure and record the mass (Mb, Mass of specimen before chemical exposure) of the test specimens (up to two decimal places in grams).

b) Place a plate on the bottom center of the container used to maintain the height of test specimen.

c) Place the test specimen on the center of that plate. The specimen's position should be fixed at the center of the plate in the chemical solution container.

In the cases where the prepared specimen floats on the chemical solution, the Petri dish with the specimen sample should be fixed to the bottom of the container with dual sided tape.

d) Carefully fill the container with the prepared chemical substance and let it rest for a specified duration (concentration ratio and duration can vary according to different national standards used to control the test method conditions).

e) After the specified duration has passed, take the test specimens out of the container, and lightly wash off any residues of chemical solution remaining on the repair material surface with distilled water, and let the test specimens dry to constant mass with +/- tolerance. and calculate the difference (up to two decimal places in grams). Measure the mass (Ma, Mass of specimen after chemical exposure) of test specimen after immersion and calculate the mass change (Mc = Mb - Ma, Mc: mass change) before and after immersion in the chemical substance.

f) Record the mass of the test specimens (up to two decimal places in grams).

Photos of the specimen and equipment conditions shall be taken at every stage during the each and every test procedure for recording and information purposes.

8 Expression of results

In this test method, the tested repair material's resistance to corrosion due to exposure to chemical substance is measured via the changes in the mass. In this case, results of the tested repair material evaluation shall be based on how much mass was lost after immersion in the chemical solution, as this information can be used to determine that materials with higher loss of mass have relatively weaker resistance to chemical corrosion. These results (Mb – Ma = Mc) can be used as a data base for an evaluation guideline in future cases of selecting appropriate repair materials with the required properties against chemical corrosion.

9 Test report

9.1 Information on the repair material of the test target

9.1.1 General

The test report should record the following information on repair material of the test target:

a) manufactured date, time, place of the repair material;

b) manufacturer (name, address, phone number);

c) type, storage method and authentication of the repair material;

e) guideline and manual on how to use and apply the repair material;

f) data on chemical composition of repair material as indicated in manufacturer's data sheet.

9.1.2 Other information

The following information is recorded on demand if required:

a) objective of the testing and related project;

b) applicable areas in construction sites using the test specimen;

c) result of eco-toxicological performance tests to account for the release of hazardous substance and the subsequent effects on health and safety.

9.2 Information on the test

The test report should record the following information on the test:

a) test manager;

b) name, purpose of the test;

c) ambient condition of the lab (temperature, humidity, safety conditions, etc.);

d) production time and place of the specimens;

e) shape and size of the specimens;

f) identification of the specimens (Lot No., etc.);

g) curing and storage conditions;

h) information on the test repair material (name, producer, validity, etc.);

i) test data (production, measurement, test period, etc.);

j) type of facilities, equipment, tools;

k) status of test equipment, tools;

l) test results;

m) details on other test programs and procedures.

Annex A
(informative)

Example test method

A.1 Principle

This example test method evaluates the chemical resistance of the repair material after being exposed to various chemical samples commonly found in underground waters or soil around the repaired crack. The test method measures any mass changes of the repair material exposed to the chemical solution to determine its chemical resistance performance based on how much the repair material corroded away. The test specimens are placed in Petri dishes which are then placed in a container filled with chemical solutions for specified period (approximately 168 h) after which the mass of the specimen is measured again to calculate the amount of material lost to chemical corrosion.

A.2 Apparatus

NOTE Similar or alternative apparatus can be used instead of the ones provided here if they possess the same required outlined properties and functions.

A.2.1 **Container** (see Figures A.1 and A.2).

Any size plastic or glass container to allow immersion of the glass Petri dish (use non-reactive materials with chemical substance).

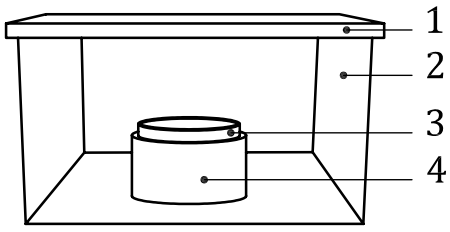
A.2.2 **Others**.

A.2.2.1 **Glass Petri dish** (ø 65 mm × 10 mm, use non-reactive materials with chemical substance).

A.2.2.2 **Electronic scale** (able to measure up to two decimal places in unit grams).

A.2.2.3 **Stirring rod** and **trowel** used for specimen placement in Petri dish.

A.2.2.4 **Plate/support** used to keep the height of specimen.



Key

1 cover plate
2 container
3 Petri dish (⌀ 65 mm × 10 mm)
4 plate used to maintain the height of the specimen (height: >20 mm)

Figure A.1 — Diagram of apparatus

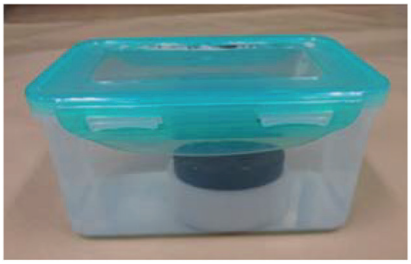


Figure A.2 — Immersed test specimen

A.3 Preparation

A.3.1 Test specimens

Completely fill the Petri dish with repair material.

Repair material surface should be treated with a trowel or other surface treating tools to make certain the surface of the material is flat (tolerance for uneven surface allowed). Should there be a specific instruction provided by the manufacturer's end on how to prepare/inject material, such method should be employed.

A.3.2 Chemical substance

Prepare 2 % H_2SO_4, 2 % HNO_3, 2 % HCl, 10 % NaCl, and 0,1 % NaOH in (20 ± 2) °C.

A.3.3 Ambient condition

Keep the test room at temperature (20 ± 3) °C and humidity at (65 ± 5) % during the experiment unless specifically required otherwise.

NOTE Temperature values are subject to change according to different national standards.

Examples may include warmer countries with ranges that can reach up to (27 ± 2) °C and colder countries at (16 ± 3) °C , etc. The same applied to humidity conditions.

A.4 Procedure

a) Measure and record the mass (Mb) of the test specimen (up to two decimal places in grams).

b) Place a plate used to maintain the height of test specimen in the container.

c) Place the test specimen on the center of plate.

d) Fill the container with chemical substance (refer to A.3.2 for the concentration ratio of the chemical solutions).

e) Let the test specimens rest in the container for 168 h.

f) After 168 h, take the test specimens out of the container, and lightly wash off the residue chemical solution on the surface of repair material with distilled water, and let the specimens dry to constant mass +/- some tolerance. Measure the mass (Ma) of the test specimen and calculate the mass change (Mc) (up to two decimal places in grams).

g) Record the mass change (up to two decimal places in grams).

Photos of the specimen and equipment conditions shall be taken at every stage possible during the each and every test procedure for recording and information purposes.

