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Accelerated life test method of mixed metal oxide anodes for cathodic protection —

Part 1: Application in concrete

Méthode d'essai accéléré de durabilité des anodes à oxydes métalliques mixtes pour la protection cathodique —

Partie 1: Application dans le béton

Reference number
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Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Test method **2**
4.1 Principle 2
4.2 Test solutions 2
4.2.1 General 2
4.2.2 Sodium chloride (NaCl) solution 2
4.2.3 Sodium hydroxide (NaOH) solution 3
4.2.4 Simulated pore water in sand 3
4.2.5 Other testing solutions 3
4.3 Test apparatus 4
4.4 Test specimens 4
4.5 Test conditions 5
4.6 Continuity of tests 7
4.7 Treatment of specimens after test 7
5 Reporting test results **8**
6 Application of results **8**
Annex A (informative) **Typical apparatus for accelerated life test** **9**
Annex B (informative) **The typical testing results of mixed metal oxide anode** **11**
Bibliography **14**

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the voluntary nature of standards, 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.

This document was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

A list of all the parts in the ISO 19097 series can be found on the ISO website.

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Introduction

Impressed current cathodic protection (ICCP) is an effective method to control corrosion of metallic structures immersed in seawater, brackish water and fresh water or buried in soil. ICCP is also widely applied to prevent steel reinforcement in concrete from corrosion in marine or other chloride contaminated environment.

Mixed metal oxide (MMO) anodes have been widely taken as impressed current anodes in the ICCP system due to their good electrocatalytic activity, low consumption rate, long service life, light weight, malleability, high ratio of performance to cost, and wide suitability for different electrolytes.

Durability is one of the most important properties of MMO anodes. ISO 19097 (all parts) examines the accelerated life test method of MMO anodes for cathodic protection to evaluate the anode's ability to achieve an expected lifetime. The accelerated lifetime can also be used to compare the stability of different MMO anodes. This document is applicable to MMO anodes intended for use in concrete. This method is not intended to give the exact service life of the anodes in the practical applications, but to provide users and manufacturers of MMO anodes a way to evaluate whether the designed life expectancy can be achieved.

Large portions of this document were derived from NACE International Standard TM0294-2016[1].

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Accelerated life test method of mixed metal oxide anodes for cathodic protection —

Part 1:
Application in concrete

1 Scope

This document specifies accelerated life test method of mixed metal oxide anodes for impressed current cathodic protection used in concrete. The accelerated life test results can be used to compare the durability of the anodes and to evaluate whether the anodes can comply with required specifications of design life expectancy at rated current output.

This document is also applicable to other anode systems that are used as impressed current anodes embedded in concrete with suitably modified apparatus to hold anodes of different geometry.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 679, *Cement — Test methods — Determination of strength*

ISO 8044, *Corrosion of metals and alloys — Basic terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8044 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
mixed metal oxide anode
impressed current anode for cathodic protection consisting of conductive coating of mixed metal oxides formed on titanium substrate

Note 1 to entry: The most common mixture used for cathodic protection is iridium oxide and tantalum oxide. Exact compositions may vary.

3.2
accelerated life
lifetime of *mixed metal oxide anode* (3.1) under accelerated testing conditions, usually in the specific electrolyte applied with large current density

Note 1 to entry: The total period of testing until the deactivation of the mixed metal oxide anode is taken as the accelerated life.

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3.3
cell voltage
voltage between anode and cathode in a single cell

3.4
charge density
product of applied current density multiplied by operating time

3.5
ripple
alternating current (AC) component in the output of a direct current (DC) power supply, arising within the power supply from incomplete filtering or from commutator action in a DC generator

4 Test method

4.1 Principle

The accelerated life testing of mixed metal oxide anode is conducted in specific simulated environments at a much higher current density than experienced in usual working conditions. This can shorten the period of time to deactivation of the anode significantly.

This document includes two parts of a test method for evaluating the anode material.

Test Method Part A is designed to evaluate whether the mixed metal oxide anode material can meet an expected lifetime criterion. It is possible that an anode may suffer from current reversal caused by erroneously connecting as a cathode or other reasons during the initial stage in practice. Therefore, current reversal testing should be conducted for a period of time before the later testing to ensure the ability of the anode to survive a brief current reversal.

Test Method Part B is a quicker test to ensure that a sample from a particular batch of anode material is suitable. It shall only be conducted on samples of a product that has passed Test Method Part A for the required design life.

4.2 Test solutions

4.2.1 General

Accelerated life testing cannot be conducted in concrete because testing at high-current levels results in premature failure of the concrete as the test electrolyte. Accelerated life testing shall therefore be conducted in an aqueous solution. The following clauses give instructions for the preparation and use of the simulated concrete electrolyte in Test Method Part A, and test solutions in Test Method Part B. All the chemicals used are reagent grade and water is distilled or deionized. All the solutions shall be freshly prepared for each test.

4.2.2 Sodium chloride (NaCl) solution

A mass of 30,0 g ± 0,1 g sodium chloride shall be added to a 1,0 l volumetric flask, then about 500 ml of distilled or deionized water added to the above. The solution shall be swirled in the flask until the NaCl crystals are totally dissolved. More distilled or deionized water shall be added to the level of the 1,0 l mark in the flask to produce a concentration of 30 g/l NaCl solution. The solution shall be thoroughly mixed.

In the cathodic protection for reinforced concrete structures like bridge piers and pilings in marine or chloride contaminated environment, the mixed metal oxide anode is exposed to the solution containing chloride ions. So sodium chloride solution is used to simulate these environments and test the ability of the mixed metal oxide anodes to tolerate chlorine evolution reaction.

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