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Corrosion of metals and alloys — Corrosion and fouling in industrial cooling water systems

Part 1:
Guidelines and requirements for conducting pilot-scale evaluation of corrosion and fouling control additives for open recirculating cooling water systems

Corrosion des métaux et alliages — Corrosion et entartrage des circuits de refroidissement à eau industriels —

Partie 1: Lignes directrices et exigences pour l'évaluation pilote des additifs anticorrosion et antitartre pour circuits de refroidissement à eau à recirculation ouverts

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Foreword

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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 document 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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This document was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 262, *Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 16784-1:2006), which has been technically revised.

The main changes are as follows:

— ~~—~~ the Introduction has been modified;

— ~~—~~ normative references have been added;

— ~~—~~ ~~Clause 3~~Clause 3 has been modified;

— ~~—~~ ~~Clause 4~~Clause 4 has been modified: the title was changed from "Types of testing" to "General requirements and recommendations" and the latest requirements on environmental protection have been added;

— ~~—~~ ~~Clauses 7~~Clauses 7 and ~~8~~8 have been combined and content related to new water treatment methods has been added.

— —the Bibliography has been modified.

A list of all parts in the ISO 16784 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.htmlwww.iso.org/members.html.

Introduction

A lot of changes have taken place in the development environment of global industrial enterprises, including advances in related technologies. As the industry grows and competition intensifies, while at the same time more stringent pollution requirements are introduced and water becomes more scarce, businesses have to operate in a safer, greener and more economical way. In many cases, cooling water quality is declining, which leads to higher concentration rates, more corrosion and more susceptibility to scaling.

Cooling water treatment technologies have developed and their use is expanding. Water pollution caused by additives used in cooling system has attracted public attention, and green environmental protection additives have become a new trend in development. Factories need to achieve zero waste water discharge. Cooling water treatments are effective measures for maintaining the best operating efficiency, protect the economic life of equipment, suppress corrosion and prevent scaling, microbial pollution and deposition on various heat transfer surfaces.

Corrosion of metals and alloys — Corrosion and fouling in industrial cooling water systems —

Part 1: Guidelines and requirements for conducting pilot-scale evaluation of corrosion and fouling control additives for open recirculating cooling water systems

1 Scope

This document specifies general requirements and parameters for the pilot test evaluation of corrosion and scaling control additives in open recirculating cooling water systems. This document covers parameters including test unit design, operation, water quality and contamination. It also covers the design and operation of pilot test devices as well as parameters to be evaluated in pilot test units.

This document covers the criteria that are used in pilot scale testing programmes for selecting water treatment programmes for specific recirculating cooling water systems.

This document is only applicable to open recirculating cooling water systems. It does not apply to closed cooling systems and once-through cooling water systems.

This document applies only to systems that incorporate shell and tube heat exchangers with standard uncoated smooth tubes and cooling water on the tube side. This document does not apply to heat exchangers with shell-side water, plate and frame and/or spiral heat exchangers and other heat exchange devices. However, when the test conditions are properly set up to model the surface temperature and shear stress in more complex heat transfer devices, the test results can predict the results of operating heat exchangers of that design.

The test criteria established in this document are not intended to govern the type of bench and pilot scale testing normally carried out by water treatment companies as part of their proprietary product development programmes. However, water treatment companies can choose to use the criteria in this document as guidelines in the development of their own product development test procedures.

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 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 terminology databases for use in standardization at the following addresses:

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

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

3.1
fouling
deposition of any material on a heat transfer surface

3.2
surface-to-volume ratio
S/V ratio
ratio of the total surface area of metal exposed to water in the cooling system to the total volume of water in the system

4 General requirements and recommendations

4.1 Selection of test methods

4.1.1 Laboratory and off-site testing

Laboratory testing, or testing at alternative off-site locations, can in some cases be necessary for selecting cooling water chemical treatment programmes. This type of testing can be used for new construction start-up programmes, when operating systems are not available, or for evaluating alternative treatment programmes. In such cases, the evaluation should include site-specific design criteria and environmental regulations that affect the cooling water system. Site-specific water supplies should be used whenever possible. All criteria in this document relating to water compositions, water treatment methods (as described in Annex A),Annex A), test unit configuration, heat exchanger design and operating conditions should be followed insofar as possible.

No laboratory or off-site testing programme can completely duplicate plant conditions. Site-specific factors (e.g. process leaks, microbiological growth, corrosion products, airborne contamination) can affect the operation of cooling water systems and the performance of chemical treatment programmes in ways that override the results of laboratory or off-site testing programmes.

4.1.2 On-site testing

Whenever possible, water treatment programmes should be evaluated on site, using plant water supplies and actual design and operating conditions, particularly those that cannot be duplicated in the laboratory.

4.1.3 Online testing

Whenever possible, all off-site, laboratory and on-site pilot scale testing should be validated by monitoring actual performance results online. Pilot units can be adapted for online work by using a side stream from the plant circulating cooling water as feedwater, bypassing the pilot unit cooling tower. Such online testing validates offline or laboratory tests. Cooling systems can be evaluated online; however, the data collected will be the result of the combination of any existing treatment and all additional chemicals that were added for the evaluation period. Online testing in this way can optimize the treatment programme to meet specific plant requirements. For example, small quantities of a treatment chemical can be added just ahead of the test heat exchanger to measure the effects of increasing additive dosage, or the possible synergistic effects of a new chemical added to the existing treatment programme.

4.2 Cost analysis

Cost analysis of the selected additives should be evaluated according to ISO 22449-2.