SIST

SLOVENSKI STANDARD
SIST EN 12502-2:2005

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Protikorozijska zaġļ ita kovinskih materialov - Navodilo za ocenjevanje verjetnosti nastanka korozije v porazdeljeni vodi in skladiġļ nih sistemih - 2. del: Vplivni dejavniki za baker in bakrove zlitine

Protection of metallic materials against corrosion - Guidance on the assessment of corrosion likelihood in water distribution and storage systems - Part 2: Influencing factors for copper and copper alloys

Korrosionsschutz metallischer Werkstoffe - Hinweise zur Abschätzung der Korrosionswahrscheinlichkeit in Wasserverteilungs- und speichersystemen - Teil 2: Einflussfaktoren für Kupfer und Kupferlegierungen

Protection des matériaux métalliques contre la corrosion - Recommandations pour l'évaluation du risque de corrosion dans les installations de distribution et de stockage d'eau - Partie 2 : Facteurs a considérer pour le cuivre et les alliages de cuivre

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23.040.99	Drugi sestavni deli za cevovode	Other pipeline components
77.060	Korozija kovin	Corrosion of metals
91.140.60	Sistemi za oskrbo z vodo	Water supply systems

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This European Standard was approved by CEN on 22 November 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 12502-2:2004) has been prepared by Technical Committee CEN/TC 262 “Metallic and other inorganic coatings”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2005, and conflicting national standards shall be withdrawn at the latest by June 2005.

This standard is in five parts:

— *Part 1: General;*

— *Part 2: Influencing factors for copper and copper alloys;*

— *Part 3: Influencing factors for hot dip galvanized ferrous materials*;

— *Part 4: Influencing factors for stainless steels;*

— *Part 5: Influencing factors for cast iron, unalloyed and low alloyed steels.*

Together these five parts constitute a package of interrelated European Standards with a common date of withdrawal (dow) of 2005-06.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This document results mainly from investigations into and experience gained of the corrosion of copper materials in drinking water distribution systems in buildings. However, it can be applied analogously to other water systems.

The corrosion likelihood of copper and copper alloys depends on the formation of a corrosion product layer that begins to form as soon as these materials come in contact with water. The more this layer prevents ionic and electronic exchanges between the metal and water, the more protective it is and the higher the durability of the metal.

Copper and copper alloy drinking water systems are, in general, resistant to corrosion damage in normal use. However, there are certain conditions under which they will sustain corrosion damage.

As a result of the complex interactions between the various influencing factors, the extent of corrosion can only be expressed in terms of likelihood. This document is a guidance document and does not set explicit rules for the use of copper and copper alloys in water systems. It can be used to minimize the likelihood of corrosion damages occurring by:

— assisting in designing, installing and operating systems from an anti-corrosion point of view;

— evaluating the need for additional corrosion protection methods for a new or existing system;

— assisting in failure analysis, when failures occur in order to prevent repeat failures occurring.

However, a corrosion expert, or at least a person with technical training and experience in the corrosion field is required to give an accurate assessment of corrosion likelihood or failure analysis.

1 Scope

This document gives a review of influencing factors of the corrosion likelihood of copper and copper alloys used as tubes, tanks and equipment in water distribution and storage systems as defined in EN 12502-1.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 12502-1:2004, *Protection of metallic materials against corrosion — Guidance on the assessment of corrosion likelihood in water distribution and storage systems — Part 1: General.*

EN ISO 8044:1999, *Corrosion of metals and alloys — Basic terms and definitions (ISO 8044:1999).*

3 Terms, definitions, and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 8044:1999 and EN 12502-1:2004 apply.

3.2 Symbols

$c(HCO_3^-)$ concentration of hydrogen carbonate ions in mmol/l

$c(SO_4^{2-})$ concentration of sulphate ions in mmol/l

$c(O_2)$ concentration of oxygen in mmol/l

4 Types of corrosion

4.1 General

The most common types of corrosion are listed in EN 12502-1.

Internal corrosion of copper and copper alloys in water distribution and storage systems generally leads to the build-up of layers formed by corrosion products, which can or cannot be protective. In some cases corrosion can lead to the impairment of the function of the system or failure because of corrosion damage (see Table 1).

Table 1 — General characteristics of the different types of corrosion of copper and copper alloys

Type of corrosion	Uniform corrosion			Pitting corrosion			Erosion corrosion	Selective corrosion	Stress corrosion	Corrosion fatigue
Manifestation	Thin adherent layer	Adherent layer	Non-protective layer of corrosion products	Locally perforated protective layer			Protective layer destroyed mechanically or removed	Dezincification	Cracks perpendicular to the principal tensile stress	Cracks perpendicular to tensile stress and parallel to bending stress
Visible corrosion products	Brown/ black Cu_2O/ CuO	Green $Cu_2(OH)_2CO_3$[a]	Blue $Cu_2(OH)_2SO_4$ green $Cu_2(OH)_2CO_3$[a]	Pits covered with nodules $Cu_2(OH)_2CO_3$ (Type 1)[a]	Pits covered with nodules $Cu_2(OH)_2SO_4$ (Type 2 and microbially induced)[a]	No products covering the pits (Type 2)[a]	None	White products of $Zn(OH)_2$ and/or $Zn_5(OH)_6(CO_3)_2$	None	None
Corrosion effect	Negligible uniform corrosion attack	Negligible uniform corrosion attack	Significant uniform corrosion attack with release of corrosion products	Pitting corrosion attack			Profiled attack	Change in colour and structure of the alloy	Cracks visible to the naked eye or under microscope	Visible cracks
Possible corrosion damage	None	None	Staining of sanitary equipment	Leakage			Leakage	Leakage, disfunction of valves	Leakage	Leakage

[a] Within a layer of Cu_2O.

The types of corrosion considered for copper and copper alloys comprise the following:

— uniform corrosion;

— pitting corrosion;

— selective corrosion;

— bimetallic corrosion;

— erosion corrosion;

— stress corrosion;

— corrosion fatigue.

For each type of corrosion, the following influencing factors, described in EN 12502-1:2004, Table 1 and Clause 5, are considered:

— characteristics of the metallic material;

— characteristics of the water;

— design and construction;

— pressure testing and commissioning;

— operating conditions.

4.2 Uniform corrosion

4.2.1 General

Experience shows that corrosion damage to copper and copper alloys as a result of uniform corrosion is rare. The occurrence of uniform corrosion of these materials strongly depends on the properties of the surface layers that are formed.

Blue-green staining of sanitary equipment and blue-green coloured water arising from dripping taps is an indicator of copper ions in the water and hence of uniform corrosion, but it cannot be taken as an indicator of corrosion damage of the copper or copper alloy component itself.

Copper ions in water can promote pitting corrosion of less noble metals (e.g. zinc, iron) in the same circuit by depositing as metallic copper, which enhances the local activity of the cathodic oxygen reduction.

Protective layers consisting of copper corrosion products normally form on copper and copper alloys. In a few cases the layer is very thin, brown and homogeneous and consists of copper (I) oxide and copper (II) oxide. In most cases, however, there is sufficient hydrogen carbonate in the water to allow the formation of a layer of copper hydroxycarbonate $Cu_2(OH)_2CO_3$ above the copper (I) oxide and copper (II) oxide. This occurs during the initial operating period, progressively forming a green scale.

The actual copper concentration is influenced by the water composition and the time and conditions of operation such as high flow rates and water hammer.

Although copper corrosion products are only sparingly soluble, copper ions are released into water. The formation of copper ions caused by uniform corrosion and dissolution of corrosion products under stagnant conditions leads to an increase of the concentration of copper ions in the water. The detectable number of copper ions will depend on: