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Marine technology — Product water quality of seawater reverse osmosis (RO) desalination — Guidelines for municipal water supply

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Contents

Page

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 documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 13, *Marine technology*.

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.html.

Introduction

With population growth, urbanization, climate change impacts and increases in household and industrial uses, fresh water scarcity will definitely affect the sustainable development of society. Seawater desalination is an effective way to meet the water needs. In some regions, it is almost the primary source of municipal water supply.

Because of technology and cost advantages, the reverse osmosis (RO) process has been used increasingly for seawater desalination. However, desalted water of seawater RO desalination is low in minerals and poorly buffered. It is usually aggressive to metallic materials used in equipment and distribution pipelines. To solve this problem, the post-treatment of desalted water, such as the addition of minerals and/or blending of waters, is necessary to achieve a balanced mineral content. Therefore, it is necessary to monitor product water quality after post-treatment to confirm the safety for municipal water supply.

Consequently, standardization of the product water quality is important and useful for the protection of corrosive pipelines and related equipment. The key parameters are monitored to meet the related limits and range. The product water will be compatible with municipal pipelines and related equipment.

These guidelines provide key parameters to manage the product water quality of seawater RO desalination for municipal water supply. They are intended to assist water engineers, authorities, decision makers and stakeholders in evaluating the compatibility of product water with pipelines and devices.

Marine technology — Product water quality of seawater reverse osmosis (RO) desalination — Guidelines for municipal water supply

1 Scope

This document provides guidelines for product water quality of seawater reverse osmosis (RO) desalination that is used for municipal water supply.

It specifies water quality parameters and ranges, monitoring frequency and test methods to ensure the compatibility of the product water with the pipelines.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/obp

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

3.1
desalted water
freshwater produced by seawater reverse osmosis desalination plants

3.2
product water
water produced by post-treatment of *desalted water* (3.1), such as mineralization and waters blending

4 Desalted water quality

The total dissolved solids (TDS) of desalted water should be as given in Table 1.

Table 1 — TDS limits of desalted water produced by different RO desalination processes

Desalted water of RO process	TDS mg/l
Single pass RO	≤ 500
Double pass RO	≤ 100

5 Product water quality

The parameters and range of product water quality should be as given in Table 2. For specific cases, see Annex C, Table C.1. For additional water quality parameters and ranges, see Reference [6] or local regulations.

Table 2 — Parameters and range of product water quality

Parameter	Range
pH	7,5 to 8,5
Calcium hardness ($H_{[Ca]}$) (As $CaCO_3$)/(mg/l)	$60 \leq H_{[Ca]} \leq 120$
Total alkalinity (As $CaCO_3$)/(mg/l)	≥ 50
Langelier saturation index (LSI)	−0,5 ≤ LSI ≤ 0,5

6 Monitoring frequency

The monitoring frequency of water quality parameters should be as given in Table 3. For specific cases, see Annex C, Table C.2.

Table 3 — Monitoring frequency of water quality parameters

Item	Parameter	Monitoring frequency
Desalted water quality	Electrical conductivity	≥ 1 (per day)
	TDS	≥ 1 (per month)
Product water quality	pH	≥ 1 (per day)
	Temperature	≥ 1 (per day)
	Electrical conductivity	≥ 1 (per day)
	Calcium hardness	≥ 1 (per week)
	Total alkalinity	≥ 1 (per week)
	TDS	≥ 1 (per month)
	LSI	≥ 1 (per month)

7 Test methods

The suitable test methods for desalted water quality and product water quality are as follows.

a) The pH should be determined in accordance with ISO 10523.

b) The electrical conductivity should be determined in accordance with ISO 7888.

c) Calcium should be determined in accordance with ISO/TS 15923-2, and calcium hardness calculation should be in accordance with Annex A.

d) Total alkalinity should be determined in accordance with ISO 9963-1.

e) TDS should be determined in accordance with EN 15216-2007.

f) The LSI should be determined in accordance with Annex B.

g) The accuracy of temperature measurement instrumentation should be ± 0,5 °C.

Annex A
(informative)

Calculation method of calcium hardness

The calcium hardness should be calculated using the following formula:

$$H_{[Ca]} = \frac{\left[Ca^{2+}\right]}{M_{Ca}} \times 100{,}09$$

where

$H_{[Ca]}$ is the calcium hardness (as $CaCO_3$), mg/l;

$\left[Ca^{2+}\right]$ is the calcium ion concentration, mg/l;

M_{Ca} is the molar mass of calcium (M_{Ca} = 40,08).

Annex B
(informative)

Calculation method of the Langelier saturation index (LSI)

The LSI is commonly used to determine the scaling tendency of $CaCO_3$, and the calculation is as follows:

$$LSI = pH - pH_s$$

where

LSI is the Langelier saturation index;

pH is the measured pH value of the water;

pH_s is the pH value of the water when the $CaCO_3$ is in the equilibrium state at saturated.

When LSI>0, $CaCO_3$ tends to precipitate. When LSI=0, $CaCO_3$ is kept in the equilibrium state at saturated. When LSI<0, $CaCO_3$ tends to dissolve.

The pH_s is calculated as follows:

$$pH_s = (9,3+A+B)-(C+D)$$

$$A = \frac{\log_{10}[TDS]-1}{10}$$

$$B = 34,55-13,2\times\log_{10}(t+273)$$

$$C = \log_{10}\left[Ca^{2+}\right]-0,4$$

$$D = \log_{10}[Alk]$$

where

A is the total dissolved solids constant;

[TDS] is the concentration of total dissolved solids in concentrate, mg/l;

B is the temperature constant;

t is the product water temperature before entering the municipal pipelines. The temperature could be the average value of measured temperature during one week;

C is the calcium hardness constant;

$\left[Ca^{2+}\right]$ is the concentration of calcium ion in concentrate(As $CaCO_3$), mg/l;

D is the total alkalinity constant;

[Alk] is the total alkalinity (As $CaCO_3$), mg/l.

