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Fine bubble technology — Evaluation method for determining gas content in fine bubble dispersions in water ~~—~~

Part~~-~~ 1:

Oxygen content

PROOF

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Foreword

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This document was prepared by Technical Committee ISO/TC 281, *Fine bubble technology*.

A list of all parts in the ISO 7383 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.html~~www.iso.org/members.html.

Introduction

Fine bubble dispersion in water has been used in various industries in recent years. Particularly in the fishery and food-processing industries, fine bubble technology is widely accepted as means for controlling dissolved oxygen level. For example, air fine bubbles are used to prevent oxygen depletion in the water of aquafarm and nitrogen fine bubbles are applied to reduce oxidization of fresh fish fillet.

The determination of the oxygen content in water is necessary to monitor the quality of object to be controlled by fine bubble dispersion in water. In the measurement of the oxygen content in fine bubble dispersion in water, however, attention should be paid to the possibility that the presence of fine bubbles themselves influences the measurement results.

In the case of air microbubble, air inside the bubbles is being dissolved during their slow floatation resulting in the increase in the oxygen content when oxygen is not oversaturated. In contrast, ultrafine bubbles (UFBs) have little influence on the oxygen content because the total amount of oxygen in UFBs is negligibly small compared to the intrinsic dissolved oxygen content in raw water. Furthermore, there is a possibility that the precipitation of visible bubbles on the surface of oxygen sensor, which is originated from dissolved gas, influences its measurement result.

Therefore, to evaluate the oxygen content of fine bubble dispersion in water, the state of bubbles in a sample water during the measurement ~~needs to be~~is figured out.

This document is intended to specify the evaluation method of the oxygen content in fine bubble dispersion in water by three measurement methods: optical sensor, electrochemical probe and iodometric methods, which are widely accepted in industries. The standardized evaluation method for the oxygen content enables easy and solid comparison among fine bubble dispersion in various states.

Fine bubble technology — Evaluation method for determining gas content in fine bubble dispersions in water —Part1: Oxygen content —

Part 1: Oxygen content

WARNING — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

IMPORTANT — It is essential that tests conducted in accordance with this document be carried out by suitably trained staff.

1 Scope

This document specifies evaluation methods for the oxygen content in fine bubble dispersion in water.

Three test methods which are adopted includethe include the optical sensor, the electrochemical probe and the iodometric method.. The first two methods have an advantage in availability of in situ and real-time measurement, and high accessibility to commercially available instruments. The last one, composed of a well-established chemical analysis procedure, is advantageous in the situation where the instruments to be used in the first two methods are unavailable.

The detection limits of the electrochemical and optical sensor methods are stated in the instruction manuals of the instruments, in most cases 0,1 mg/l or 0,2 mg/l. The upper limit depends on the specification of the instrument used. Most instruments allow measurement of a supersaturated sample.

Measurement range of the iodometric method is between 0,2 mg/l and 20 mg/l.

NOTE Chemical analysis methods other than the iodometric method can be applied[1] as an alternative.

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 5813:1983, *Water quality — Determination of dissolved oxygen — Iodometric method*

ISO 5814:2012, *Water quality — Determination of dissolved oxygen — Electrochemical probe method*

ISO 17289:2014, *Water quality — Determination of dissolved oxygen — Optical sensor method*

ISO 20480-1, *Fine bubble technology — General principles for usage and measurement of fine bubbles — Part 1: Terminology*

ISO/TR 23015, *Fine bubble technology — Measurement technique matrix for the characterization of fine bubbles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20480-1 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~~https://www.iso.org/obp

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

3.1
UFB dispersion
UFBD
liquid which contains ultrafine bubbles

[SOURCE: ISO 21255:2018, 3.2~~[2]~~[2]]

4 Interferences

4.1 Iodometric method

Readily oxidizable organic substances such as tannins, humic acid and lignins, interfere. Oxidizable sulfur compounds such as sulfides and thiourea also interfere.

To avoid such interferences, it is preferable to use the electrochemical probe, or the optical sensor method described in ISO 5714 or ISO 17289 respectively.

In the presence of suspended matter capable of fixing or consuming iodine, or if in doubt about the presence of such matter, the modified procedure described in ISO 5813:1983, Annex, shall be used.

Preferably, however, determine the oxygen content with the electrochemical probe or the optical sensor method described in ISO 5714 or ISO 17289 respectively.

4.2 Electrochemical probe method

Gases and vapours such as chlorine, hydrogen sulfide, amines, ammonia, bromine and iodine which diffuse through the membrane can interfere.

Solvents, oils, sulfides, carbonates and biofilms can also interfere with the measured current by causing obstruction and deterioration of the membrane or corrosion of the electrodes.

If in doubt about such interferences, it is preferable to use the optical sensor method described in ISO 17289.

5 Implication of measurement result

In the measurement of MB dispersion in water, the oxygen content should be determined after the bubbles are completely dissolved in the water sample. When MBs remain in water, the measured data indicate those in the process of dissolving of MBs.

In the measurement of UFB dispersion in water, the implication of measurement results differs depending on whether UFBs are present or not during the measurement. When UFBs are present, the