International Standard

ISO 7383-3

First edition
2026-07

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

Part 3: Ozone content

Technologie des fines bulles — Méthode d'évaluation pour déterminer la teneur en gaz dans les dispersions de fines bulles dans l'eau —

Partie 3: Teneur en ozone

Reference number
ISO 7383-3:2026(en)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of 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 www.iso.org/iso/foreword.html.

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.

Introduction

The integration of microbubble (MB) and ultrafine bubble (UFB) technologies with ozonation results in considerably enhanced solubility and oxidative capacity of ozone. This innovative and effective approach has been used for applications such as advanced treatment of recalcitrant wastewater, cleaning processes in the semiconductor industry, and general cleaning tasks. Ozone concentration is a critical parameter in these applications as it determines the effectiveness of the ozone MB and UFB generation equipment as well as the efficiency of the cleaning processes. The ozone concentration needs to be accurately measured for evaluating the performances of different ozone-generation systems and ensuring effectiveness of ozone-enriched water products used in the abovementioned applications. Common methods for measuring ozone concentration in water, such as electrochemical sensing via membrane-type polarography, iodometric titration, and ultraviolet (UV) photometry, are unsuitable for water containing MBs and UFBs because bubbles introduce complexities in reliable and precise measurements. To accurately determine ozone levels in such scenarios, the usual methods require adaptations and specific considerations.

Membrane-type polarography has considerable limitations in determining ozone concentrations in water containing MBs and ultrafine bubbles (UFBs). As the ozone in bubbles adhering to the electrode surface can permeate the membrane and enter the electrolyte, the measured ozone concentration exceeds the actual concentration in the water. Furthermore, deviation in measurement results increases with increasing bubble number concentration because the affected surface area increases with increasing number of bubbles. The flow rate of the fluid over the electrode surface is another critical factor; inappropriate flow rates do not always effectively remove the adhering bubbles, further impacting the measurement accuracy. Finally, ozone at high concentrations can corrode the membrane used in the measurements, affecting its performance and destabilizing the results. To ensure accuracy and reliability of ozone concentration determination, membrane-type polarography requires specific adaptations such as a flow cell that maintains suitable flow rates and regular checking and replacement of damaged membranes. This method can be used to measure the ozone concentration in bubble-free water up to 20 mg/l but is unsuitable for concentrations exceeding this threshold.

UV photometry also involves limitations in accurately determining the ozone concentration in water containing MBs or UFBs; MBs and UFBs scatter and reflect UV light, thereby inflating the involved absorbance measurements. Moreover, considerable scattering occurs for high bubble concentrations, so the quantity and size of the bubbles further influence the measurements. Meanwhile, dynamic changes with regard to the bubbles in water, such as formation and floating, can cause fluctuations in the absorbance readings, complicating the measurement process. To mitigate such bubble effects, UV photometry in situations with MBs and UFBs requires specific measures such as titration-based calibration and compensation using data processing.

Although UFBs do not directly substantially impact the ozone concentration obtained using iodometric titration in water containing MBs and UFBs, the dissolved-ozone concentration in the water can be altered when the ozone molecules within the bubbles transition to a dissolved state. This change, which can manifest as a “titration reflection” phenomenon, requires the operator to quickly and accurately adjust the speed and amount of reagent addition to accommodate the changing concentration. Consequently, the single-measurement titration time may be prolonged; the involved manual operations need to be performed at high precision. Therefore, iodometric titration is appropriate for single measurements in a laboratory setting but unsuitable for continuous online measurements.

This document recommends iodometric titration for single measurements of ozone concentration in water containing MBs and UFBs. For online measurements, the data should be preliminarily corrected through sodium thiosulfate titration and then analysed via UV photometry in combination with a flow cell to enhance the accuracy and reliability of continuous monitoring. The establishment of the method in this document provides a common measurement approach for the ozone content, facilitating the comparison and interpretation of the qualities and functions of ozone-based cleaning products.

ISO 20304-1 assesses the performance of ozone fine bubble systems through the decolourization of methylene blue, which evaluates the oxidizing ability of the system without measuring the actual ozone concentration. Although the methylene blue test effectively evaluates the treatment potential of ozone in certain applications, it does not provide precise ozone concentration data, which are essential for applications demanding accurate dosing and control.

Evaluation methods for determining oxygen and hydrogen contents in fine bubble (FB) dispersions in water have been published as ISO 7383-1 and ISO 7383-2, respectively. Evaluation methods for determining reactive oxygen species in UFB dispersions in water have also been published as ISO 24758-1 and ISO 24758-2. These methods address reactive oxygen species and do not involve the determination of ozone content, which is the focus of this document. An evaluation method for the ozone content is also necessary because ozone plays a critical role in various advanced applications, particularly when integrated with MB and UFB technologies. This document emphasizes the importance of accurately measuring the ozone content in water containing MBs and UFBs and facilitates industrial applications requiring precise ozone dosing and control, thereby supporting consistent quality assurance and performance evaluation in processes involving ozone MB and UFB systems.

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

Part 3:
Ozone content

1 Scope

This document specifies two evaluation methods for ozone content (total ozone, including ozone contained in ultrafine bubbles (UFBs) or microbubbles (MBs) and dissolved ozone) in UFB dispersions in water, namely, iodometric titration and UV photometry.

Iodometric titration is applicable as a well-established, high accuracy chemical procedure, particularly suitable for single-point determinations. The direct measurement range of this technique is typically 0,01 mg/l to 50 mg/l.

Ultraviolet (UV) photometry is applicable for rapid or continuous measurement and real-time monitoring. Its typical measurement range is from 0,075 mg/l to 200 mg/l, depending on instrument specification.

This document is applicable to industrial processes that require precise ozone dosing and control when MB or UFB systems are used.

NOTE This document does not involve the specific effects of ozone UFB dispersion applications. High concentrations of dissolved oxygen (DO), commonly found in water containing oxygen UFBs, can interfere with iodometric titration and lead to overestimation of ozone content. When extremely high ozone levels are expected, water containing oxygen UFBs can be used as the blank control.

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
dissolved ozone
ozone molecules dissolved in water

3.2
ozone ultrafine bubble
ozone UFB
ultrafine bubble containing ozone molecules inside