BS ISO 23016-4:2023

BSI Standards Publication

Fine bubble technology — Agricultural applications

Part 4: Test method for evaluating the number concentration of ultrafine bubbles (UFB) achieving the promotion of barley seed germination

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National foreword

This British Standard is the UK implementation of ISO 23016-4:2023.

The UK participation in its preparation was entrusted to Technical Committee LBI/50, Fine Bubble Technology (FBT).

A list of organizations represented on this committee can be obtained on request to its committee manager.

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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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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 23016 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

Fine bubble (FB) technology is increasingly attracting attention in numerous different fields. In the agriculture and aquaculture fields, ultrafine bubbles (UFBs) have been widely and practically used to accelerate the growth of plants and fish (air or oxygen UFBs). However, a lot of cases reported in recent years are field data, some of which are not supported statistically.

In the light of this situation of scientifically insufficient information on fine bubble technology in agriculture, this document has been developed to establish standards in this area focusing on a method to find an adequate number concentration of UFBs demonstrating the effect for promoting the germination of barley seeds.

A test method for the promotion of the germination of barley seeds has been published as ISO 23016-2 and a guideline of the minimum viable number concentration of UFBs for promoting the germination of barley seeds has been published as ISO/TR 23016-3. Successive accumulation of data, however, revealed that a positive/negative effect on germination appears depending on the variety of barley seed. Therefore, a method to assess the UFB number concentration which assures the promotion of germination irrespective of variety is needed for popularizing this technology.

INTERNATIONAL STANDARD **ISO 23016-4:2023**

Fine bubble technology — Agricultural applications —

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1 Scope

This document specifies a method to assess the ultrafine bubble (UFB) number concentration in order to find whether the number concentration of UFB generated by users is in the adequate range for promoting the barley seed germination stably irrespective of seed variety conforming to ISO 23016-2 and ISO/TR 23016-3.

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 23016-2:2019, *Fine bubble technology — Agricultural applications — Part 2: Test method for evaluating the promotion of the germination of barley seeds*

ISO/TR 23016-3, *Fine bubble technology — Agricultural applications — Part 3: Guidelines for the minimum viable number concentration of ultrafine bubbles for promoting the germination of barley seeds*

ISO 21255, *Fine bubble technology — Storage and transportation of ultrafine bubble dispersion in water*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23016-2 and ISO/TR 23016-3 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/

4 Requirements for UFB water used

The items subject to the test shall be air UFB water stored in bottles or other containers for preservation and transport in accordance to ISO 21255, and the UFB generating system used to generate UFB water. UFB water shall be generated by supplying raw water to the UFB generating system. Distilled water with a quality of A2[1)] or greater shall be used as raw water according to ISO 23016-2.

The size, quantity and concentration of UFB in UFB water shall be measured. For the generation of air UFB in water, a pressure dissolution system, whose pressure just after the pressurizing pump is around 700 kPa and that at the saturator is around 300 kPa was used. For measurement, a commercial device

1) Electrical conductivity 0,1 mS/S (25 °C), total organic carbon (TOC) 0,5 mgC/l or less, zinc 0,5 µgZn/l or less, silica 50 µgSiO_2/l or less, chloride ions µgCl^-/l, sulfide ions µgSO_4^{2-}/l.