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Fine bubble technology — Elimination method for sample characterization —

Part 1:
Evaluation procedure

ICS: 07.030

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Foreword

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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 20480 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 technology has recently seen grown in its application to markets in, cleaning, water treatment, agriculture, and aquaculture as well as biomedical fields. Now methods are required to evaluate the generation systems. Especially the characteristics like the number concentration index of fine bubbles and the size index of them are indispensable for those evaluations.

Furthermore, fine bubble dispersion water may contain other solid and liquid particles. Clearly due to this is a concern, as it may be impossible to evaluate the characteristics of fine bubbles. Therefore, it is an urgent task to solve this concern.

Currently there are several measurement methods widely used to evaluate the number concentration index the size index of particles. However, there are few methods to distinguish bubbles in fine bubble dispersion from other particles.

This issue can be resolved, using the phenomenon that the bubbles can be eliminated without any residues after dissolution and flotation. If a method that eliminates fine bubbles in specific size range is known, it is possible to distinguish fine bubbles from other solid and liquid particles. The eliminated particles can be fine bubbles. If most of fine bubbles decreased, solution that doesn't have them can be used as blank solution which is used for measurements as background. Because it is expected that fine bubbles elimination techniques will develop more, standardizing elimination techniques and evaluation method is required.

This document is intended to specify the evaluation method for elimination efficiency of fine bubbles from fine bubble dispersions in water.

Standardization for evaluating elimination efficiency of fine bubble enable easy and clear comparison among the several elimination techniques and realizes the optimization of conditions for respective elimination technique.

Fine bubble technology — Elimination method for sample characterization —

Part 1: Evaluation procedure

1 Scope

This document specifies the evaluation procedure of fine bubble elimination for fine bubble dispersion in water. This document is applicable to fine bubbles without shell and not applicable to fine bubbles with shell.

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

ISO 20480-2, *Fine bubble technology — General principles for usage and measurement of fine bubbles — Part 2: Categorization of the attributes of fine bubbles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20480-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
elimination of fine bubbles (FB)
process for decrease of the concentration index of fine bubbles

3.2
fine bubble dispersion
FBD
liquid which contains fine bubbles

[SOURCE: ISO 20298-1, 3.1]

4 Requirements

4.1 Sample

Fine bubble dispersion to be evaluated shall be generated by cleaned fine bubble generating systems using pure water and pure gas such as air, nitrogen and oxygen.

The fine bubble dispersion shall not contain stabilizing agents.

4.2 Measuring instruments

Measuring instruments to be used for evaluating fine bubble elimination for fine bubble dispersion in water shall satisfy the following specifications.

Total number concentration and/or total volume concentration including fine bubbles and contaminants such as solid particles and liquid particles can be measured. Water diluent can be used for dilute the fine bubble dispersion when the concentration is over measuring range.

Total size range including fine bubbles, contaminants and aggregates of contaminants can be measured. Another measuring instrument can be used to confirm the larger aggregates.

NOTE For example, particle tracking analysis method can be used for evaluation of number concentration, and laser diffraction method can be used for evaluation of volume concentration.

5 Environment

The classification of air cleanliness should be applied for the measurement to prevent the contamination of impurities. Ambient temperature and atmospheric pressure should be stable to keep the stability of ultrafine bubbles.

6 Evaluation of fine bubble elimination efficiency

6.1 General

Fine bubbles can be eliminated from fine bubble dispersion in water using some techniques such as ultrasonication method, ultracentrifugal fractionation and freezing method. If most of fine bubbles can be eliminated from fine bubble dispersion in water, this water can be used for blank water.

6.2 Reduction rate

The elimination efficiency should be evaluated using the number reduction rate and volume reduction rate, which are defined as the following expressions Formula (1) and Formula (2).

In the case that an increase in the number of large particles because of contaminants aggregation by elimination process can be ignored, the number reduction rate in the specified size range can be used as the elimination efficiency of fine bubbles from fine bubble dispersion.

$$r_0 = (q_{0,b} - q_{0,a}) / q_{0,b} \times 100 \quad (1)$$

where

r_0 is the number reduction rate (%);

$q_{0,a}$ is the number concentration index in the specified size range after elimination process;

$q_{0,b}$ is the number concentration index in the specified size range before elimination process.

$$r_3 = (q_{3,b} - q_{3,a}) / q_{3,b} \times 100 \quad (2)$$

where

r_3 is the volume reduction rate (%);

$q_{3,a}$ is the volume concentration index in the specified size range after elimination process;

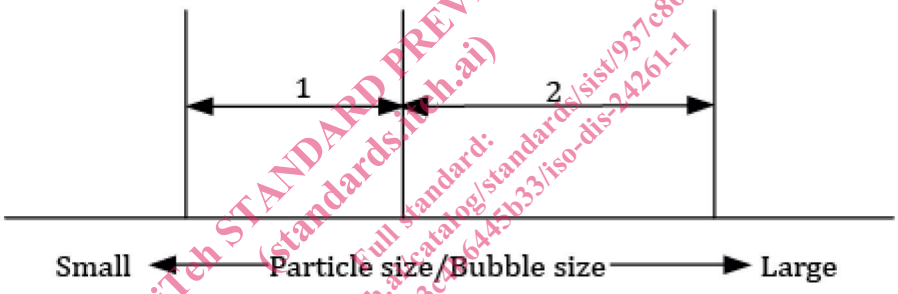
$q_{3,b}$ is the volume concentration index in the specified size range before elimination process.

6.3 Confirmation of contaminants aggregation

Number concentration index of small contaminants may be decreased because of aggregation of these particles by this elimination process. In this case, concentration index in the larger size range may increase because of aggregation. It is very difficult to confirm the changes of particles amount in the larger size range using number concentration index, so volume concentration index should be used to confirm the aggregation (See Annex A).

Therefore, decrease of number concentration index of small particles cannot mean the elimination of fine bubbles directly, and both the number concentration index and volume concentration index should be analysed to confirm actual elimination efficiency of fine bubbles.

Change in volume concentration index of particles in the larger size range should be confirmed even in the evaluation of elimination efficiency in the specified narrow size range.



Key

1 specified size range to calculate the number reduction rate

2 specified larger size range to calculate volume reduction index

Figure 1 — Size range to calculate reduction rates

6.4 Evaluation procedure of fine bubble elimination

It shall be measured in accordance with the following procedure to calculate the concentration index of fine bubbles.

1) Disperse uniformly the fine bubble dispersion in water.

2) Measure number concentration index in the specified size range.

3) Measure volume concentration index in the specified larger size range.

4) Eliminate fine bubbles from the fine bubble dispersion.

5) Homogenize the fine bubble dispersion after the step 4).

6) Measure number concentration index in the specified size range.

7) Measure volume concentration index in the specified larger size range.

8) Calculate the number reduction rate in the specified size range as defined by expression (1) and (2).