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Fine bubble technology — Sampling and sample preparation for measurement —

Part 1: Ultrafine bubble dispersion in water

Technologie des fines bulles — Échantillonnage et préparation des échantillons pour la réalisation de mesures —

Partie 1: Dispersion de bulles ultrafines dans l'eau

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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 the 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 technologies offer performance enhancement in a number of processes and applications such as cleaning, aquaculture and agriculture.

Characterization of ultrafine bubbles is critical to the further development of industrial applications. A number of characteristics such as bubble size, bubble number stability, bubble number concentration as well as other physical and chemical characteristics are important in such applications. In order to provide a verifiable characterization platform for these applications, a set of sampling and sample preparation procedures has been developed. This approach results in the most reliable correlation between the characteristics of the fine bubbles in dispersion and their application effectiveness.

It is commonly accepted that the sample preparation technique will depend on the characterization technique used.

Fine bubble technology — Sampling and sample preparation for measurement —

Part 1: Ultrafine bubble dispersion in water

1 Scope

This document specifies procedures and requirements for sampling and sample preparation of ultrafine bubble dispersions in water.

This document is applicable to relatively stable dispersions where the size and number of bubbles are relatively constant for the duration of the sampling, sample preparation and measurement.

This document is not applicable to less stable fine bubble dispersions or microbubble dispersions.

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*

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:

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

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

3.1
fine bubble dispersion
FBD
liquid which contains fine bubbles

3.2
water diluent
homogeneous water which is used for dilution without causing any deleterious effects and whose number concentration of ultrafine bubbles is known

Note 1 to entry: Water diluent is used to decrease the number concentration of ultrafine bubbles in a dispersion without changing their total number, state of aggregation with particles, size or surface chemistry.

Note 2 to entry: Water diluent is called blank water when its number concentration of ultrafine bubbles is known to be zero and when it is used for the evaluation of ultrafine bubbles.

3.3
ultrafine bubble dispersion
UFBD
liquid which contains ultrafine bubbles

3.4
microbubble dispersion
MBD
liquid which contains microbubbles

4 Liquids for sampling and sample preparation

The liquids for sampling and sample preparation shall be UFBD, with sufficient stability in size and number concentration of ultrafine bubbles and in other characteristics during the process including sampling, sample preparation and measurement.

5 Sampling

5.1 General

This procedure is applicable to static samples such as those contained in a tank. It is not applicable to running or flowing samples.

5.2 Apparatus

5.2.1 **Tank**, where UFBD are generated or UFBD are kept temporarily after being generated.

5.2.2 **Container**, closed by a lid to receive and keep the sample from the tank.

5.2.3 **Pipette**, to take the sample from the tank and transfer it to the container.

5.2.4 **Motor-driven stirrer**, for homogenization in the tank, capable of operating at approximately 50 rpm to 200 rpm.

See example in Figure A.1.

5.2.5 **Motor-driven drum roller**, for homogenization after taking the sample in a cylindrical container with a lid, capable of rotating a drum at approximately 10 rpm to 20 rpm and capable of seesaw motion.

See example in Figure A.2.

5.3 Cleaning of apparatus

Clean the surface of the tank (5.2.1) by rinsing it several times with water diluent.

Clean the surface of the container (5.2.2), the pipette (5.2.3) and the motor-driven stirrer (5.2.4) by rinsing several times with UFBD or water diluent.

5.4 Sampling procedure

Take the UFBD from the tank (5.2.1) and transfer it to the container (5.2.2) using the pipette (5.2.3), to slowly drawn it down.

Flow the contents of the pipette gently down along the inside wall of the container.

Do not add the last drop of the UFBD in the pipette to the container as this may introduce large bubbles.

It is recommended to evaluate the influence of the speed at which the UFBD is aspirated into the pipette on the characteristics of the UFBD to estimate uncertainty[1].

6 Sample preparation

Prior to any transfer of the UFBD, such as feeding to the measuring instrument, homogeneity shall be established in the containers. Refer to Annex A for information on establishing homogeneity.

Every measuring instrument has its own measuring range of number concentration in UFBD. Whenever the number concentration is higher than the range, it shall be diluted by using water diluent associated to the UFBD. The dilution ratio, mass or volume of the UFBD to those of the diluted UFBD, corrects the output of the measuring instrument by normalizing it to the number concentration of the UFBD. Refer to Annex B for information on diluting UFBD.

7 Records

The following data shall be recorded.

a) Sample

   Purity and chemical information of raw gas UFBD and water diluent.

b) Sampling

   1) Site and environments.

   2) Date.

   3) Procedure.

   4) Operator.

c) Sample preparation

   1) Site and environments.

   2) Date.

   3) Procedure.

   4) Operator.

Annex A
(informative)

Homogeneity

If the mean number concentration in the tank is to be measured, for example, homogeneity over the tank should be established as described in this annex.

Homogeneity is achieved by stirring the UFBD following the methods described in ISO 123[2]. A homogenization method should be selected carefully in order to prevent the change of characteristics of UFBD. The period of stirring should be minimized to avoid changing the characteristics of the UFBD.

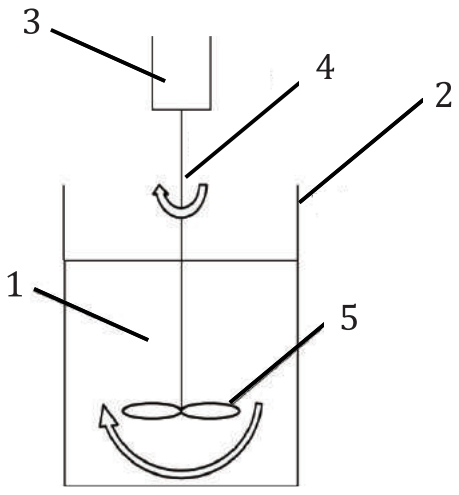
The homogenization method may be selected depending on the tank size and the tank type such as an open tank or a cylindrical tank with tight lid.

The use of stirring at a speed over 200 rpm may significantly affect the number concentration of UFBD. It is recommended that this effect be evaluated and controlled.

To confirm homogeneity, samples collected from various positions in the tank should be measured in terms of size and number concentration and evaluated by studying their differences. The absence of significant difference should be confirmed.

Even after the homogenization is over, homogeneity is deteriorated before application of the next process such as measuring and UFBD should be stored in appropriate containers. The details of recommended controls and containers are described in ISO 21255[3].

Figure A.1 shows an example of homogenization using a typical stirring mechanism consisting of motor-driven stirrer useful for open tank.

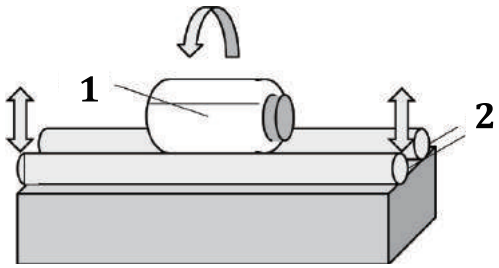


Key

1 UFBD
2 tank
3 motor
4 stainless shaft
5 stainless steel propeller

Figure A.1 — Typical stirring mechanism by a motor-driven stirrer

Figure A.2 shows an example of homogenization using a typical motor-driven drum roller useful for cylindrical tank with tight lid.



Key

1 UFBD

2 two parallel drum rollers

Figure A.2 — Motor-driven drum roller

Annex B
(informative)

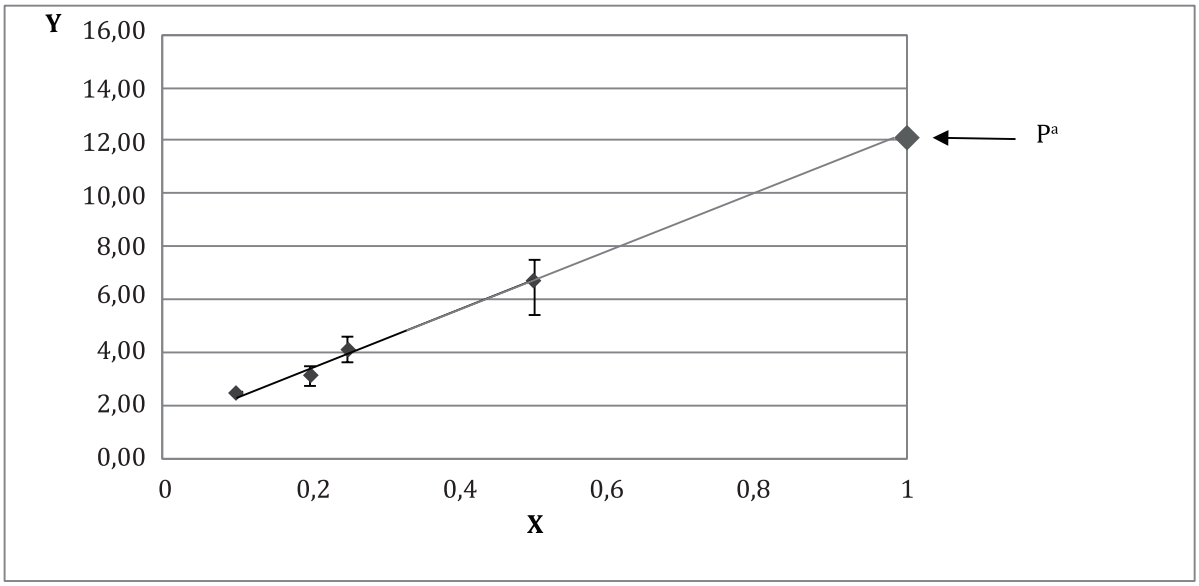
Example of procedure to dilute UFBD and related record

B.1 Example of dilution procedure

The UFBD is diluted using water diluent based on its mass or volume (refer to Clause 6) to achieve the dynamic range of the measuring instrument. If mass is used, the mass of both the UFBD and the diluent is measured using a calibrated balance. If volume is used, the volume of the UFBD and the diluent is measured using calibrated volumetric glassware. The UFBD and diluent mixture is homogenized using the methods described in ISO 123 before measurement is made.

B.2 Measurement of the UFBD number concentration

Prepare a set of diluted UFBs, each of which is assigned with its dilution ratio, i.e. the mass of the UFBD to the mass of the diluted UFBD. In the example shown in Figure B.1, four diluted UFBDs are prepared from the UFBD, whose number concentration is unknown and out of the dynamic range. The measuring instrument yields four concentrations ranging from 2×10^8/ml to 7×10^8/ml for each of diluted UFBs. The linear regression fitting to each data set consisting of dilution ratio and number concentration gives good estimate for the calibration curve for output of measuring instrument. The intercept of the curve at the dilution ratio, 1,0, corresponding to the dilution ratio of the UFBD, gives the number concentration of the UFBD.



Key

X dilution ratio

Y number concentration, expressed in E+8 particles/ml

P extrapolated point with the linear regression fitting

a Original value of number concentration was estimated to be 12,0 E+8 particles/ml for this example.

Figure B.1 — Calibration curve for the measuring instrument

B.3 Record of sampling and sample preparation for the measurement described in B.2

Table B.1 shows an example of record of sampling and sample preparation applied to the measurement described in B.2, which follows the specification given in Clause 7.

Table B.1 — Example of a record

Items		Value
a) Sample		
1)	Raw gas	Air purity level ***
2)	UFBD	Generated by ***system
3)	Water diluent	Ultra-pure water ***
b) Sampling		
1)	Site and environments	Mylab/25 °C, 50 % RH
2)	Date	Calendar year, calendar month and calendar day of the month
3)	Procedure	Mylab SOP-sampling ver.***
4)	Operator	John Doe
c) Sample preparation		
1)	Site and environments	Mylab/25 °C, 50 % RH
2)	Date	Calendar year, calendar month and calendar day of the month
3)	Procedure	Mylab SOP-dilution ver.***
4)	Operator	John Doe
NOTE The sign *** is used to indicate the blank space to be filled in.		

Bibliography

[1] ISO/IEC Guide 98-1:2009, *Uncertainty of measurement — Part 1: Introduction to the expression of uncertainty in measurement*

[2] ISO 123, *Rubber latex — Sampling*

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

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