
**Fine bubble technology — General
principles for usage and measurement
of fine bubbles —**

Part 4:
**Terminology related to microbubble
beds**

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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 documents 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*.

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.

A list of all parts in the ISO 20304 series can be found on the ISO website.

Introduction

The flotation process to separate the desired minerals from the gangue started over 2 000 years ago in Ancient Greece. As the one of the flotation processes, dissolved air flotation (DAF) was used mainly in applications in which the material to be removed, such as fat, oil, fibres and grease from water, initially. In the late 1960s, however, the process also became acceptable for wastewater and potable water treatment applications.^[3]

DAF has been used as an effective alternative to the more conventional separation process of sediments. The sedimentation process removes particles by submerging them on the floor, while the DAF process utilizes fine bubbles to float on water. Particles floating on the water surface are finally collected through a scraper. Through DAF, low-density flocs can be removed using fine bubbles. Compared to conventional sedimentation processes, DAF has the advantage of being an efficient process because of high hydraulic loading rates.^[4]

There are various factors that affect the treatment efficiency of the DAF process, such as air saturation, bubbles and particles size, coagulant, etc. Among them is the bubble bed. To increase the treatment capacity, DAF has been developed as bubble bed become thicker by increasing in the depth of the flotation basin.

NOTE A coagulant is a chemical that causes coagulation to increase particles size during water treatment process.

Even though the characteristics of bubble bed influence on the removal efficiency of DAF process, it was not possible to observe the bubble bed depth in full-scale DAF tanks until few years ago.^[6] Recently, new theories and techniques were developed for measurement and evaluation of the bubble bed in full-scale DAF tank. However, these technologies are not yet widely applied in the field. Therefore, it is necessary to minimize the confusion for researchers and pioneers by setting the definitions related to bubble bed before the standards of these measurement and evaluation methods are prepared.

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Fine bubble technology — General principles for usage and measurement of fine bubbles —

Part 4: Terminology related to microbubble beds

1 Scope

This document specifies the terminology related to dissolved air flotation (DAF) bubble bed and its characteristics in the dissolved air flotation process.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

flotation process

gravity separation process in which gas bubbles attach to solid particles to cause the apparent density of the bubble-solid agglomerates to be less than that of the water, thereby allowing the agglomerate to float to the surface

Note 1 to entry: Different methods of producing gas bubbles give rise to different types of flotation processes: electrolytic flotation, dispersed air flotation, and *dissolved air flotation* (3.2).

3.2

dissolved air flotation

DAF

flotation process (3.1) by which low density particles are removed from water and wastewater by using fine bubbles which are produced by the reduction in pressure of a water stream saturated with air

Note 1 to entry: Pressurized solution system (ISO/DIS 20480-3:2020, 4.5) is usually for generating fine bubbles used in DAF process. However, every fine bubbles generating system can be used if number concentration and size of microbubbles can be produced.

3.3

dissolved air flotation tank

DAF tank

tank in which *dissolved air flotation* (3.2) process is performed and that is roughly divided into two compartments containing contact and *separation zone* (3.10) according to the step of *flotation process* (3.1): formation of particle-bubble aggregates and rising to the surface

3.4

treatment capacity

capacity that a certain process can handle for a unit time

3.5

hydraulic loading rate

index representing the *treatment capacity* (3.4) at a limited area, calculated as the ratio of the flowrate to the *dissolved air flotation* (3.2) process to the surface area of the dissolved air flotation tank

3.6

recycle water

water used to generate fine bubbles required for the *dissolved air flotation* (3.2) process among the treated water by the DAF process

3.7

recycle ratio

ratio of the flowrate of *recycle water* (3.6) to the flowrate of inflow to the *dissolved air flotation* (3.2) process

Note 1 to entry: In case of full stream saturation, no recycle water is required

3.8

saturation pressure

inner pressure of saturator which is used for generating bubble

3.9

contact zone

zone where the floc particles are carried into and generate the particle-bubble aggregates by contacted with air bubbles

3.10

separation zone

zone where aggregates are separated from the water and become concentrated in a float layer at the top of the tank

3.11

dissolved air flotation bubble bed

DAF bubble bed

layer generated by fine bubbles in the *separation zone* (3.10)

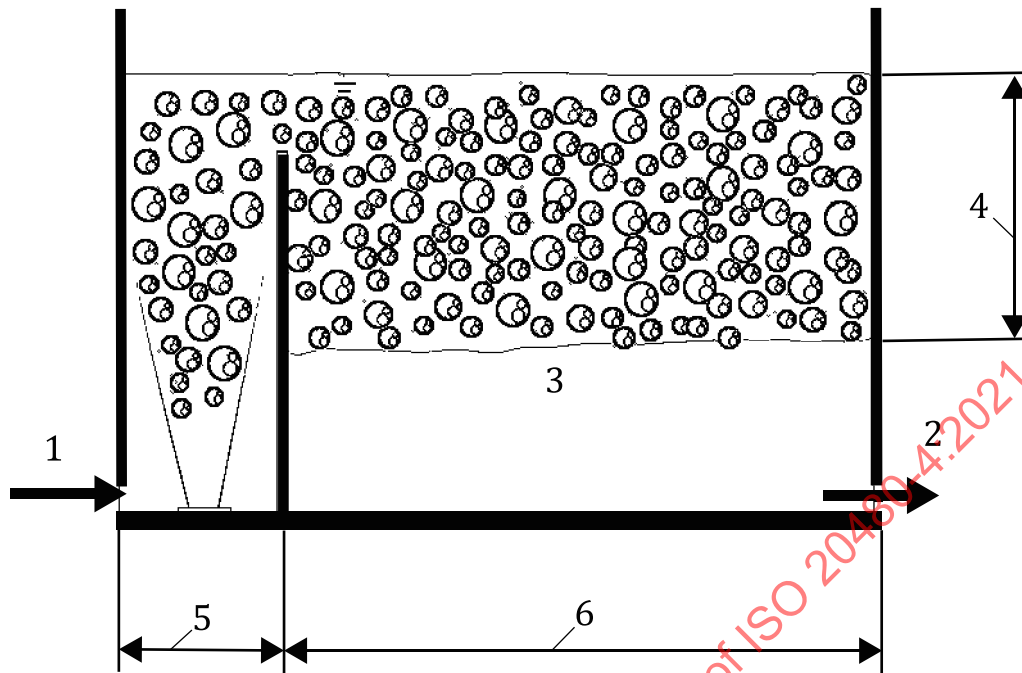
3.12

effective depth of dissolved air flotation bubble bed

effective depth of DAF bubble bed

thickness of *dissolved air flotation bubble bed* (3.11) after the *dissolved air flotation* (3.2) process reaches state of equilibrium

Note 1 to entry: See [Figure 1](#).

**Key**

- 1 raw water
- 2 treated water
- 3 DAF bubble bed
- 4 effective depth of DAF bubble bed
- 5 contact zone
- 6 separation zone

Figure 1 — Effective depth of dissolved air flotation bubble bed

3.13**bubble number concentration**

total number of bubbles present in unit volume of water

3.14**dissolved air flotation bubble bed compactness****DAF bubble bed compactness**

index indicating the degree to which the *dissolved air flotation bubble bed* (3.11) is saturated with bubbles at state of equilibrium

Note 1 to entry: It is calculated as the ratio of the *total bubble volume* (3.15) to the volume of DAF bubble bed, expressed in % [see [Formula \(1\)](#)]:

$$C = \frac{V_b}{V_{bb}} \times 100 = \sum_i (n_i \times i) \times 100 \quad (1)$$

where