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

Part 4:
Terminology related to microbubble beds

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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 parts in the ISO 20304 series can be found on the ISO website.

Introduction

Flotation process to separate the desired minerals from the gangue was started over 2000 years ago by Greeks. 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 (Letterman and AWWA, 1999).

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 following advantages: it is an efficiency process, because of high hydraulic loading rates (Amato et al., 2013; AWWA, 2011).

There are various factors that affect the treatment efficiency of the DAF process, such as air saturation, bubbles and particles size, coagulant, and so on. 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 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 (Edzwald and Haarhoff, 2012). 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, we want to minimize the confusion in the researchers and pioneers by making the definition related to bubble bed before the standards of these measurement and evaluation methods are prepared.

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 DAF bubble bed and its characteristics in the dissolved air flotation process.

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

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

— ISO Online browsing platform: available at http://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
dissolved air flotation (DAF)
flotation process 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: Note to 1 entry: Pressurized solution system (ISO/CD 20480-3 Fine bubble technology - General principles for usage and measurement of fine bubbles - Part 3: Terminology of fine bubbles in generating systems, subclause 4.1.5) is usually for generating microbubbles used in DAF process. However, every microbubble generating system can be used if sufficient number and size of microbubbles can be produced.

3.3
DAF tank
tank that DAF process is performed in and is roughly divided into two compartments containing contact and separation zone according to the step of flotation process: 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 at a limited area, calculated as the ratio of the flowrate to the DAF process to the surface area of the DAF tank

3.6
recycle water
water used to generate fine bubbles required for the DAF process among the treated water by the DAF process

3.7
recycle ratio
ratio of the flowrate of recycle water to the flowrate of inflow to the DAF process

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

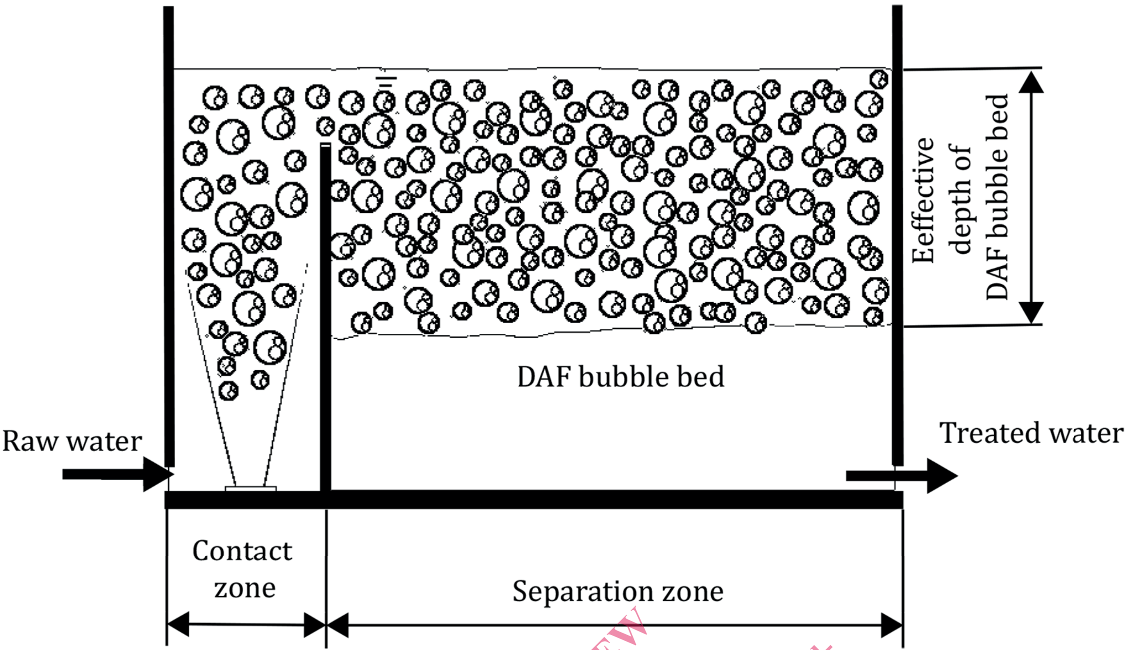
3.8
saturation pressure
inner pressure of saturator which is used for generating bubble

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
DAF bubble bed
layer generated by fine bubbles in separation zone

3.12
effective depth of DAF bubble bed
thickness of DAF bubble bed after the DAF process reaches state of equilibrium



3.13
bubble number concentration
total number of bubbles present in unit volume of water

3.14
DAF bubble bed compactness
index indicating the degree to which the DAF bubble bed is saturated with bubbles at state of equilibrium

Note 1 to entry: Note to 1 entry: calculated as the ratio of the total bubble volume to the volume of DAF bubble bed, with % as the unit

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

where

C	is DAF bubble bed compactness (%)
V_{bubble}	is the volume of bubbles in DAF bubble bed, calculated as the sum of each bubble volume (m^3)
V_{bb}	is the total volume of DAF bubble bed, calculated by multiplying surface area and effective depth of DAF bubble bed (m^3)
i	is the volume of a bubble (m^3/EA)
n_i	is the bubble number concentration whose volume is i (EA/m^3)

3.15
total bubble volume
total volume of air which used for bubble generation

3.16
bubble volume concentration index
index of the volume of bubbles contained in the unit volume of water

Note 1 to entry: calculated by the ratio of the total bubble volume to the volume of generated bubble water during any given time, with % as the unit

