○“Standardization and certification as technical platform of FBT” 0.5 h (Mr.FUSE & Dr.TANAKA)

Basics of conformity assessment

Introduction of conformity assessment by FBIA

ABSTRACT:

Technical committee “ISO TC 281 “Fine bubble technology”” was established in order to support sound market formation by developing standards. Delegates from many economies in APEC area are actively participating the discussion. So far, 9 International Standards and 2 Technical Specifications and 1 Technical Report have been published and 7 standards are under development. The standardization is also necessary for objective evaluation of R&D fine bubble technology. The progresses of the standardization in the TC 281 will be introduced.

The products on market and technology for R&D with objective evidence and the establishing the infrastructure for the evaluation will be necessary. Inter nationally agreed conformity assessment will be the final goal for guaranteeing the confidence of the evaluation for mature technology. Currently, in fine bubble products area the technology is evolving and the market is just growing. An example of conformity assessment system accommodating with current stage of the evolution of the technology will be introduced.

○“Role of inter-laboratory comparison” 0.5 h (Prof. OSHITA &Dr.TANAKA)

Reliable conformity based on inter-laboratory comparison will be introduced

ABSTRACT

In order to guarantee the confidence of evaluation, measurement method, procedure, environment and personal competence must be sound. The typical evaluations currently of interest for fine bubble technology are fine bubble characteristics and fine bubble enhanced performances of applied fine bubble technology. Evaluation of fine bubble characteristics, being typically size and number concentration, is still under evolving and needs to proceed to have objective evidence for the equivalence of measurement. Similarly, the parameters measuring the performance must have equivalence, under the deliberate choice of the parameter representing the parameter.

Since different measurements on identical object should show equivalence, the practical evidence for the equivalence are supported by the results of comparison. Showing examples, the talk will show current status of process and result of inter laboratory comparison. It covers measurement on fine bubble characteristics of ultrafine bubble water and fine bubble-enabled enhancement of germination of barley seed. From the example, participant will be aware of the current state of inter-laboratory and its importance. A proposal for another inter-laboratory comparison for the fine bubble characteristic will be presented.

○“Development of application standards and cooperation by data sharing”

0.5 h (Dr.YABE & Dr.TANAKA)

Introduction of ISO Technical Specification on 〃Test method for evaluating the growth promotion of hydroponically grown lettuce〃. Discussions on cooperation for Agro- and aqua- farming and water treatment applications of FBT by data sharing

ABSTRACT

The development of application of fine bubble technology needs reliable test method agreed by the stakeholders, which is linked to the development of test method standards. These standards has to be developed by cooperation of specialists under ISO activity. However, in the fields of application for agro-, aqua- farming and water treatment, the species of objects are so enormous that development for individual object cannot be productive. Development of a kind of systematic testing covering broad range of species will be efficient. In order facilitate the cooperation those who participate the cooperation have to share systematic information describing each testing. The talk explains an example of fine bubble-enhanced facilitation performance on leaf lettuce under hydroponic growth. The standard may be applicable at least over all kind of lettuces, or all linds of

leaf vegetables. For systematic information, the commonly applied information format will be efficient and to be discussed

Title: Current Status of Fine bubble technology (FBT)

Presentation by: Dr. Akira YABE, Special Advisor & Researcher Emeritus, AIST, Japan

Abstract:

The history of fine bubbles are discussed from various aspects. Starting from the actual applications of microbubbles in the 20 century for froth flotation, purification of contaminated water in the lake and the enhancement of growth of living things in the ocean, the various kinds of effects of microbubbles and ultrafine bubbles have been explained historically. Since the ultrapure water has become one of the key technologies for the semi-conductor process, the contaminated solid particles in the ultrapure water have become negligibly small amount. Therefore, the ultrafine bubbles which have the diameter below 1μm have become the targets of researches without large number of contaminated solid particles. Many challenges have tried to clear the characteristics of ultrafine bubbles and to create the useful effects of ultrafine bubbles. Furthermore, the experimental evidence of ultrafine bubbles and the theoretical investigation of the mechanism of existing ultrafine bubbles for the long time have been tried actively so far and explained historically. Especially, the characteristics and the application of the ultrafine bubbles have been widely and intensively conducted. The existence of the ultrafine bubbles has been cleared and measured by several methods and the useful application effects such as the cleaning effect have been investigated and clarified. The systematic scope of the historically challenged applications fields and effective functions of ultrafine bubbles has been categorized and the fruitful future applications would be estimated. As for the ultrafine bubble technology, the wider application possibility and the new effective functions would be expected in the future.

Title: Standards for basic principle and measurement of fine bubbles

Introduction of measurement of FB based on ISO standards (with movies): Storage and transportation, Sampling and sample preparation, and Characterization of microbubbles

Presentation by: Seika Ohuchi and Hirona Kobayashi, National Institute of Technology and Evaluation, Japan

Abstract:

Fine bubbles are classified into 2 types. One is micro bubbles with a diameter of less than 100 micrometers. We can see them as cloudy water, however it is too unstable to analyze using conventional methods. The other one is ultrafine bubbles with a diameter of less than 1 micrometer. They are stable in water for a long time and are not visible to the naked eye, though. These unique characteristics made precise measurement difficult before the following ISO standards were developed: Storage and transportation, Sampling and sample preparation, and Characterization of microbubbles.

In this workshop, we will share the measurement method of fine bubbles based on the above mentioned ISO standards with movies showing experimental procedures. We hope you will develop fine bubble technologies in various fields utilizing these standards and expanding them further.

Role of inter-laboratory comparison (Prof.Oshita, Dr.M. Tanaka) Reliable conformity based on inter-laboratory comparison will be introduced
この内、種子成長促進効果３か国の比較部分（大下先生）

Title

Examples of inter-laboratory tests between Vietnam, Indonesia, Hawaii (USA) and Japan

Abstract

In order to confirm the promotion effect of UFB on seed germination, we visited Hanoi University of Science (Vietnam), Bogor Agricultural University (Indonesia) and MetroGrow Hawaii (USA) to do the seed germination test. The experimental procedure and results obtained will be introduce.

Title: Introduction of an ISO Technical Specification on Test Method for “FB growth promotion effect of hydroponically grown Lettuce”

Presentation by: Dr. Akira YABE, Special Advisor & Researcher Emeritus, AIST Japan

Abstract:

The applications for agro- and aqua- farming and food industrial field also draw high interests of markets in view of fine bubble enabled performance in enhancing growth of agro- and aqua- products, improving their quality, saving resources for farming and ensuring safety of the food products. Furthermore, the performance evaluation based on objective evidence resulting from standardized procedures is intended to bridge the two technologies and facilitate diverse fields of applications for fine bubble technology in the global market. In order to accelerate sound global market formation, development of test procedures is urgently demanded by both technology stakeholders. This process is intended to meet these needs by specifying the test procedure to be applied to the generating system for agro- and aqua- farming and food industries uses. The evaluation is made by applying fine bubble water generated by the object system to lettuce and by measuring its growth. The product, lettuce, is globally accepted and the yielded test data represents the performance of the tested system over other products in such major product family as, for example, leaf vegetable. The growth process of lettuce is much simpler than other vegetables making the measuring process much easier in the test procedure. The specified test conditions, namely the environment for growth, are also easy to be controlled allowing many testing plants globally available. The parameter measured is the change in the harvested mass of lettuces with application of fine bubbles compared to that without application in a specified period of growth. Since the performance in terms of parameters is improving rapidly as the technology evolves, the quantitative criteria for the testing are not specified in this document.

ABSTRACT (all of lectures and reports)

b) "Standardization and certification as technical platform of fine bubble technology"
Presentation by: Mr.FUSE & Dr.TANAKA

Basics of conformity assessment and Introduction of an example of conformity assessment

ABSTRACT:

Technical committee "ISO TC 281 "Fine bubble technology"" was established in order to support sound market formation by developing standards. Delegates from many economies in APEC area are actively participating the discussion. So far, 9 International Standards, 2 Technical Specifications and 1 Technical Report have been published and 7 standards are under development. The standardization is also necessary for objective evaluation of R&D fine bubble technology. The progresses of the role of standardization in the TC 281 will be introduced.

The products on market and technology for R&D with objective evidence and the establishing the infrastructure for the evaluation will be necessary. Inter nationally agreed conformity assessment will be the final goal for guaranteeing the confidence of the evaluation for mature technology. Currently, in fine bubble products area the technology is evolving, although rapidly, and the market is just growing. An example of conformity assessment system accommodating with current stage of the evolution of the technology will be introduced.

c) “Current Status of Fine bubble technology”

Presentation by: Dr. Akira YABE, Special Advisor & Researcher Emeritus, AIST, Japan

Abstract:

The history of fine bubbles are discussed from various aspects. Starting from the actual applications of microbubbles in the 20 century for froth flotation, purification of contaminated water in the lake and the enhancement of growth of living things in the ocean, the various kinds of effects of microbubbles and ultrafine bubbles have been explained historically. Since the ultrapure water has become one of the key technologies for the semi-conductor process, the contaminated solid particles in the ultrapure water have become negligibly small amount. Therefore, the ultrafine bubbles which have the diameter below 1μm have become the targets of researches without large number of contaminated solid particles. Many challenges have tried to clear the characteristics of ultrafine bubbles and to create the useful effects of ultrafine bubbles. Furthermore, the experimental evidence of ultrafine bubbles and the theoretical investigation of the mechanism of existing ultrafine bubbles for the long time have been tried actively so far and explained historically. Especially, the characteristics and the application of the ultrafine bubbles have been widely and intensively conducted. The existence of the ultrafine bubbles has been cleared and measured by several methods and the useful application effects such as the cleaning effect have been investigated and clarified. The systematic scope of the historically challenged applications fields and effective functions of ultrafine bubbles has been categorized and the fruitful future applications would be estimated. As for the ultrafine bubble technology, the wider application possibility and the new effective functions would be expected in the future.

d) “Standards for basic principle and measurement of fine bubbles”

Introduction of measurement of FB based on ISO standards (with movies): Storage and transportation, Sampling and sample preparation, and Characterization of microbubbles

Presentation by: Seika Ohuchi and Hirona Kobayashi, National Institute of Technology and Evaluation, Japan

Abstract:

Fine bubbles are classified into 2 types. One is micro bubbles with a diameter of less than 100 micrometers. We can see them as cloudy water, however it is too unstable to analyze using conventional methods. The other one is ultrafine bubbles with a diameter of less than 1 micrometer. They are stable in water for a long time and are not visible to the naked eye, though. These unique characteristics made precise measurement difficult before the following ISO standards were developed: Storage and transportation, Sampling and sample preparation, and Characterization of microbubbles.

In this workshop, we will share the measurement method of fine bubbles based on the above mentioned ISO standards with movies showing experimental procedures. We hope you will develop fine bubble technologies in various fields utilizing these standards and expanding them further.

e) “Role of inter-laboratory comparison”

Presentation by: Prof. OSHITA & Dr.TANAKA

Reliable conformity based on inter-laboratory comparison will be introduced

“Examples of inter-laboratory tests between Vietnam, Indonesia, Hawaii (USA) and Japan” By Prof. Oshita

Abstract

In order to confirm the promotion effect of UFB on seed germination, we visited Hanoi University of Science (Vietnam), Bogor Agricultural University (Indonesia) and MetroGrow Hawaii (USA) to do the seed germination test. The experimental procedure and results obtained will be introduce.

“Performance of inter-laboratory comparison” by Dr. Tanaka

In order to guarantee the confidence of evaluation, related measurement method, procedure, environment and personal competence must be sound. The typical evaluations currently of interest for fine bubble technology are fine bubble characteristics and fine bubble enhanced performances of applied fine bubble technology and its products. Evaluation of fine bubble characteristics, being typically size and number concentration, is still under evolving and needs to proceed to have objective evidence for the equivalence of measurement results. Similarly, the parameters measuring the performance must have equivalence, based on the deliberate choice of the parameter representing the performance. Since different measurements on identical object should show equivalence, the practical evidences for the equivalence are supported by the results of comparison. With some examples, the presentation will show current status of process and result of inter laboratory comparison. It covers measurement on fine bubble characteristics of ultrafine bubble water and fine bubble-enabled enhancement of germination of barley seed. From the examples, participant will be aware of the current state of inter-laboratory and its importance. A proposal for another inter-laboratory comparison for the fine bubble characteristic in APEC area will be presented.

f) "Activities in Chile"
Mr. Manuel VIAL, KRAN

From Theory to Practice: Kran's UFB leadership in America

Chile, with its more than 6,000 km of coastline, more than half a million hectares planted for agriculture, and almost 1.5 million tons of annual aquaculture production, is an especially important geographical setting to give way to disruptive technologies that restore and protect the environment. By containing virtually all ecosystems -from the driest desert in the world to millenary glaciers-, we have the mission to find solutions that allow us to work with nature and not against it. This is how Kran was born, from the Patagonia and for the world, with the clear vision of transforming the production processes throughout a wide range of industries for a more sustainable present and future.

In this presentation I will share with you some successful applications of ultra-fine bubbles executed by Kran. In the aquaculture industry, we effectively eradicate the *beggiatoa* bacteria (the cause of closure of many aquaculture centers) from the seabed; and achieved a disinfectant power 30% higher than the common chemical used in the industry. In the agricultural field, we increase the shelf life of oranges by 8 weeks; and reduced lettuce harvest time by 10 days. Finally, in water treatment, the use of coagulant consumption was reduced by 50% maintaining the efficiency of removal of total suspended solids.

g) "Activities in China"

Fine Bubble Technology in China

-Application and Standardization

Zhaojun LI

Institute of Process Engineering, Chinese Academy of Sciences

Abstract

Fine bubble technology has been developed since 1970's in water treatment area. The CJ/T 3015 series standards about fine bubble aerator were developed in 1990's. From then on, it has been developed in many areas, such as film industry, medical treatment, floatation column, waste water treatment, oil industry, agriculture, aquaculture and chemical industry. Now we have established a Micro/nano Bubble Committee of Chines Society of Particuology and National Technical Committee 584 on Fine Bubble Technology of Standardization Administration of China in order to organize the academic exchange and develop standards accordingly.

Recently, we have achieved successes on agriculture, aquaculture and water treatment by fine bubble technology. Besides we have got high quality rice from ordinary soil, we also harvest rice on saline-alkali soil. We cultured Jelawat and got excellent result both in quantity and in quality. We have processed polluted water in many cases and got very good results. We are developing some standards from these results in order to expand the application more and more. Moreover we are also developing some characterization standards to know more fine bubbles.

h) "Activities in Indonesia"

Application of Fine Bubble Technology to Agri-Aqua Farming in Indonesia

Y. Aris Purwanto
Department of Mechanical and Biosystem, IPB University, Indonesia
Email: arispurwanto@apps.ipb.ac.id

Currently, Indonesia is trying to increase food production for self-sufficiency. Many technologies related to agri-aqua farming have been developing to support food production. Fine bubble technology has a great potency to be applied in agri-aqua farming. In the agriculture sector, fine bubble technology can be used in enhancing the germination and breaking dormancy of seeds. In the aqua-farming, fine bubble technology can be utilized in the freshwater fish pond to increase the number of fish in the pond. This paper discussed the utilization of ultrafine bubbles technology for enhancing germination and breaking dormancy of seeds and for freshwater fish farming in Indonesia.

i) "Activities in Korea"

Dr. Chang Gyun KIM, Inha Univ

Title: Introduction of fine bubble applications for the agriculture and the aquaculture in Korea

Abstract:

Fine bubble technology has been applied for aquaculture farm in Korea for last decade. However, the technology has not widely distributed in Korea due to lack of scientific evaluation.

Recently, the fine bubble technology is also being applied for the agriculture industry in Korea.

In the present study, the 2 most common cases of fine bubble applications in the aquaculture and agriculture industry in Korea are introduced.

One is to increase the level of dissolved oxygen of the fish-farm water.

Another is to increase the washing efficiency of the harvested fruits.

Information sharing of the evaluation results of the technology would be significant to promote the industrialization.

j) "Activities in Singapore"

Novel Development & Application of FBT in Singapore

Chee-Wee Lee, Aquaculture Innovation Centre, Singapore

Project 1 by Centre for Water Research, National University of Singapore:
Ozonation is a well-known and widely applied advanced oxidation process for industrial wastewater treatment, while ozonation efficiency in conventional process might be limited by low mass transfer, poor solubility, and rapid decomposition rate of ozone molecules in aqueous phase. Microbubble-catalytic ozonation could overcome the drawback of conventional ozonation process by enhancing ozone mass transfer and promoting organics degradation in wastewater with their superior performance of ●OH generation.

Project 2 by Aquaculture Innovation Centre:
Shipping of live shrimps in a waterless condition is a practical, profitable but challenging endeavour as survivability of animals is depending on pre-transit preparation of the animals and transiting condition. Our study showed pre-conditioning of shrimps with FB prior shipping improved the survival rate after 12 hrs of waterless condition.

Project 3 by SIMTech, A*Star:
To use acoustic meta-surface to focus ultrasonic energy to enhance the interaction between FB and contamination on the surface to improve the cleaning effect on aero-engine parts. Two ultrasonic cleaning prototypes (one spray cleaning machine and one soak cleaning machine) to use FB will be developed.

l) "Activities in Japan"

Dr. Seiichi. OSHITA, Tokyo University

Title

Promotion effect of air ultrafine bubbles on barley seed germination

Abstract

Water containing air ultrafine bubbles (UFB) has been applied to barley seeds and found to promote germination. However, at least how much number concentration is indispensable to promote germination is still unclear. There should be a threshold of UFB concentration beyond which seed germination can be promoted. Thus, we conducted germination examination by applying UFB water of 11 different number concentrations from the order of 10^7 /mL to 1.4 x 10^9 /mL. No promotion effect was observed for the UFB water with less than or equal to the order of 10^6 /mL. While, when UFB water with 7.2 x 10^7 /mL and higher is applied, barley seed germination was promoted statistically.

k) "Activities in Chinese Taipei

Overview of Fine Bubble Technology Development and Application in Agriculture in Chinese Taipei

Jong-Shinn Wu1*, Shi-Chan Chen2, and Chih-Tung Liu1
1Department of Mechanical Engineering, NTU, Hsinchu, Chinese Taipei
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Fine bubble technology (hereafter FBT) has attracted tremendous attention recently due to its unique characteristics such as large gas-liquid interfacial area, long residence time in water, higher internal gas pressure and capable of penetrating small pores without surface tension problem. These features result in many remarkable effects such as dissolved oxygen enhancement and surface cleaning which have the potential of tens of billions of market value in the water treatment, medical care, agriculture, aquaculture, to name a few. Recently, government of Chinese Taipei is committed to promote "new agriculture + green energy + circular economy", in which the FBT can definitely play a crucial role. Recently, many applications in agriculture have been successfully demonstrated in the real production field. For example, in strawberry planting, the ozonated fine bubbles suppress the growth of microorganisms and can prolong the time span of the harvest season. In hydroponic applications, fine-bubble solution applying on the roots enhances the absorption of nutrition due to a higher dissolved oxygen in cultured solution, and ozonated fine bubbles spraying on the leaves greatly decrease the spawning and breeding of insect pests. In sweet-potato washing, fine-bubble washing reveals an outstanding cleaning capability without harming sweet-potato itself, and the washed sweet potato are being sold in more than 3,000 convenient stores in Chinese Taipei currently. In Chinese herbal medicine, ozonated fine bubbles show very prominent cleaning and bleaching results without chemicals residues that would otherwise risk human's lives. More details will be presented in the workshop.

m) "Deve lop m en t of app lica tio n sta nd a rds a nd co op e ratio n b y d a ta sh a rin g "
Presentation by: Dr.YABE & Dr.TANAKA

Introduction of ISO Technical Specification on "Test method for evaluating the growth promotion of hydroponically grown lettuce" . Discussions on cooperation for Agro- and aqua- farming and water treatment applications of FBT by data sharing

Abstract by Dr. Akira YABE, Special Advisor & Researcher Emeritus, AIST Japan

The applications for agro- and aqua- farming and food industrial field also draw high interests of markets in view of fine bubble enabled performance in enhancing growth of agro- and aqua- products, improving their quality, saving resources for farming and ensuring safety of the food products. Furthermore, the performance evaluation based on objective evidence resulting from standardized procedures is intended to bridge the two technologies and facilitate diverse fields of applications for fine bubble technology in the global market. In order to accelerate sound global market formation, development of test procedures is urgently demanded by both technology stakeholders. This process is intended to meet these needs by specifying the test procedure to be applied to the generating system for agro- and aqua- farming and food industries uses. The evaluation is made by applying fine bubble water generated by the object system to lettuce and by measuring its growth. The product, lettuce, is globally accepted and the yielded test data represents the performance of the tested system over other products in such major product family as, for example, leaf vegetable. The growth process of lettuce is much simpler than other vegetables making the measuring process much easier in the test procedure. The specified test conditions, namely the environment for growth, are also easy to be controlled allowing many testing plants globally available. The parameter measured is the change in the harvested mass of lettuces with application of fine bubbles compared to that without application in a specified period of growth. Since the performance in terms of parameters is improving rapidly as the technology evolves, the quantitative criteria for the testing are not specified in this document.

ABSTRACT by Dr. TANAKA

The development of application of fine bubble technology needs reliable test method agreed by the stakeholders, which is linked to the development of test method standards. These standards has to be developed by cooperation of specialists under ISO activity. However, in the fields of application for agro-, aqua-farming and water treatment, the species of objects are so enormous that development for individual object cannot be productive. Development of a kind of systematic testing covering broad range of species will be efficient. In order

facilitate the cooperation those who pa icipate the cooperation have to share systematic information describing each testing. The talk explains an example of fine bubble-enhanced facilitation peげOrmance on leaf letluce under hydroponic growth. The standard may be applicable at least over all kind of letluces, or all linds of leaf vegetables. For systematic information, the commonly applied information format will be
efficient and to be discussed