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P15

宇宙での殺菌利用に向けたウルトラファインバブルの特性

Properties of Ultra Fine Bubble for Disinfection Application in Space

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1. Introduction

The International Space Station (ISS) procures water through the resupply and water recovery systems. For future human space exploration, it is required to increase the regeneration rate of water once brought and reduce the amount of resupply from the ground. Iodine or silver are used to disinfect the water on the ISS. In this situation, the biocide adding the recycled water is also consumable which need to supply from the ground.

In recent years, the bactericidal action of ultrafine bubble (nano bubble) water has attracted attention, and its application to various fields is progressing[1, 2]. It is expected that this can be utilized as a technology for water regeneration in space. For space application, simple and effective one is desirable. However, the properties of the ultrafine bubbles are still veiled. As a first step to understand and apply the ultrafine bubbles to space applications, we elucidated the relationship between the flow rate and the number density of ultrafine bubbles generated by the simple ultrafine bubble generator.

2. Experimental method

2.1 Experimental apparatus

Figure1 shows the schematic of experimental apparatus which is consisted of a pump, a flowmeter, gauges, and an ultrafine bubble generator. Bubbles were generated by passing water through the fine holes. The Volumetric flow rate Q was changed from 0 to 5 L/min. The dissolved air which is considered to be an origin of the bubbles is estimated by measuring oxygen concentration in water.

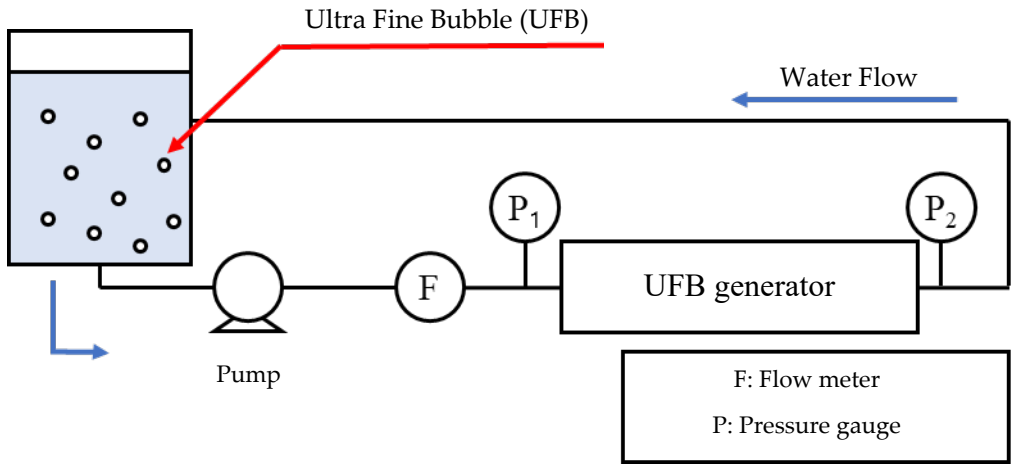


Fig1. Schematic of experimental apparatus

2.2 Measurement of the Number and diameter of Ultrafine Bubbles

The ultrafine bubble generated in the tank is measured by Nanoparticle Tracking Analysis (NTA), which uses a laser to obtain scattered light from the nanoparticles and visualize their Brownian motion. The generated sample is taken in a syringe and passed through NTA. In this measures, the momentum of Brownian motion of the ultrafine bubble within a given time. Particle size measurements are analyzed by nanoparticle tracking analysis. Diffusion coefficients are analyzed by tracking scattered light and particle size is calculated using Stokes-Einstein command (Dt). At this time, the number density [particles/ml], dissolved oxygen content [mg/L], temperature [°C], and bubble diameter [nm] of the ultrafine bubble are measured. Particle travel distance $(\overline{x,y})^2$is defined as follows;

$$\frac{(\overline{x,y})^2}{4} = Dt \tag{1}$$

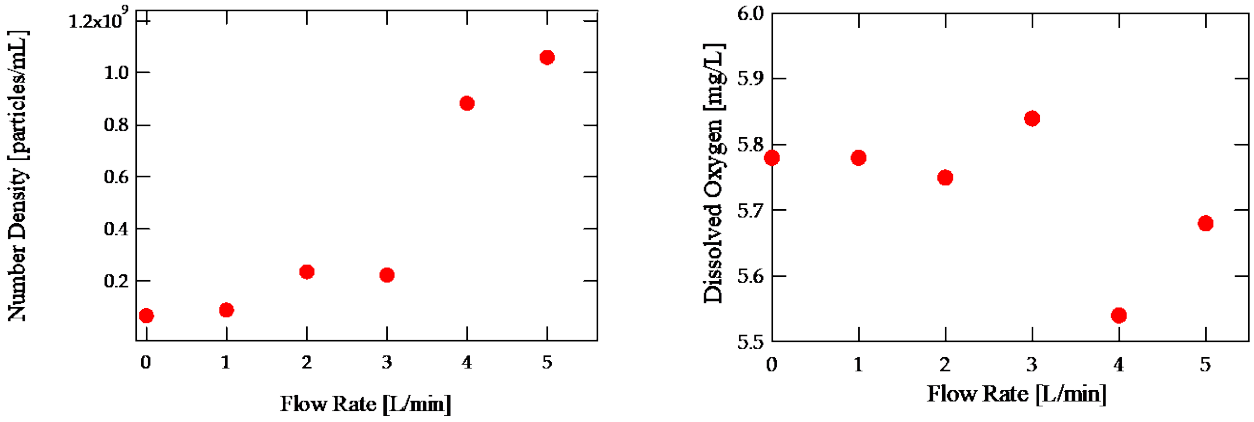
here, and bubble diameter Dt is defined as following.

$$Dt = \frac{TK_B}{3\pi\eta d} \tag{2}$$

Where, $(\overline{x,y})^2$ is Particle travel distance, K_B is Boltzmann's constant, η is Viscosity of solvent, T is Temperature of the solvent, and d is particle size[3].

3. Results and Discussion

The number density of ultrafine bubbles sampled from the tank is shown in **Fig. 2** (1) as a function of flow rate. It is drastically increased above the flow rate of 4 L/min. It shows that there is an optimum passage speed of the fine holes of ultrafine bubble generator. The concentration of dissolved oxygen is shown in **Fig. 2** (2) as a function of flow rate. It is slightly decreasing when the flow rate of 4 and 5 L/min. Therefore, the oxygen dissolved in the water may have precipitated as bubbles.



(1) Number density (2) Concentration of dissolved oxygen

Fig. 2 Number density of generated ultrafine bubbles and concentration of dissolved oxygen as a function of flow rate

4.Conclusion

Ultrafine bubbles were generated by using ultrafine bubble generator passing water through the fine holes. It is found that the condition which many bubbles are generated. It is suggested that the dissolved air in the water may be the origin of the bubbles.

References

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