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論文表題	CHARACTERISTICS OF GENERATED ICE CONTAINING OZONE MICRO BUBBLES FROM TAP WATER TO USE CONTINUOUS ICE MAKING SYSTEM(MEASUREMENT OF OZONE MICRO-BUBBLES CONCENTRATION FIXED IN ICE)				
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CHARACTERISTICS OF GENERATED ICE CONTAINING OZONE MICRO BUBBLES FROM TAP WATER TO USE CONTINUOUS ICE MAKING SYSTEM(MEASUREMENT OF OZONE MICRO-BUBBLES CONCENTRATION FIXED IN ICE)

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Abstract

1. INTRODUCTION

Ozone has a sterilizing effect and deodorizing effect due to its strong oxidizing power. Finally, it is decomposed into oxygen which is safe for human body. Therefore, ozone utilization in the food field is said to be effective and noticed. In addition to ozone having such an effect, ozone ice also has a cooling function. Because of that, we can say it is a functional ice that is very effective for keeping freshness of fresh food. As a conventional method for producing ice containing ozone MBs, attention was paid to microbubbles (MBs) with a diameter of several tens [μm], and a batch formula was used in which MBs were trapped in ice by cooling water in which ozone MBs were generated to produce ice [1]. By this method, high-concentration ozone ice can be generated by trapping as a gas in addition to dissolved ozone. However, with this production method, it was necessary to interrupt the ice formation during ice recovery and apply heat or external force to remove the ice from the cooling plate, making continuous ice making impossible. In addition, as the ice becomes thicker, MBs cannot be taken into the ice. Therefore, authors installed a metal leaf belt around the cooling plate and developed a device that efficiently continuously makes ozone MBs-containing ice by rotating the belt in one direction. The authors also examined the ability to retain the ozone concentration in the ice produced, and found that it retained the concentration required for sterilization even after 7 [days] [2]. Therefore, in order to further reduce costs, pure water was used in the past, but in consideration of actual use, tap water is used for ice making. However, since the chlorine component in tap water may accelerate the decomposition of ozone, the ozone concentration in ice and the emitted ozone gas are used in this experiment. Measure the concentration and examine the effect of chlorine.

2. EXPERIMENT

2.1 Experimental apparatus

The outline of the experimental apparatus is shown in Fig. 1.

An ozone MBs continuous ice making apparatus is installed in a thermostatic chamber set at a room temperature of -5 [° C]. An oxygen bomb, an ozonizer, and a thermostatic bath are installed outside the thermostatic room. The constant temperature bath for cooling water is set at -2.0 ° C, and the constant temperature bath for cooling the cooling plate is set at -15.0 ° C. The water tank is made of acrylic resin. The stainless steel tube is installed in the lower water tank, and the water in the water tank is cooled by flowing cooling brine in it, and the water is paired by continuously rotating the agitator to keep the water temperature constant. The ice making part is installed on the upper water tank, and it is composed of roller, stainless steel belt, and copper cooling plate with electroless nickel plating. Ozone MBs containing ice is continuously produced by cooling a belt by flowing cooling brine in a copper cooling plate and cooling water in which ozone MBs floats in an upper water tank. The inclination of the upper tank is set to 20 ° to prevent air bubbles from accumulating on the cooling surface, coalescing and expanding air bubbles from obstructing the ice making process. The rotation speed of the belt can be changed to any speed, and the thickness of the ice can be controlled by changing the belt speed. The water in the tank decreases as ice is produced, but it can be kept constant by installing a water surface maintenance device.

2.2 Measuring method of concentration of ozone MBs fixed in ice

Fig. 2 shows a method for measuring the concentration of ozone in ice. The generated ozone ice is stored in a freezer set at −18 [° C] for a specified period. After the period has elapsed, the ozone ice is sealed in a resin container and immersed in hot water at about 100 [° C] to quickly melt. By quickly melting the ozone ice, the concentration can be measured in a state where the ozone is less likely to decompose spontaneously. When the ozone ice is completely melted, the concentration is measured by sucking up the gas in the container with an ozone gas detector tube shown in Fig. 2. The ozone water with the shortest storage period 1 [h] is used to prevent the ozone water adhering to the ice surface from affecting the measurement of ozone concentration in ice.

3. RESULTS AND DISCUSSION

Comparison with pure water results is shown graphically. The black circles are the measurement results of tap water, and the white circles are the measurement results of pure water. The bubble content was almost the same as Fig. 3. Since there was no difference in the bubbles contained in the ice, the ozone concentration did not change. However, as can be seen from the result of ozone concentration in ice in Fig. 4, the difference was made in the shorter storage period. It seems to be greatly affected by chlorine in tap water. The ozone concentration decreases as the storage period increases. However, even after 1 week, the ozone concentration required for sterilization was maintained at 0.5 ppm or higher. From this fact, it is considered that the decomposition action of chlorine is suppressed after it becomes ice

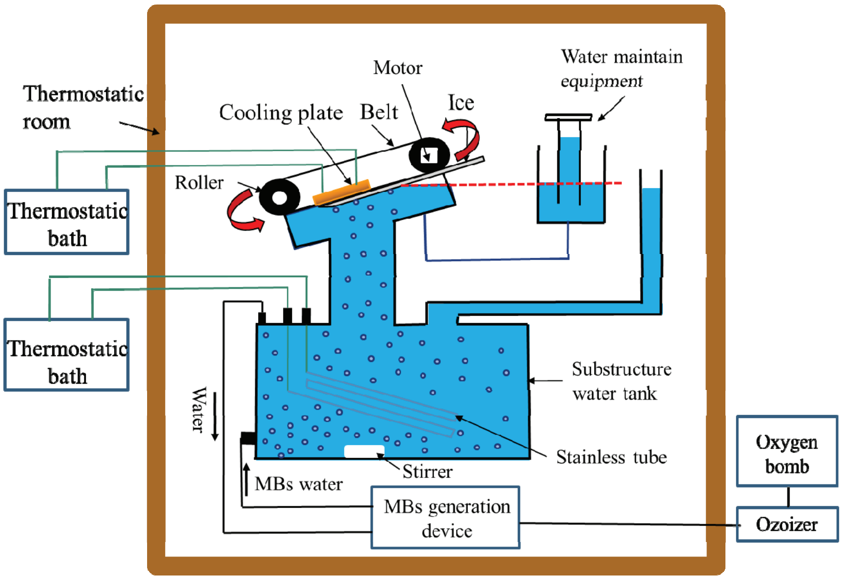


Fig.1 Outline of the experimental apparatus

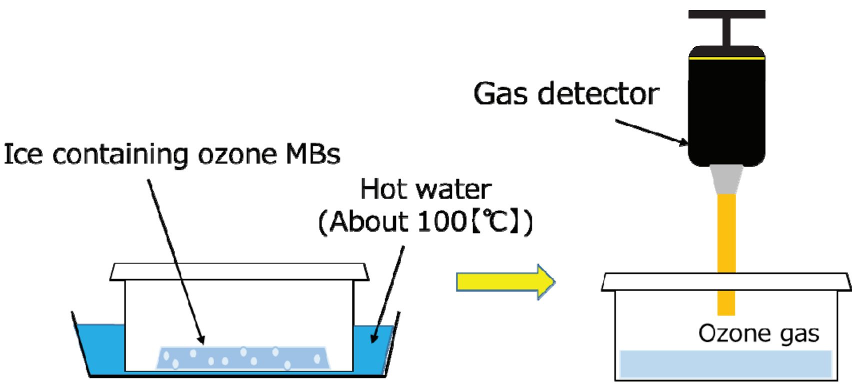
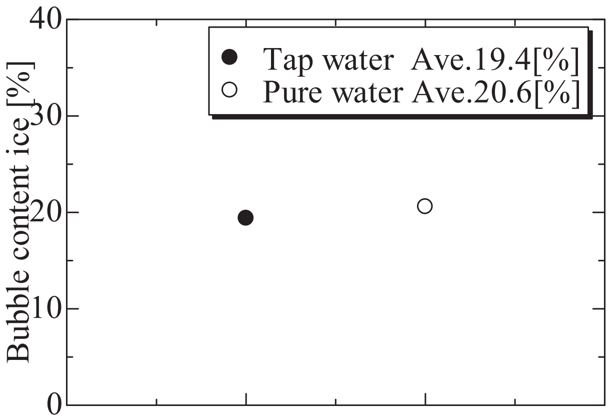


Fig. 2 Measurement of ozone MBs concentration



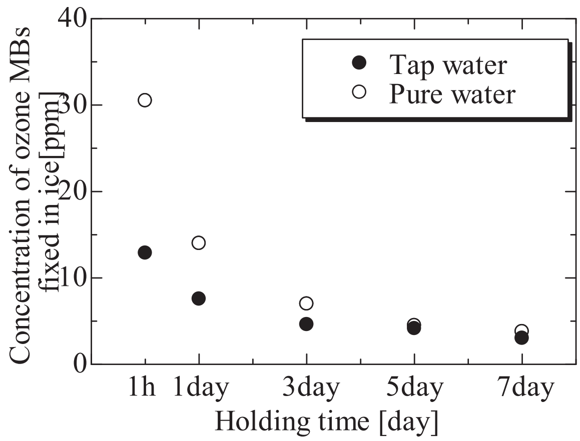


Fig. 3 Relationship between bubbles content of concentration of ozone MBs fixed in ice water

Fig. 4 Relationship between holding time and ice containing ozone MBs made from

4. CONCLUSION

(1) The ozone concentration in the ice was found to be considerably low due to the influence of chlorine, but the decomposition effect seemed to be suppressed after the ice was made.

(2) Since the concentration necessary for sterilization can be ensured even after 7 days storage, it seems to be useful for long-term transportation.

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