

# Relation between icicles formation and inflow velocity/concentration due to brinicle phenomenon

GroupA

## 1. First

We were impressed by brinicle phenomenon on TV and thought about how to reproduce it. Relations between weight percent of brine (highly concentrated salt water) and icicles formation were found in the past research, but we don't know the relations between inflow velocity/concentration of brine. We would like to clarify those relations.

## 2. What is brinicle?



It is a phenomenon in which icicles form under the sea, which can be seen in polar seas. Sea ice produces brine, and it flows in seawater. Brine cools seawater temperature and seawater freezes and icicles are produced.

## 3. Hypothesis

We thought that if we changed the inflow velocity or the weight percent of brine, we would be able to verify the condition in which icicles are formed.

## 4. Experiment 1

### ①Purpose

To test if there is a relationship between brine inflow velocity / concentration and icicles forming.

### ②Experimental method

- 1.Cool seawater (3.40 wt% salt water) and brine to each freezing point.
- 2.Pour seawater into the prepared container and

set up the equipment in the freezer.

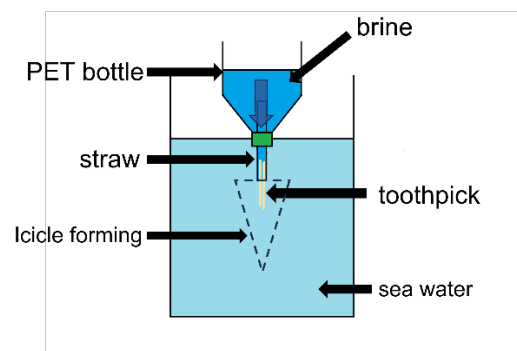
3.Pour brine into the equipment and leave it in the freezer for 15 minutes.

4.Check if an icicle was formed.

### ③Conditions

- Keep the brine inflow velocity constant and vary the brine concentration. \*1
- Keep the brine concentration constant and vary the brine inflow velocity. \*2

### ④Experimental equipment



### ⑤Results

Inflow velocity (mL/s)	0.51	0.90	1.07	1.67
Icicle forming	×	○	○	×

\*1

Icicles were formed in a certain range of inflow velocity at 15 wt% and 20 wt%.

wt%	10.0	15.0	20.0	26.5
Icicle forming	×	○	○	×

\*2

Icicles were formed in a certain range of weight percent at 0.9 mL/s and 1.07 mL/s.

### ⑤Considerations

When the inflow velocity and weight percent of brine are within a certain range, icicles were formed.

## 6. Experiment 2

### ① Purpose

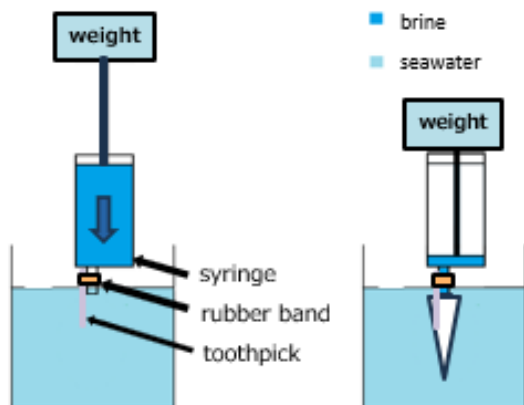
To search the detailed range of conditions which icicles are formed.

### ② Experimental method

- Cool seawater and brine (10.0, 15.0, 20.0 wt%) to each freezing point.
- Pour seawater into a container and set up the equipment inside a freezer.
- Pour brine into seawater and leave it in the freezer for 15 minutes.
- Check if icicles are formed

### ③ Experimental equipment

The equipment used in the experiment is as follows.



## Results

### 10.0 wt%

Inflow velocity (mL/s)	0.82	0.85	1.00
Icicle forming	×	○	○

### 15.0 wt%

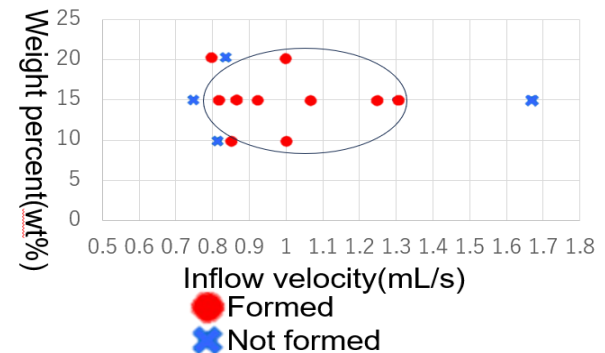
Inflow velocity (mL/s)	0.75	0.82	0.87	0.92
Icicle forming	×	○	○	○

### 20.0 wt%

Inflow velocity (mL/s)	0.80	0.84	1.00
Icicle forming	○	×	○

Inflow velocity (mL/s)	1.07	1.25	1.30	1.67
Icicle forming	○	○	○	×



### ⑤ Considerations

At 20.0 wt% and 0.84 mL/s, an icicle wasn't formed. We thought this is because the temperatures of the seawater and brine were not cooled to freezing point. Based on the past research and graphs, we thought that above 9.0 wt%, there is a certain range where icicles are formed regardless of the weight percent.

### 7. Future prospects

- Improve the equipment to ensure a steady flow of brine.
- Increase the number of experiments to obtain more data.
- The range of inflow velocity and concentrations that help form an icicle have to be more accurately verified.
- Numerically research if or not icicles have formed.
- Research about unknown icicle conditions of forming.

### 8. References

1. Brinicle," an amazing natural phenomenon that freezes anything it touches in an instant, attacks sea creatures (Antarctica)  
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