Monitoring of Blockages by Shellfishes in a Pipe Utilizing an Optical Fiber Acoustic Emission System

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Water supply facilities

Blockage of water pipes by shellfishes ➡ Problem for safe operation

Limnoperna fortunei

▪Bivalve type shell(Non-native shellfish)

Come into pipes as larvae

⬇

Grow up and make colonies

⬇

Block fresh water pipe

Limnperna fortunei

Prevention of invasion is difficult

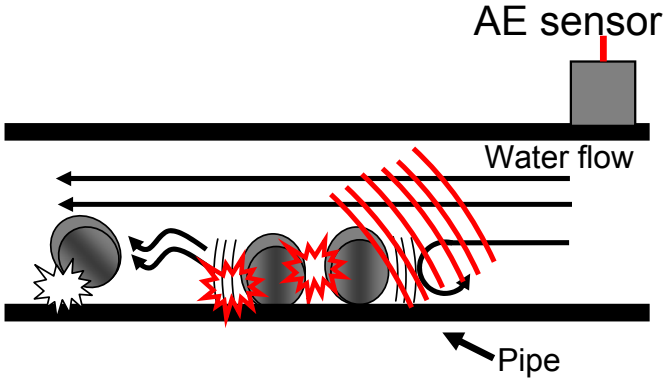
⬇

Solution

Chemical agents : ▲ safety problem

Manpower : ▲ difficult to remove in large area

AE (Acoustic Emission) Method



acoustic wave(AE) was generated

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Detected by AE sensor

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Blocked point was detected

↓

Removed by manpower become easy

Purpose

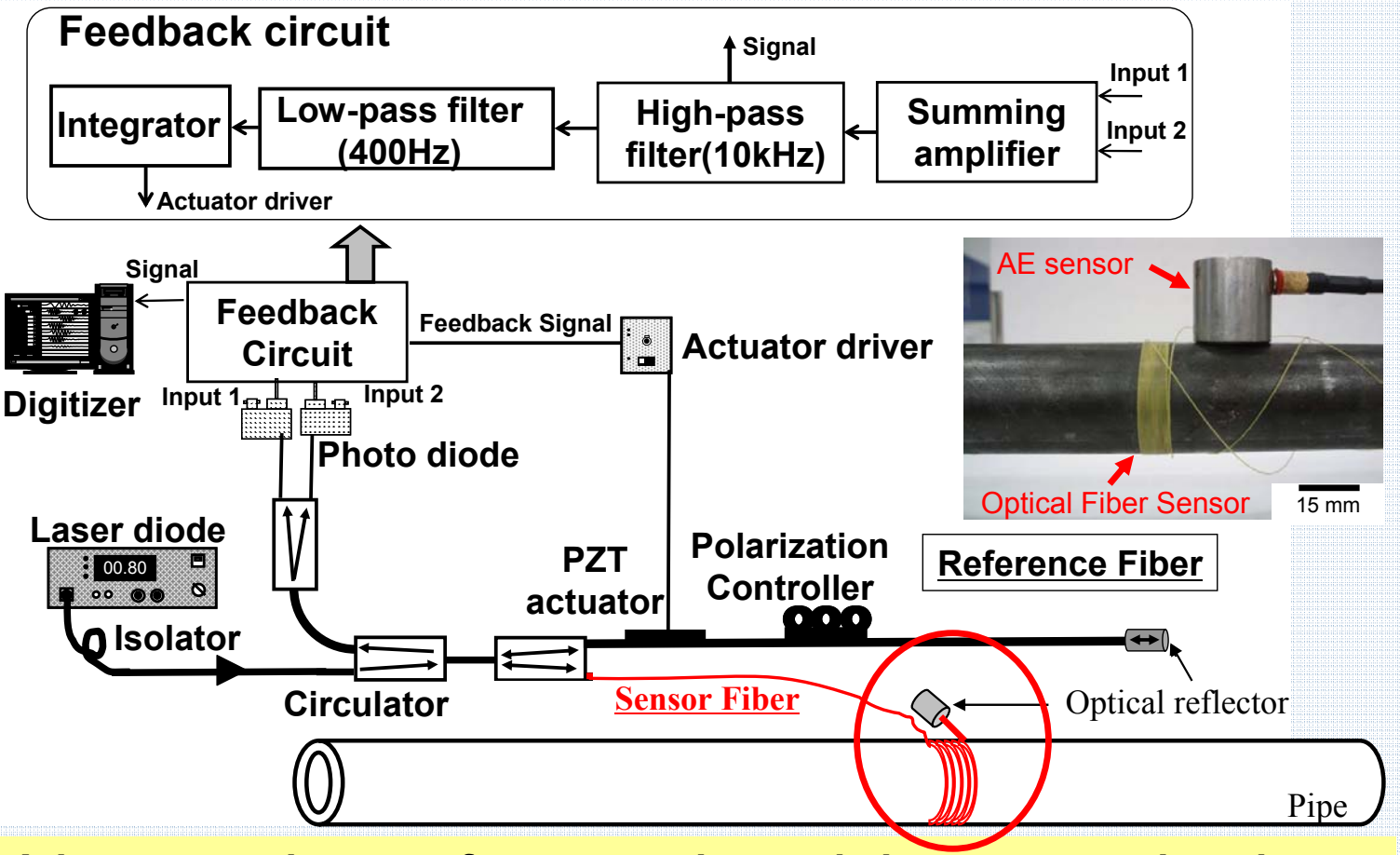
- Monitor AE from colony of shellfishes
- Identify the blockage statement by using AE

This presentation

- How AE signals are generated
- How to detect the number of shellfishes in the pipe
- Relationship between size of shellfish and AE parameter

➡ **Rough estimation of blockage statement**

Optical Fiber AE Monitoring System

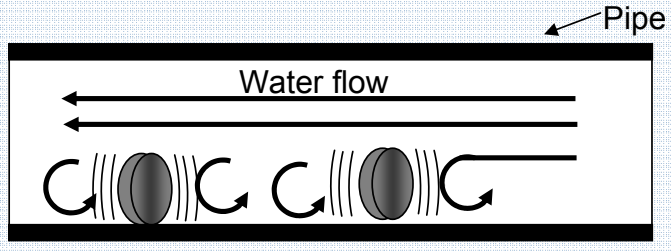


Advantage : ・immune from corrosion and electro magnetic noise
・flexible, light weight , water proof

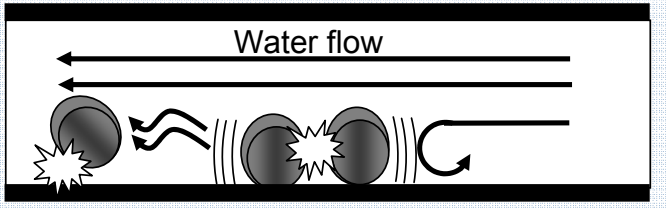
Michelson Type Optical Fiber AE system

Mechanism of AE generation

Type-1. vortex behind the shell or vibration of shells



Type-2. Collision of shells to the wall or another shell



Feasible 2 type AE sources by bivalve shell

AE monitoring from modeled blockage

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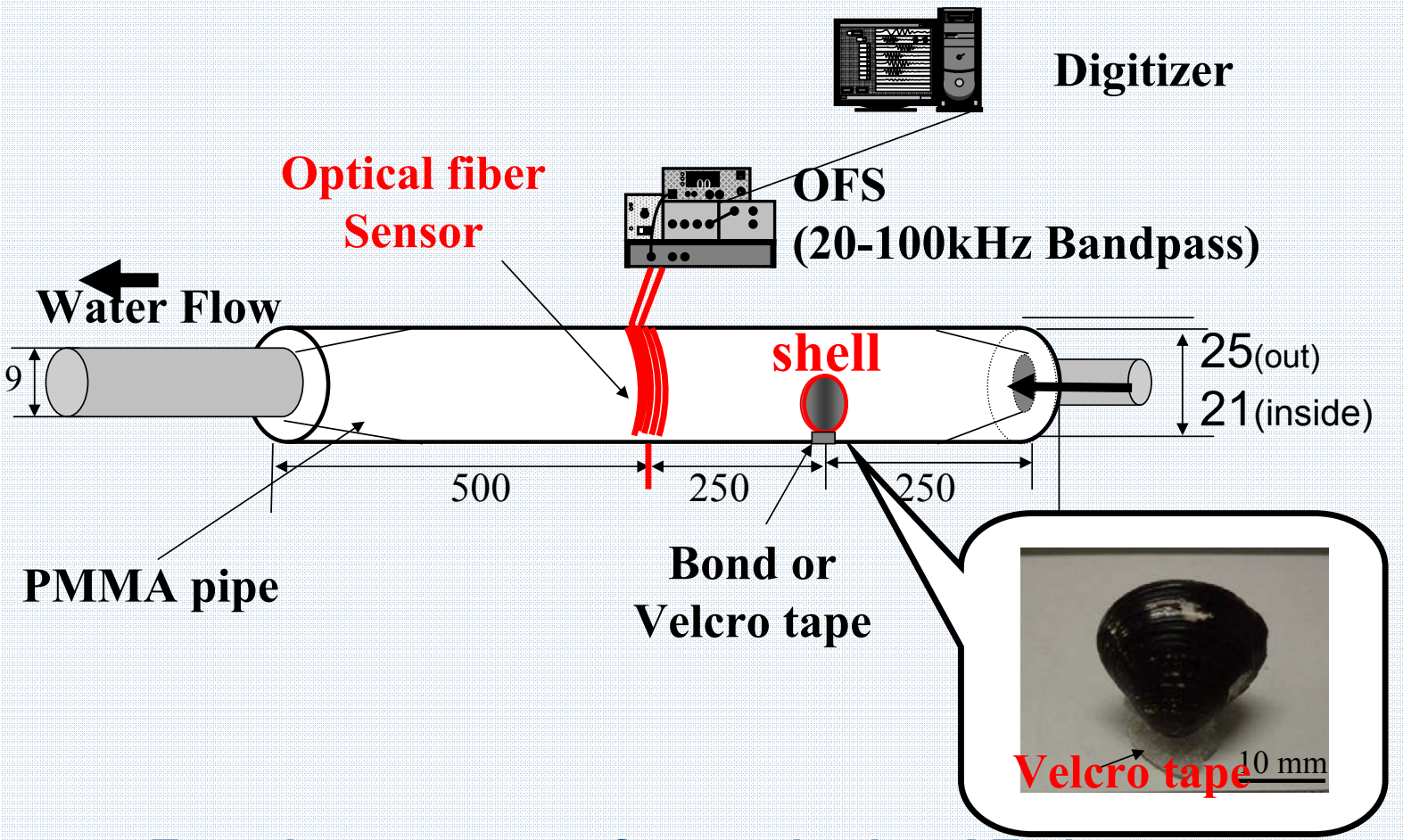
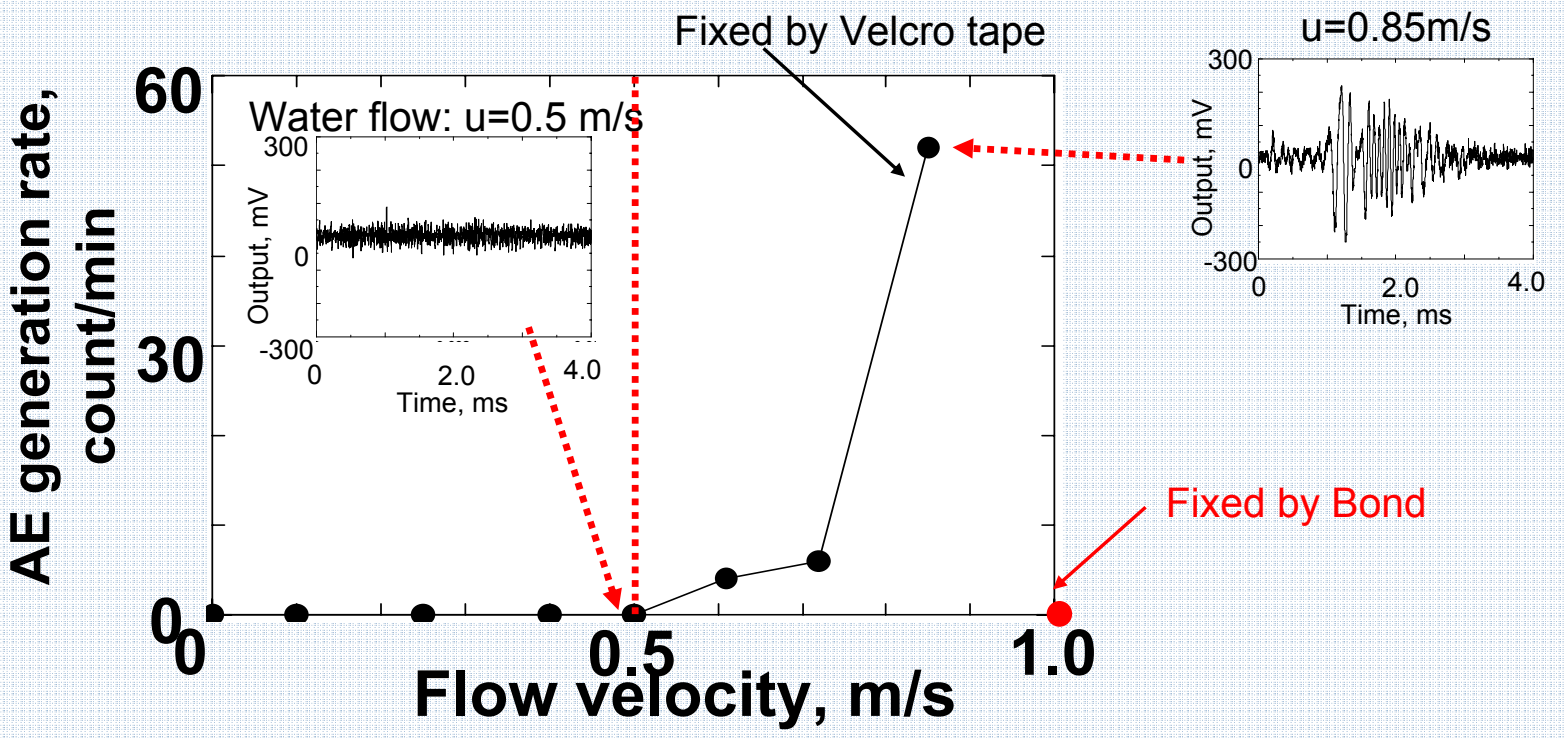


Experimental setup for monitoring AE signals using modeled shell

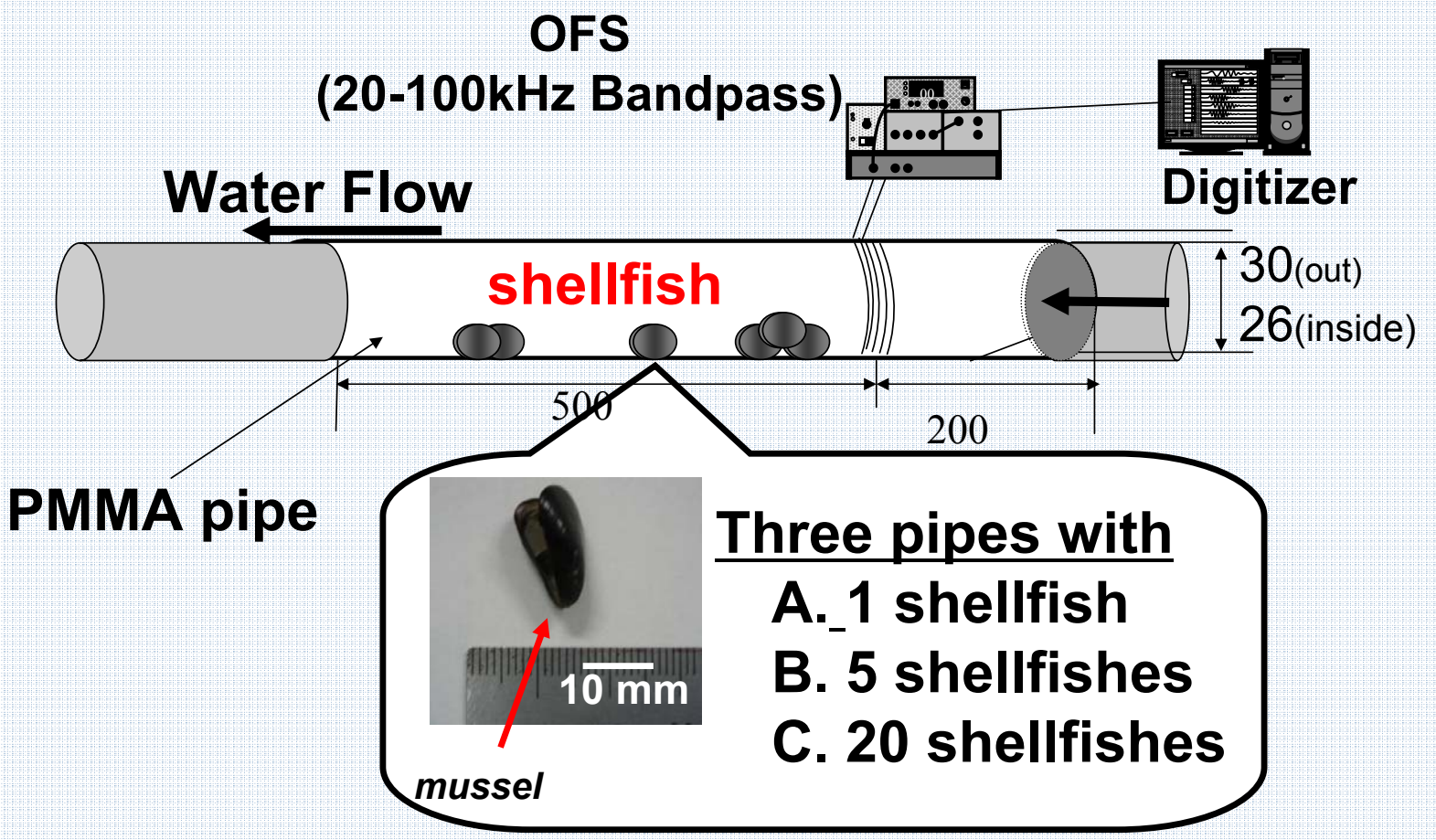
Flow velocity vs. AE generation rate



AE was generated by collision of shells to the wall

Relationship between flow velocity and AE generation rate fixed by velcro tape and bond

How to detect the number of shellfishes

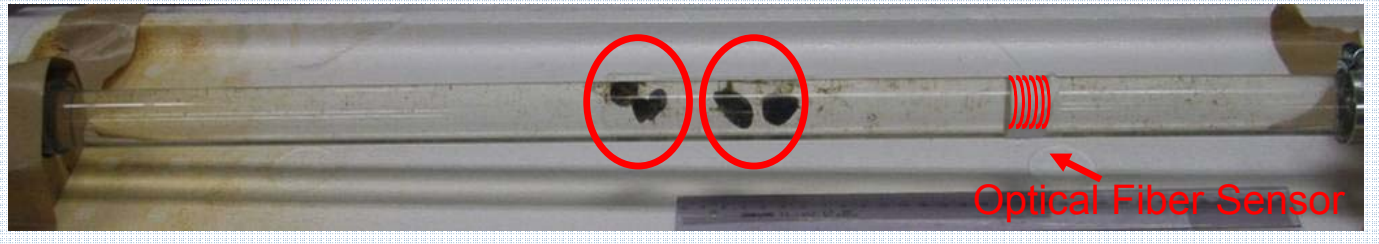


Experimental setup for monitoring AE signals from mussels

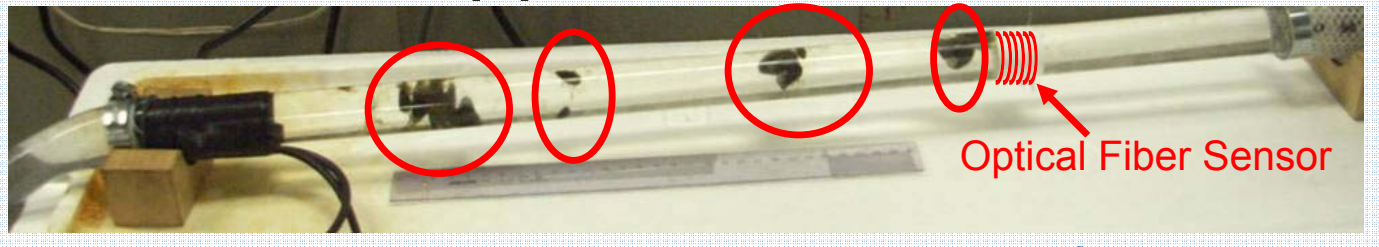
3 pipes with 1, 5 and 20 shellfishes

A. 1 shell in the pipe

B. 5 shell in the pipe

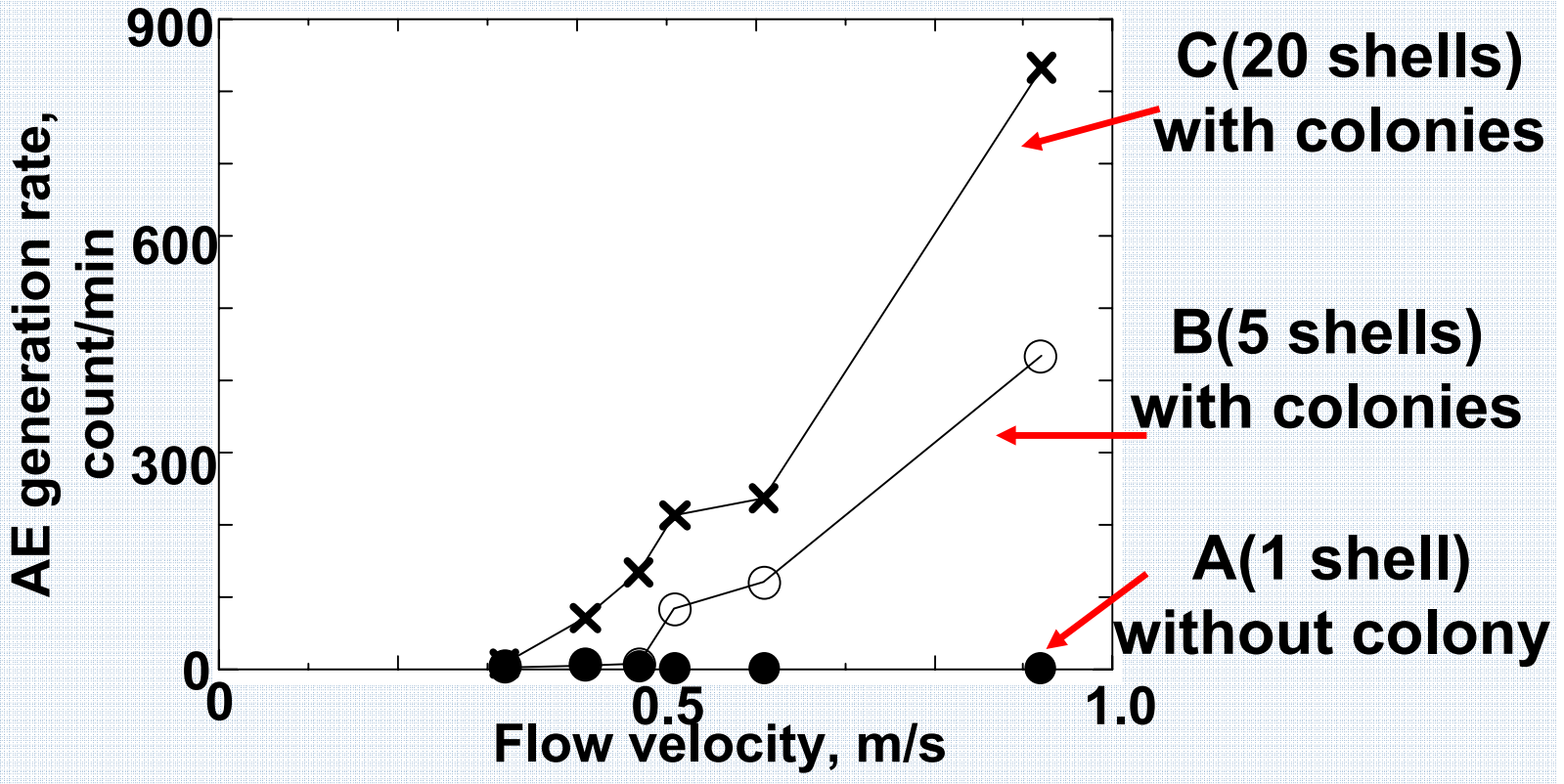


C. 20 shells in the pipe



Three pipes with 1, 5 and 20 shells after 20 days

Comparison of AE generation rate

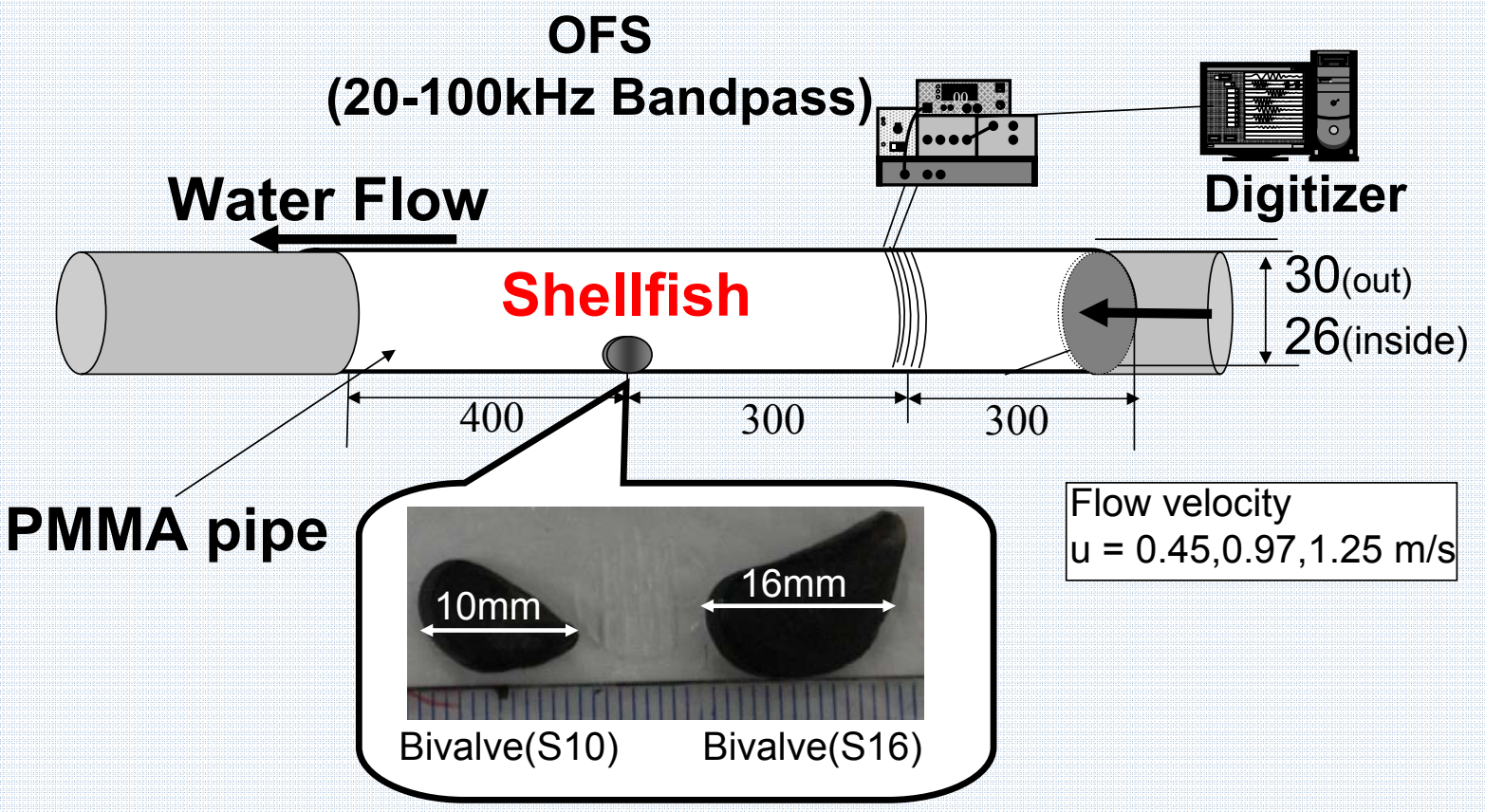


AE signals are mainly produced by collision of shells in the colonies.

Higher AE generation rate means higher number of colonies

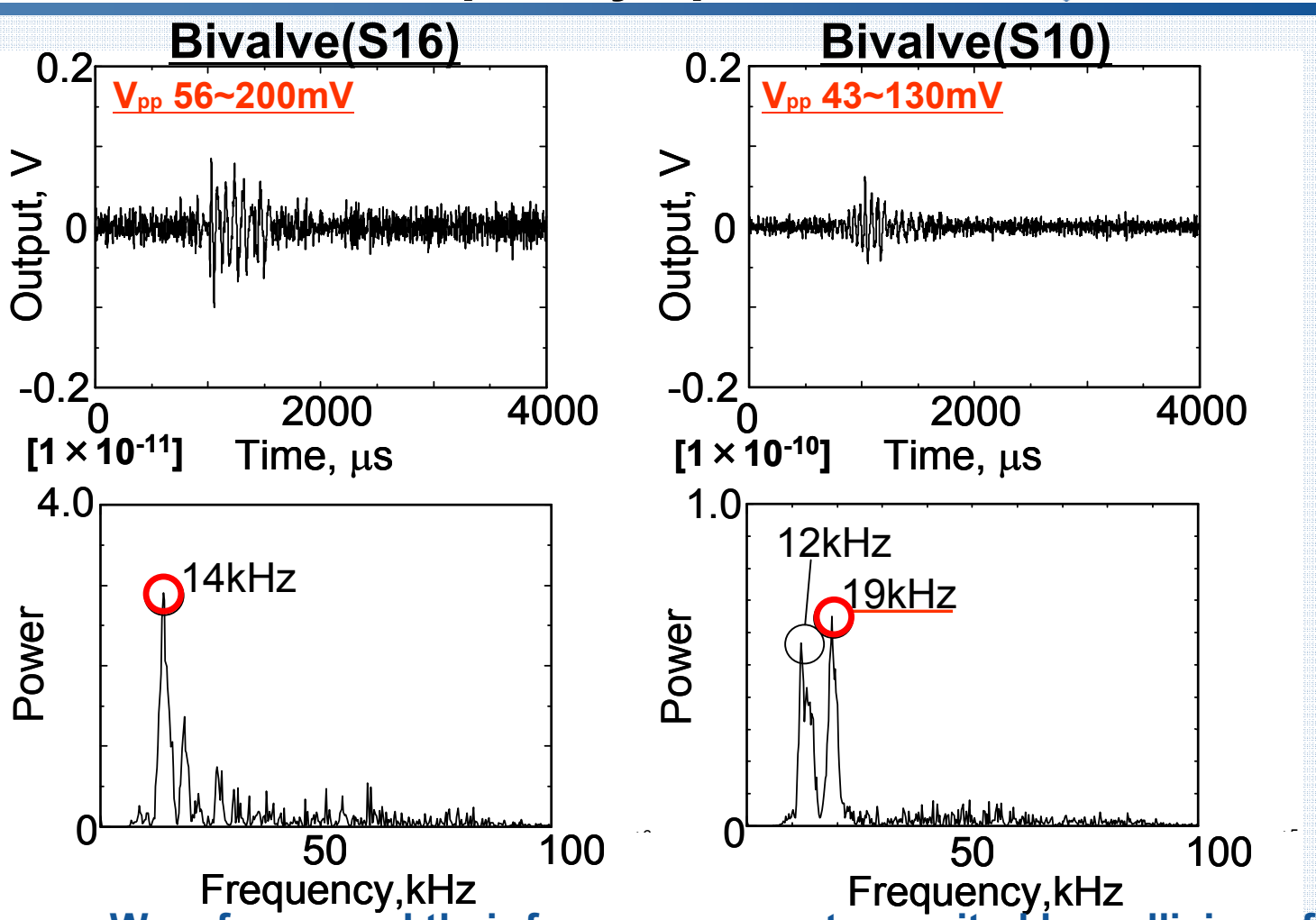
Relationship between flow velocity and AE generation rate

Relationship between AE and shell size



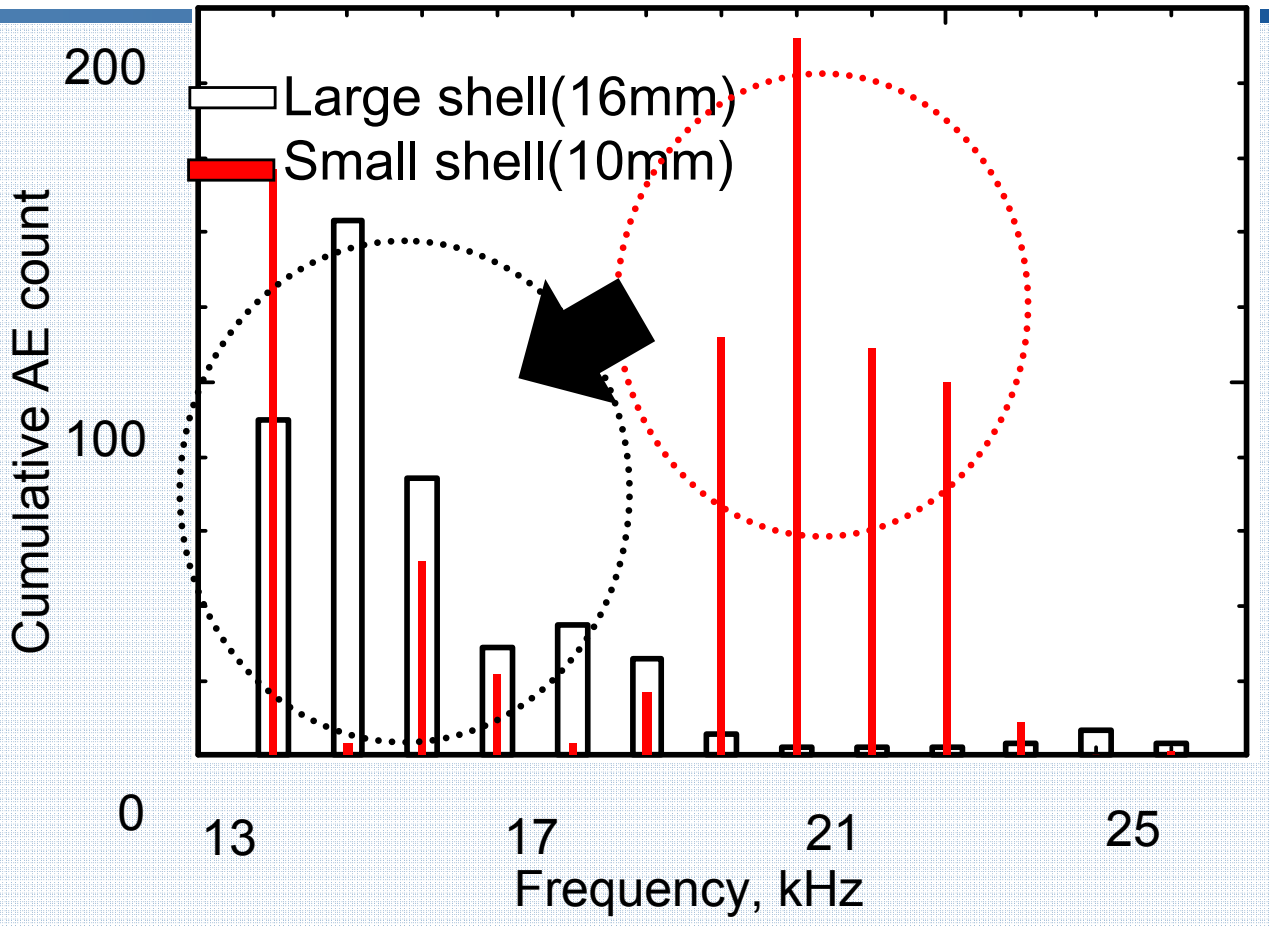
Experimental setup for comparing AE signals

Waveform and frequency spectra



Waveforms and their frequency spectra excited by collision of shells to the wall

Cumulative AE counts



Shell size was estimated by peak frequency of AE waveform

Relationship between shell size and AE count

Conclusion

We monitored AE from collision using dead and live native bivalve shells using optical fiber AE sensor.

1)AE monitoring from modeled blockage

・AE was generated by collision of shells to the wall.

2)AE monitoring from live bivalves

・AE generation rate increase with an increase of the number of shells.

・Peak frequency was changed by changing the shell size

AE generation rate → Number of colonies
Peak frequency of AE signal → shell size
↓
rough estimation is possible