

Detection of barnacles on a thick steel plate bottom

厚鋼板裏面へのフジツボ付着の検出

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1. Introduction

Biofouling on ship's hull causes increase of frictional resistance and fuel cost¹⁻³. In addition the fouling on ship's hull may cause cross-border transfer of alien organism. To avoid such consequences, simple and low cost inspection technique to quantify the fouling is needed. We conducted feasibility study on detection method for marine organisms such as barnacle by using ultrasonic testing from inner side of the ship (Fig.1).

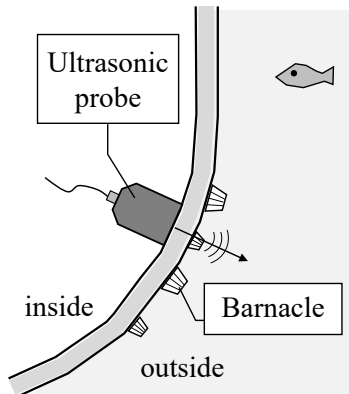


Fig.1 Concept of detection method for barnacle on a ship's hull from inner side

2. Experimental method

The sizes of the test piece are 190 mm in height, 200 mm in width and 9 mm in thickness. The test piece is made from stainless steel (SS400) and coated by anti-corrosion paint film (NKM Coatings, Epomarine AC). The thickness of the paint film is about 250 μm . The test piece was immersed into actual sea for adhesion of barnacles. The test piece was immersed into sea water in Tateyama port (Tateyama, Chiba) from June 26th 2017 to July 25th 2017. Fig.2 is an image of the test piece after the immersion. As shown in the figure, barnacles (*Balanus trigonus*) accreted to the test piece.

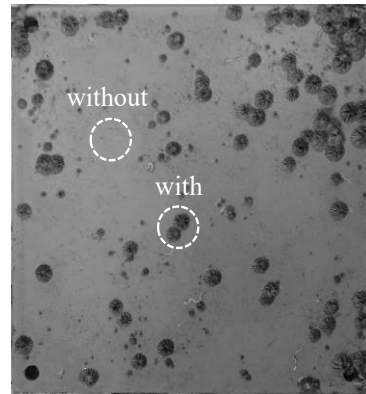


Fig.2 Test piece with barnacles

Experimental setup is shown in Fig.3. Immersed ultrasonic inspection method was used. Ultrasonic waves irradiated from one side of the test piece from the ultrasonic probe (Panametrics, 5 MHz), and the reflected echo data capture into the laptop computer via the pulser receiver (JSR, DPR300) and the oscilloscope (Iwatsu, Waverunner). Two measurement points with/without barnacles were chosen as shown in Fig.2.

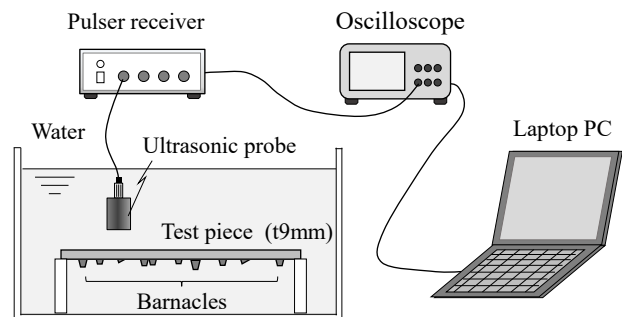


Fig.3 Experimental setup

3. Experimental results

Fig.4 shows ultrasonic measurement results. The upper and lower graph indicate measurement result of with and without barnacle conditions, respectively.

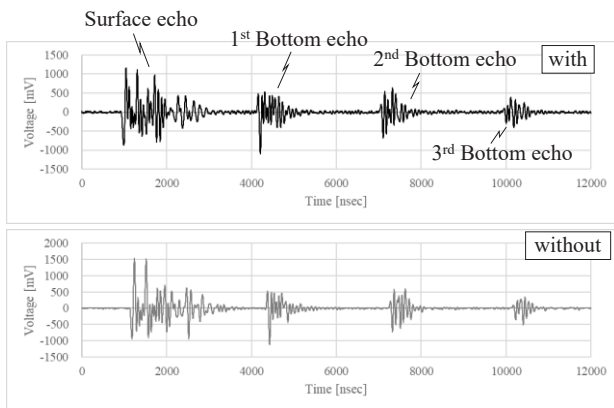


Fig.4 Ultrasonic measurement results (with/without barnacles)

Fig.5 indicates difference in 1st bottom echo comparison between with and without condition. Fig.5 (a) shows the raw data of the 1st bottom echo and (b) shows the absolute value of the data. By comparison with the "without" data, the echo intensity of "with" is slightly big.

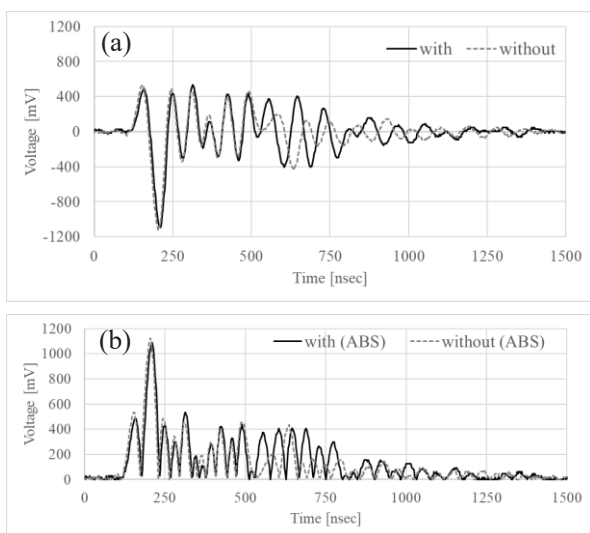


Fig.5 Comparison between with/without data.

The integrated values of the absolute values (Fig.5 (b)) are shown in Fig.6. The interval of the integration is 500 ns to 1500 ns in Fig.5 (b). The integrated value of "with" is clearly bigger than that of "without". We consider that adhesion of barnacles can be detected by using this integrated value.

For example, measure the reflected echoes and calculate the integral values in the absence of barnacle just after launch or repair (after washing the hull). Thereafter, by measuring the echo at an appropriate timing and comparing the integral value with the initial value of it, it is possible to judge the presence or absence of barnacle adhesion on a ship's hull.

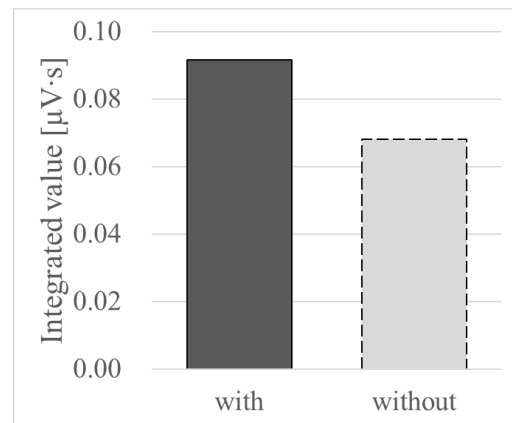


Fig.6 Integrated values of the echo data

4. Conclusions

We conducted feasibility study on detection method for marine organisms such as barnacle by using ultrasonic testing from inner side of the ship. A test piece was prepared by immersion in actual seawater. The presence or absence of barnacle adhesion causes a difference in the intensity of the reflected echo data. We conclude the detection method is feasible.

Acknowledgment

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References

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