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Marine biofouling contributions to suppressing the vortex-induced vibrations

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Underwater surface of man-made structures is quickly covered by unwanted aquatic organisms. Above 2,000 species comprising over 5,000 organisms cause biofouling. Biofouling is commonly treated as a challenge in ocean engineering as it adversely affects the performance and function of a wide range of resources and devices, such as offshore structures, seagoing vessels, culture cages, etc. It changes the surface roughens, the flow regime around the structure, the hydrodynamic loads acting on the structure and its vibrations. Here, we present the results of a comprehensive in-water experimental study on the vortex-induced vibration (VIV) of circular cylinders covered by artificial barnacles. We focus on the effects of the shape of the fouling elements. A 3D printing technique was used to physically synthetize small scale artificial barnacles on the cylinder surface. The Reynolds number ranged from 5.8×10^3 to 6.6×10^4. The experimental results showed that, the fouling beneficially suppresses the VIV. It noticeably reduced the peak VIV amplitude, narrowed the synchronization zone and lowered the hydrodynamic forces acting on the structure. The shape of the artificial barnacles had little effects on the maximum oscillation amplitude. Interestingly, the VIV suppression effectiveness grew as the coverage ratio decreased. Flow visualization showed that the separation was delayed and the vortices size and recirculation length turn out to be shorter in the artificially biofouled cylinders.

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