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Reducing Biofilms and the Associated Drag Penalties: *Studies into the Impact of UVC Applications for Dynamically Grown Marine Biofilms*

Kelli Z. Hunsucker^{1*}, Geligne Franklin¹, Madison Tate¹, Michael P. Schultz², J. Travis Hunsucker³

¹ Center for Corrosion and Biofouling Control, Florida Institute of Technology,
Melbourne Florida, USA

² Dept. of Naval Architecture & Ocean Engineering, United States Naval Academy,
Annapolis, Maryland, USA

³ Hydromechanics and Naval Architecture Lab, Florida Institute of Technology,
Melbourne Florida, USA

* khunsucker@fit.edu

ABSTRACT

The growth of marine biofilms can lead to functional and financial problems for the shipping industry. Application of ultraviolet light (UVC) is of growing interest for biofilm prevention. Most of the current research on UVC in the marine environment has focused on growth under static conditions, not taking into consideration the different communities and structure of biofilms which form under flow regimes. This experiment was designed to examine how biofilm which forms under flow can be reduced by the application of UVC and how these changes manifest in improvement of drag penalties for ships.

Field biofilms were allowed to accumulate on epoxy-coated panels (10 cm wide x 75 cm long) in an open grow channel (10 cm wide x 300 cm long) for approximately one week. The panels were assessed for percent cover, thickness, chlorophyll a content, and microbial composition. Panels were then placed in a separate field deployed flow channel ($Re_{\tau} \sim 2.5 \times 10^3$) to measure drag using streamwise pressure gradient. Drag penalties were determined from comparisons with the panel in the clean condition. After the initial drag measurements, panels were placed back in the grow channel for UVC treatment. A UVC dose (254 nm) was applied, with minimal flow in the grow channel to represent a pier-side ship. The biofilm assessment and drag measurements were repeated after the UVC treatment.

The experiment was designed to mimic a ship duty cycle- dynamic biofilm growth while underway and then a UVC treatment while in port. This process was repeated at different time periods to account for seasonal and environmental changes that influence biofilm growth. Results demonstrate that UVC can significantly reduce biofilm formation under flow, which results in lower drag penalties. This presentation will also discuss the importance of understanding how ecological changes in biofilms can manifest in the frictional drag and how matching the correct UVC dose with these changes can improve biofouling management strategies.