INTRODUCTION

Ultraviolet (UV) light is commonly used in the medical field to prevent the buildup of bacteria, as well as biofilms in water treatment facilities [1]. This research has investigated the application of UV on ship hull coatings to prevent biofouling recruitment. The most common method to prevent biofouling on ship hulls is the application of fouling control coatings [2,3]. While these provide an effective method to slow down the development of biofouling, most ships will require some sort of in-water husbandry during their operational cycles. Hull grooming has been proposed as a technique to remove biofilms and incipient fouling before they can become established. This is performed with an underwater vehicle which has a grooming tool consisting of soft brushes, which wipe the surface to dislodge potential fouling species [2,3]. The purpose of this experiment was to test the efficacy of utilizing ultraviolet light, specifically UVC, to prevent biofouling, with the goal of implementing a UV lamp into a grooming tool in the future. A proof of concept study was designed using UVC lamps to determine: (1) how the frequency of UV exposure impacts biofouling recruitment, (2) if biofouling recruitment is influenced by distance from the UV lamp, (3) if UV can be used in conjunction with different ship hull coatings.

RESULTS [Four Months Exposure, Figure 3]

- Control coatings (no UV) had more fouling than those exposed to UV.
- The surfaces exposed to continuous UV had no biofouling recruitment.
- The one minute per six hours and the one minute per day frequency prevented macrofouling recruitment on the copper and fouling release coatings.
- There were light biofilms present on each of the coatings under both of these UV exposures.
- The epoxy coating exposed to one minute per day of UV had encrusting bryozoans, calcareous tubeworms, and tunicates. These organisms were growing towards the center of the coating due to insufficient UV exposure along the edges of the panel.
- All of the UV exposures (including the lowest exposure time of one minute per day) were effective at preventing biofouling recruitment on the copper and fouling release coatings.
- Copper coatings exposed to continuous UV had visible damage at both distances.
- There was no apparent difference between the fouling on panels exposed at 25 mm and 50 mm.

METHODS

Test Site

The test site is located in Port Canaveral, FL (Figure 1). The average salinity is 34 ± 2 ppt and the average water temperature is 27 ± 2 °C. Facilities include rafts for static and dynamic immersion, a large scale test assembly for grooming/ROV research, and a 10.4 m support vessel which serves as floating laboratory.

Ship Hull Coatings

The ship hull coatings used in this experiment were an ablative copper antifouling coating, a silicone fouling release coating, and an epoxy barrier coat, which served as a control surface.

Experimental Design

Two-sided UV lamp boxes were constructed, each consisting of a panel insert and a housing (Figure 2). The housings were designed so that the lamps were spaced 25 mm and 50 mm away from the coatings. Each panel insert on the box held four 100 mm x 200 mm panels. Each box had a total of eight panels, four panels on each insert. Each side of the box had at least one copper, silicone fouling release, and epoxy coating. The UV lamp boxes had a timer set for the designated frequencies: no UV (Control), continuous UV, one minute per six hours, and one minute per day. The setup was such that the maximum UV exposure level was in the center of the panel (located closest to the lamp), and decreased towards the edges of the panel.

SUMMARY

The results demonstrate that an intermittent UVC light treatment provides a mechanism to control biofouling on fouling control coatings, and may be a viable addition to a grooming tool. Future studies will investigate the mechanism of UV exposure on biofouling prevention. Current efforts are underway to assess the feasibility of incorporating a UV lamp onto an underwater grooming vehicle.

REFERENCES


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