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UV LEDs Help Eliminate Biofouling

Biofouling can be an issue for systems operating in watery surroundings. Traditional methods of anti-fouling, like biocides and mechanical options, have proven to be ineffective or unsafe in some situations. Crystal IS, a manufacturer of UV LED lights, has an alternative. *Sea Technology* asked Crystal IS about its UVC LEDs and why UV light is an effective, environmentally friendly way to mitigate biofouling.

WHAT ARE THE EFFECTS OF BIOFOULING ON INSTRUMENTATION AND SENSORS?

Biofouling is the accumulation of microorganisms, plants, algae or other organisms on wetted surfaces. The mechanism of fouling involves the initial bacterial attachment and formation of a biofilm on the surface, followed by the attachment of larger marine organisms. Biofouling affects a range of systems and components across many industries, especially those deployed in the coastal and marine environments.

Sensors and cameras used for underwater imaging, along with lenses used for optical communication, can be adversely affected within a week of deployment. Overall, the cost to industry due to biofilms is estimated to be at least $200 billion annually in the United States alone.

HOW DOES UV LIGHT PREVENT BIOFOULING?

Radiation in the UVC range of 250-280 nm can be used to prevent and control biofouling. Light in these wavelengths deactivates bacteria, viruses and other microbes by destroying the genetic information encoded in the DNA. By inactivating the microorganism, it prevents the formation of a biofilm, thereby preventing the later phases of biofouling where larger organisms attach to the instrument and render it inoperable.

WHY IS UV LIGHT A BETTER METHOD THAN BIOCIDES OR MECHANICAL OPTIONS?

Biocides are being eliminated or reduced due to environmental concerns—the most common biocide over the past 40 years, Tributyltin (TBT), was banned in 2008 due to its toxicity to other organisms and the environment. Additionally, some microorganisms form a resistance to biocides over time, making this technique less effective.

Mechanical options, such as wipers, have a high failure rate, relatively high power consumption and cannot effectively clean surfaces with complex shapes. Other techniques, such as copper or tin plating, have been used to limit and slow organism growth but are not effective in all environments.

UVC irradiation is a proven disinfection method already used in water treatment, healthcare and food processing. UVC irradiation offers a better method than the existing options as it is non-contact, non-chemical, and can be used on a variety of instrument materials and shapes.

HOW ARE THE CRYSTAL IS LEDS DIFFERENT FROM OTHER PRODUCTS ON THE MARKET?

Although the potential of UV radiation for biofouling control has been known for some time, traditional UV lamps containing mercury are not a feasible option due to their bulk, fragility, high power consumption and the toxic nature of mercury. These lamps are also difficult to start in cold environments. LEDs that emit UVC light offer a more suitable solution that overcomes the limitations of mercury lamps.

Crystal IS UVC LEDs are grown on aluminum nitride substrates, which results in a million times fewer defects than UVC LEDs based on sapphire substrates. The lower defect density in Crystal IS UVC LEDs leads to significantly higher light outputs and longer lifetimes, thus making UVC light a viable option for biofouling control in these instruments.

HOW DID THE IDEA FOR THE PRODUCTS COME ABOUT?

Crystal IS was founded in 1997 by Leo Schowalter and Glen Slack to develop native aluminum nitride substrate technology. This technology is the basis for the company's high-performance UVC LEDs that are integrated into products to sterilize and disinfect water, air and surfaces.

In 2014, Crystal IS released their first commercial product—Optan with a ball lens—to the instrumentation market. Optan is used as a light source for scientific and industrial measurement and monitoring applications in various environments, including water. It was through working with customers in these markets that Crystal IS discovered the opportunity for UVC LEDs as a solution to this industry-wide problem.

WHERE ARE CRYSTAL IS LEDS CURRENTLY IN USE?

Crystal IS commercial UVC LEDs for instrumentation are already in use by leading manufacturers of life science and analytical instruments. A number of marine and industrial sensor manufacturers are performing lab and field tests with Crystal IS UVC LEDs for biofilm and biofouling prevention.

DO YOU THINK THE INDUSTRY IS SHIFTING TOWARD USING UV LEDS AS THE MAIN SOLUTION FOR BIOFOULING CONTROL?

The problem of biofilms and biofouling is a vast one—the Alliance for Coastal Technologies has estimated that maintenance costs due to biofouling consume 50 percent of operational budgets. With environmental regulations doing away with biocides and the relative ineffectiveness of other mechanical methods, the industry is investigating new, more effective methods of prevention. The small footprint and high brightness of UVC LEDs enables use in a variety of sensors, including remote monitoring in far areas of the world. By controlling biofilm growth, UVC LEDs allow manufacturers to extend the duration of in-situ deployments in marine environments while reducing maintenance costs. It is certainly an emerging trend that will become one of the mainstays of the industry as the technology continues to improve.

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