

Introduction

Biofouling is one of the greatest challenges or hurdles to get past when thinking about long term deployments. There are many different preventative measures to help decrease biofouling but none offer the end-all solution to the problem. In fact, doing as much as you possibly can to reduce biofouling will still only solve part, albeit most, of the problem and that may be good enough.

Microorganisms, algae, are precursors to larger settling organisms like tunicates or mussels. Algae first settle onto a substrate and “prepare” it for other settlers which if left unmaintained turns into a biofouling nightmare as the larger settlers are much harder to remove. Doing the best you can to “nip it in the bud” and stop the first settling organism from getting a foothold is when preventing biofouling yields the best results.

Delrin and Wipers

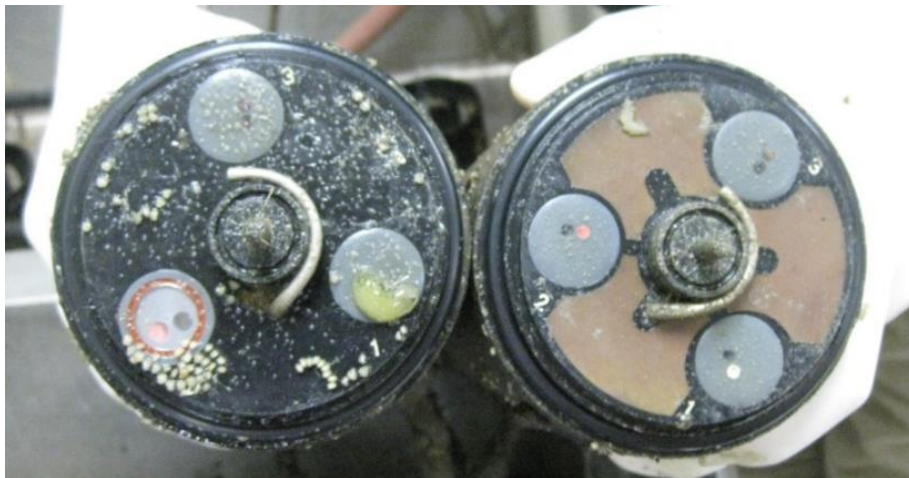
Over the years Turner Designs has offered various options for preventing biofouling on our popular C3 and C6P Submersible Fluorometers starting with its initial design. First off, the fluorometers are made entirely of Delrin plastic which is porous and therefore easy to clean. Organisms slide right off and the plastic doesn’t degrade. The only metal part on our C3 and C6P is the temperature probe which is made of a material that will not rust or degrade. Secondly, we offer a wiper which cleans the optical windows keeping organisms off. Initially the C3 used a one-arm wiper. We quickly found out that these organisms mean business and upgraded our wiper to three arms.



The three-arm wiper does a fairly decent job at keeping critters off the optical head but these organisms grow anywhere there is room so yes, even on the wiper arms themselves as you can see in the image above.

Copper Tape

Next we added copper tape cutouts to our C3 Submersible Fluorometer to help with reducing biofouling since copper is one of the metals organisms will absolutely not grow on. These work well but our cutouts don't cover all spaces on the optical head and we still have the potential problem with organisms growing on wiper arms. As you can see from the image below, organisms don't mind settling next to the tape, even bordering the copper.



The copper ion concentration simply isn't enough to prevent growth in active environments. To be fully effective you would have to coat the optical head in tape, every bit of real estate, to prevent any kind of growth that may affect readings, though our results show that the copper tape cutouts do a decent job at preventing growth. Coupled with the wiper, copper tape is an effective & low cost solution for reducing biofouling. However, we kept testing to see if we could offer a simpler, more thorough method of preventing biofouling.

Copper Plate

The result is a copper plate that easily installs onto C3 and C6P optical heads. Images below are from a >15 day C3 deployment in the San Francisco Bay without wiping, though wipers were present on both units. We saw a big difference between control and copper plate instruments as shown in the photos below:



Notice the wiper arms and other surfaces on the two instruments. What you'll see is that organism growth was greatly inhibited by the copper plate, not only on or near the optical sensors but also on adjacent surfaces. It looks like the copper ion concentration was enough to deter growth in as well as near that area. And when comparing the optical glass for each sensor the copper plated was clean as a whistle, meaning readings will not be impacted by biofouling organisms. Clearly the control unit would have issues passing light through the optical glass windows which are coated with organisms.

Although the copper tape helps, our latest accessory, the Antifouling Copper Plate and Collar PN 2300/2360-507, yields the best results for preventing growth from organisms on or around the optical head. Coupled with the 3 arm wiper which can be set to a large range of wiping intervals, the C3 and C6P can now be deployed for very long periods of time with minimal maintenance. Although we haven't solved the world's biofouling problems, we've at least made it possible for our customers to obtain a good, robust data set from long term deployments without worrying about biofouling. Now you can enjoy your cup of coffee in your office and not at the deployment site!