Abstracts for the Presentations

Dirty Laundry

Designed to Leak??? - Trials and Tribulations of Waterproofing a New Tank
MIKE DEMAINE
Two Oceans Aquarium, Dock Road, V & A Waterfront, Cape Town, 8002, South Africa

The challenges of building a new large exhibit at the Two Oceans Aquarium, Cape Town, South Africa was presented on at AALSO 2015. This presentation serves as an update to the findings with regards to the cracked and leaking tank. The presentation also details the challenges associated with changing the waterproofing specification and the challenges associated with the new waterproofing systems application. Why did the tank crack so badly, why did it leak so badly, why was the waterproofing specification changed and don't believe everything in a suppliers product sheets. To polyurea or not to polyurea.

The Disaster that Wasn't: Praziquantel, a Bacterial Bloom, an Endangered Species, and the Role of Water Quality and Life Support in Disaster Mitigation on Friday Nights
KASIE REGNIER; BRIAN ROOSA
Virginia Aquarium & Marine Science Center, 717 General Booth Boulevard, Virginia Beach, VA, 23451, USA

The administration of medication into an aquarium is often considered relatively simple, but the compounding effects of additions of any chemical into a system can be unpredictable and potentially catastrophic. In July 2015, praziquantel was administered by Virginia Aquarium husbandry staff to the 45,000 gallon Chesapeake Bay Aquarium exhibit as dry powder. The second dose of the treatment was administered three weeks later, partially dissolved in ethyl alcohol, after the previous method for dosing was brought to the attention of the water quality lab and life support engineers. The exhibit behaved normally for twelve hours, though a mild bacterial bloom was observed and monitored closely. Twenty four hours after administration, at approximately 1600 on a Friday, the water quality lab supervisor was called by frantic husbandry staff due to a sudden decrease in water clarity. The water quality supervisor returned to the Aquarium to find that the water was nearly opaque and that the DO in the system had dropped to 19% in two hours. Over the course of the next 10 hours, a team of husbandry staff was directed through a series of steps to re-oxygenate the system, return life support to normal operation, and relocate and resuscitate an endangered Atlantic sturgeon housed in the aquarium. DO levels reached 100% within an hour; the aquarium was brought to normal water clarity and stable water quality parameters within 24 hours, with no mortality among the fish or staff. The loss of an entire major exhibit, and an endangered species, was prevented, Two weeks later, the praziquantel treatment was completed, with the final dose administered by water quality staff, with no adverse effects on the system. Water quality staff and life support engineers analyzed the dosing methods and the exhibit's system parameters that could have led to this near-disaster. The analysis resulted in several new protocols developed jointly by the water quality supervisor, life support engineers, and veterinary staff. It also resulted in re-evaluated, redesigned and re-assigned dosing techniques, better understanding of this particular exhibit's chemistry, and a more scientific approach to future system-wide procedures.

Texas State Aquarium Event Summary: What Happened Then and Where We Are Now
TOM SCHMID; JESSE GILBERT; VERONICA THOMPSON
Texas State Aquarium, 2710 N. Shoreline Boulevard. Corpus Christi, Tx. 78402, USA

In April of 2015, the Texas State Aquarium experienced a large mortality event due to a mislabeled chemical received from a bulk drug distributor. In the days and months following the mortality event, a number of changes were made to the daily operation of the system and to the standard operating procedures for life support, animal care and fish medicine in an effort to prevent the occurrence of a similar event.

Effect of Supplemental Phosphorus and Organic Carbon in Chemical Cycling of Life Support Systems BARRETT L. CHRISTIE
Dallas Zoo, 650 S R L Thornton Freeway, Dallas, TX 75203

Chemical cycling of newly-constructed life support systems (LSS) through the use of ammonium salts or urea is standard practice in the aquarium industry. These artificial sources of nitrogen have long been used to facilitate growth of ammonia oxidizing bacteria (AOB) and nitrite oxidizing bacteria (NOB) in biofilters prior to the introduction of teleost fishes and other aquatic life, though the process has its limitations. All too often the cycling period essential for good water quality and animal health is cut short or otherwise constrained by the rigors of construction schedules, forcing aquarists and operators to expedite these microbiological processes as much as possible. Cycling of nitrite typically is typically more problematic than ammonia as NOB communities develop more slowly than AOB and must compete for space in biofilms. Though the cycling process promotes chemoautotrophic nitrification most species of NOB are facultative organoautotrophs, and as such can utilize organic compounds as the electron donor in nitrification. Supplementation of organic carbon (as sugar or ethanol) in addition to carbonates and bicarbonates has been found to enable NOB to more rapidly oxidize nitrite concentrations during cycling. Additionally, the supplementation of phosphorus (as phosphoric acid) has been used in aquaculture for years to similar effect to ameliorate "phosphate block" in cycling. The effect of each constituent on nitrification is quantified from small-scale trials, and the practical benefit observed from using both techniques in cycling of multiple mid-sized LSS is discussed. Options for sourcing a cost-effective, readily available substrate to provide both phosphorous and organic carbon are also presented.

Water Quality/ Chemistry

The Stress Response in Fish and How it is Influenced by Water Quality
DR ROBERT JONES BVSC, MACVSC
The Aquarium Vet, PO Box 2327 Moorabbin, Victoria, Australia, 3189

Fish experience stress for a variety of reasons but by far the major cause is poor water quality. We will examine the physiologic basis for the stress response in fish. Fish that are under stress become immunocompromised which is then a major contributor to disease problems in aquatic animals. Maintaining superb LSS and thus good water quality is the most important role in maintaining healthy fish.

Sterile May Not Equal Healthy, Oxidant Disinfectants and Health
ED LATSON MS, DVM
Central Park Aquatic Health, 2715 Main Street, Buffalo, NY 14214, USA

Oxidants including Chlorine, Bromine and Ozone are commonly used in Life Support Systems for Marine Mammals. The goal is to reduce the potential for infectious disease and also to aid in the clarity and appearance of the water in the habitats. Their use in excess is known to cause injury but it has been thought that with careful use they can be safe. Recent discoveries concerning the biological effects of these compounds and the by-products produced by their use brings the safety of their use into question. Discussions of their use in water disinfection generally assume minimal organic matter in the water. This may not be the case in water where animals are living. Hypochlorous and hypobromous acid are biological molecules produced by white blood cells during inflammatory and immune responses. These compounds in life support systems may mimic inflammatory processes. Oxidants change or eliminate the normal microbiome selecting for the most resistant organisms and possibly affecting the immune response of the system inhabitants. Oxidant levels and coliform testing may not be the best measures of the health of the systems. Our animals should 'Swim in Living Pools not Live in Swimming Pools.'

Aquarium Microbiology 101
TIMOTHY A. HOVANEC PHD
DrTim's Aquatics, 530 Los Angeles Ave., Ste 115-243, Moorpark, CA 93021, USA

This talk will focus on the key microbiological processes that occur in marine aquaria along with an explanation of the common terms associated with these processes and bacteria such as nitrification, denitrification, biodegradation and bacterial assimilation. Much of the popular literature concerning bacterial processes in aquaria ascribes wrong terms to these processes prompting confusion amongst aquarists. Bacteria are often, falsely, thought of as 'simple' single-celled organisms when the fact is that a majority of bacteria are capable of changing the reactants they use yielding different products; all depending upon the ambient water conditions. Understanding these processes, the terms associated with them, and the how the processes change with different water quality conditions will allow a clearer conversation amongst all involved in maintaining water quality and healthy animals in aquaria.

Operator & Water Chemistry Review

LSS Lecture 101: Life Support Theory and Best Practices
ARNEL BAUTISTA[1]; STEVE MASSAR[2]; MATT REGENSBURGER[3]; BYRON WALLER[4]
[1] California Academy of Sciences, 55 Music Concourse Dr, San Francisco, CA 94118, USA
[2] Vancouver Aquarium, 845 Avison Way, Vancouver, BC V6G 3E2, Canada
[3] Georgia Aquarium, 225 Baker St NW, Atlanta, GA 30313, USA
[4] Virginia Aquarium, 717 General Booth Blvd, Virginia Beach, VA 23451, USA

An overview of industry standards and best practices in life support operation. This lecture will be a panel discussion on general life support information and will serve as the exam review for the Level 1 and 2 Life Support Operator Exam.

Water Quality Lecture 101: Water Quality Theory and Best Practices
JEFF GIBULA[1]; JEFF SEDON[2]; LAURIE SHAW[3]; KAREN TUTTLE STEARNS[4]
[1] Newport Aquarium, 1 Aquarium Way, Newport, KY 41071, USA
[2] Walt Disney Parks & Resorts, 2016 North Avenue of the Stars, EC W-251 Lake Buena Vista, FL 32830, USA
[3] California Academy of Sciences, 55 Music Concourse Dr, San Francisco, CA 94118, USA
[4] Aquarium of the Pacific, 100 Aquarium Way, Long Beach, CA 90802, USA

An overview of industry standards and best practices in water quality. This lecture will be a panel discussion on general water quality information and will serve as the exam review for the Level 1 Water Quality Exam.

Symposium Theme- Species Specific

Water Quality Parameters for Successful Live Coral Exhibits
ROB BRYANDA[1]; J CHARLES DELBEEK MSC[2]
[1] Landry's Denver Downtown Aquarium, 700 Water St, Denver, CO 80211, USA
[2] California Academy of Sciences, 55 Music Concourse Dr, San Francisco, CA 94118, USA

In the last 20 years, live tropical coral exhibits have become increasingly common in public aquariums. It is not unusual today to find at least one, and often several exhibits housing live corals and other calcifying marine organisms. Recent trends have also included increasingly larger exhibits that present their own unique challenges for LSS. Several water quality parameters are critical to monitor and maintain for live coral systems, these include temperature, pH, calcium, alkalinity, phosphate, nitrate, magnesium, and trace and minor elements such as manganese, strontium, iodide, iron and barium all known or thought to play roles in coral health. Paradigms for acceptable nitrate and phosphate levels for coral exhibits could also be challenged as recent studies have shown that nitrate and phosphate levels ten to twenty times that of natural seawater actually increase coral growth rates in some species.

How the Georgia Aquarium Manages Lanthanum Dosing
MATT REGENSBURGER; ERIC HALL; JOHN MASSON
Georgia Aquarium, 225 Baker St NW, Atlanta, GA 30313, USA

The Georgia Aquarium utilizes lanthanum chloride dosing for the reduction of phosphates in Ocean Voyager. Ocean Voyager is a 6.3 million gallon exhibit that houses a plethora of species most notably whale sharks and manta rays. Through the years, we have fine-tuned the dosing protocol to eliminate many pitfalls that the end product, lanthanum phosphate, can create. We dose lanthanum into the influent line of a sacrificial sand filter that has slower than normal flow rates to minimize any lanthanum phosphate entering the exhibit. By utilizing a dedicated sand filter we are able to control the process in a more rigorous manner. Dosing lanthanum chloride does present some challenges which includes having to jet the sand filter every few months, physically remove the lanthanum phosphate/sand mixture from the sand filter, and remediate the sand filter more frequently when compared to normal operations. The list of pitfalls includes over-dosing lanthanum, whiting out exhibits, impacting mechanical operations like impellers and mechanical seals. Through this process, we have come up with what we believe is a best practice guide to dosing lanthanum chloride. For us, best practices include using a dedicated sand filter, slowing the flow rate through this sand filter, using a metering pump to accurately dose small amounts of lanthanum chloride at a time, not overdosing lanthanum chloride, injecting lanthanum chloride into the sand filter influent line after the pump, and not dosing into protein skimmers or surface skimmers.

Life Support: Is There Any Otter Job?
LOVE RUDDELL
2395 Apopka Blvd Apopka FL 32703, USA

This presentation will highlight Life Support Systems for the different varieties of otters found in zoo and aquariums facilities. It will highlight AZA and USDA standards and discuss the trials of achieving these standards. I will also reflect on my experience with maintaining the filtration and water quality on otter life support systems. I will also take time to discuss the otter keeper conference, TAG and other resources for care of these animals. The main purpose of this presentation is to help educate other operators in the different varieties of otters in captivity, their physical demands, personality quirks, facility limitations as well as provide them resources to handle any situation that may arise. My ultimate goal is to open conversation between operators to share their experience with otters and improve how we care for these animals.

When the Species IS the Filtration
MATT MCLAUGHLIN
Minnesota Zoo, 13000 Zoo Blvd, Apple Valley, MN 55124, USA
Over the past year, the Minnesota Zoo has teamed up with the Minnesota DNR and the University of Minnesota on the formation of a native freshwater mussel conservation, propagation, epidemiology, and wild re-introduction program. This presentation will look at the challenges and obstacles to starting this program. Can native mussels survive and thrive in a small lake that receives the majority of zoo site storm water? Will the mechanical equipment survive at -15 degrees F? Will the staff get frost bite finding out? Can we actually grow endangered mussels and clean up our lake at the same time? Questions to be answered.

Dive Operations & Green Initiatives

Evaluating The National Mississippi River Museum and Aquarium's Dive Program and the Process of Becoming a Commercial Dive Team
MARISA FOSTER
National Mississippi River Museum and Aquarium, 350 E 3rd St, Dubuque, IA 52001, USA

The National Mississippi River Museum and Aquarium's largest exhibits are a 30,000 gallon freshwater system called the Main Channel and a 45,000 gallon salt water system called the Gulf of Mexico. Due to the size of these exhibits our team of aquarists dives regularly to maintain habitats, observe animals, and clean systems. We, as well as many other aquariums, have struggled with the concept of commercial dive programs vs. scientific dive programs. It can be extremely difficult to determine which program your facility falls under due to the nature of caring for animals in a captive setting. During recent years, our aquarium has taken several steps to determine which dive program we fall under and have made sure that we are in accordance with OSHA regulations. The National Mississippi River Museum and Aquarium has determined that its dive program is considered to be more of a commercial dive program rather than a scientific dive program as we do not record any data after each dive unless we note something out of the ordinary. This presentation will focus on the differences between commercial dive programs and scientific dive programs and the steps our aquarium took to ensure that we hold the highest safety protocols for our dive team.

Occupational Diving in Zoo & Aquarium Industry
GEORGE PETERSON; ARNOLD POSTELL
Association of Dive Program Administrators

There is a wide array of dive tasks needed to support the habitats and exhibits at our facilities. Inspecting intake pipes, maintaining backup systems, cleaning exhibits, and much more. This presentation will include a general overview of current industry example dive practices and considerations on how Life Support and Dive Operations work together. A discussion with Q & A will ensue.

Greening Up LSS- Resource Conservation (Water, Energy Usage, Design)
STEVE MASSAR
Vancouver Aquarium, 845 Avison Way, Vancouver, BC V6G 3E2, Canada

During a recent renovation the Vancouver Aquarium Marine Science Center (VAMSC) installed a District Energy System or DES for short. VAMSC is one of only a few institutions in British Columbia to integrate such an innovative system to manage energy use. VAMSC follows LEED and ISO 14001 construction practices and in 2015 was awarded the Green Award by AZA in part due to the implementation of the District Energy System. The DES is a site wide low grade energy loop that extracts or rejects energy through a variety of sources. Heat producing equipment such as chillers and food service refrigeration reject heat in to the loop through liquid cooled condensers. Isolated water and glycol systems are circulated using variable speed pumps to move energy around the system. Heat is extracted through heat exchangers to warm habitats, galleries and coils in local HVAC air handlers. Cooling is accomplished in the same way using the cold side of the system. Temperatures in the loop are maintained in a specified range using seawater heat exchangers, boilers, heat pumps and a cooling tower. Planning is underway to install a geothermal field to store excess heat produced in warmer months for use in the winter. The net effect is that heating and cooling costs can be reduced since it requires much less energy to redistribute the energy than it would to produce it at multiple points of use.

Poster Presentations

Impacts on Applied Ozone Concentration Maintenance and Efficiency of Automatic Oxidation Reduction Potential Set Points in Natural Seawater Outer Systems

AJUA AMPADU [1]; DAVID DENARDO[1]; GREGG SANDERS [2]
1 WCS- New York Aquarium, 602 Surf Ave Brooklyn, NY 11224, USA
2 Water Tech Solutions – 385 Timber Rd, Mooresville, NC 28115, USA

The New York Aquarium's Sea Cliffs exhibit is an outdoor marine mammal and marine bird enclosure consisting of six pools ranging from 18,000 US gallons to 180,000 US gallons (68.14cu./m to 681.4 cu/m). Seawater is drawn from the Northern Atlantic Ocean, filtered and pumped directly into the pools. The exhibit houses a Pacific walrus (Odobenus rosmarus), California sea lions (Zalophus californianus), harbor seals (Phoca vitulina), sea otters (Enhydra lutris), black-footed penguins (Spheniscus demersus) and six species of fish with both an outdoor and underwater viewing gallery. Ozone (O3) is a reactive, unstable gas with a relatively short life span that is largely temperature pH and water quality dependent. O3 has an average redox potential of 2.07V (1.60V at pH 8.00) and is the preferred disinfectant for marine aquaria and others areas of life support systematic fields. Observed historic fluctuations of oxidation-reduction potential values in this exhibit, (ORP / mV range) inspired a hypothesis that weather conditions experienced during the winter-spring (December- April) affect ORP of the pools. Weather conditions during December 2015 until April 2016 were recorded and documented the following variables: rain, wind and snow, sun exposure, ambient temperatures and humidity. These variables were then compared to fluctuations of ORP values, ozone levels, total residual oxidants (TRO), and measures of disinfection effectiveness in the pool (densities of heterotrophic bacteria) with a goal to determine correlations between these fluctuations and weather events. Preliminary data trends suggest minor dilution of ozone concentration during and after weather events and observation of variations to ORP values these momentary interferences. This study is ongoing and additional data will be summarized and discussed. Comprehension of atmospheric impact on efficiency of applied ozone dosage may impact controller automatic set points in anticipation of future weather events.

University of New England Facility Update for the Marine Science Center Life Support System and the AALSO Club – 2015-2016

TIM ARIENTI; JERI FOX
University of New England, 11 Hills Beach Road, Biddeford ME 04005, USA

The Aquaculture and Aquarium Science (AQS) program at the University of New England has added to their research goals and projects. The program and its students benefit from the fact that Marine Science Center is repurposing a marine mammal rehabilitation facility into a diversity of research spaces. The restructuring involves a significant change in need in terms of plumbing, water quality, filtration and lighting. These changes give us the opportunity to use a 486,000 gallon capacity flow-through life support system as a hands-on teaching laboratory. With the hiring of Zachary Miller-Hope, whose time is split between the academic portion of the Aquaculture and Aquarium Science program and aiding the Marine Science Center (MSC) facility side, we have had been able to concentrate on a few key projects, some of which are represented by our student poster presentations. Our recirculating aquaculture system (RAS), which was described last year in our update, is in the process of refurbishment due to the bioload of accumulated trout feed and waste that must be handled by the system and which has been overpowering the filtration. Our aquaponics system is now represented both by a floating raft/NFT (nutrient film technique) and a solar powered recirculating system. As mentioned last year in our update, we hope to partially filter the liquid waste from our systems through aquaponics. This year we have added a demonstration setup with goldfish, strawberries and solar powered pump, aeration and lighting. The raft/NFT system is ready to be scaled to a bigger system when safety measures are put in place for implementing vertical grow areas up into the cathedral ceiling of our viewing pools. Our work in alternative lighting for life support of seaweed and phytoplankton culture has progressed due to the work of a few dedicated undergraduate students. A summer fellowship was awarded to a student to construct a ROV designed to take water quality measurements in our pools. That work will hopefully bloom into more projects with microprocessors and minicomputers. Our AALSO Club boasted 35 new members, thirteen of whom took the Level 1 certification exam with eleven scoring a passing grade. On the purely academic side, we are reorganizing some of the training of the skills associated with Life Support into workshops where students earn credit for each workshop passed and in doing so, are hoping to instruct the AQS students in more skills related curriculum.

Using Aquaculture Engineering to Maximize Self-Cleaning Potential

ELIZABETH BOWE
University of New England, 11 Hills Beach Road, Biddeford ME, 04005, USA

Aquaculture engineering combines engineering, aquatics, and biology to optimize resources, and space while enhancing the quality of life for aquatic organisms. Aquaculture engineering requires the background knowledge in mechanical, environmental and technical engineering with an understanding of biology, chemistry and ecology. This project uses all of the aforementioned disciplines in order equip a tank with the hydrodynamics required in order to maximize self-cleaning potential by maximizing the removal of settled solids, thus improving water quality, system function, maintenance time and quality of life for the organisms. By implementing mechanical and technological advances, we are able to repurpose large rectangular, below-ground pools to facilitate an aquaculture system.

Aquaculture Opportunities Offered at Texas A&M University at Galveston

BROOKE CARLSON; ALLISSA RODRIGUEZ
Texas A&M University at Galveston, 1001 Texas Clipper Road, Galveston TX, 77554, USA

Texas A&M University at Galveston is the only university in the state of Texas that offers an undergraduate degree in Marine Biology. Many courses are offered in order to prepare their students for a future in this competitive field. One such course is the mariculture class in which students learn the basics of aquaculture and aquatic animal care. Throughout the semester, students work in groups in order to care for and maintain multiple culture systems including sheepshead minnow breeding tanks, algae cultures, rotifer cultures, and *Artemia sp.* cultures. Last semester was the first time that Texas A&M University at Galveston has worked with AALSO to offer its mariculture students the Level One Operator Certification. Through this amazing opportunity, the students were able to enhance their learning by translating what they learned in the classroom to real world applications. In addition to the mariculture course, the campus features the Sea Life Facility, where students can volunteer to work with various aquaculture systems used for research by the university's professors. The Sea Life Facility also works with NOAA to house and care for sea turtles that need rehabilitation and care, as well as provide education on sea turtle conservation. Thus, the mariculture program is just one of the many unique and hands-on experiences Texas A&M University at Galveston offers in addition to its in-depth courses to immerse students in the field of marine biology. These experiences and opportunities help mold the future of not only the students of this university, but of the whole scientific community.

Learning LSS Design & Operation in the Aquarium Science Program

JONATHAN DINMAN; KATIE LANGLAND
Oregon Coast Community College, 400 Southeast College Way, Newport, OR 97366, USA

The Oregon Coast Community College's Aquarium Science Program trains students in the art of aquarium science and delves deeply into the realm of life support. In our course titled Life Support System Design & Operation, students simulate a real-life team of LSS professionals that must design a full-scale theoretical life support system. Additionally, we receive hands-on experience and skills through laboratory activities and the construction of recirculating aquarium systems in our facility. We will discuss how the course provides a strong background in LSS both for the rest of the Aquarium Science Program's curriculum and for training hopeful industry professionals.

Elephant Pools: Examining a New Model for Herbivore Sanitation Systems

JENNIFER BASL MCINTYRE
Fresno Chaffee Zoo, 894 W Belmont Ave, Fresno, CA 93728, USA

Opening in October 2015, the Fresno Chaffee Zoo Africa Adventure Exhibit includes three pools accessible by elephants with 750,000 gallons of water circulating through a system that connects a double moat pool, lower elephant pool, and a waterfall. Use of this newly expanded space prompted evaluation of life support system components to assess and improve water quality. The previous generation of elephant pools has largely been a drop-and-fill system, but as we see the next generation of elephant exhibits feature large scale water re-cycling features it is important that we monitor, evaluate, and address issues that are specifically related to water cycling through elephant pools over long terms. System components, water quality chemistry results, and comparison with other institution system components were the main focus of these studies. Water quality criteria monitored during this study included turbidity, pH, oxidation-reduction potential, and phosphorus levels. Sanitation system components from this and similar systems are evaluated with suggestions for modifications in system running and chemical testing provided.

Ozone & Chlorine Working Together for Polar Bears

RICHARD STUCKEY
Kansas City Zoo, 6800 Zoo Drive, Kansas City, Missouri 64132, USA

AZA recommends that water filtration for a Polar Bear exhibit use Ozone as primary disinfection and sodium hypochlorite as back-up disinfection when ozone is not available for production (Sec1.3 AZA Polar Bear Care Manual). In the 160,000 gallon polar pool at the Kansas City Zoo, ozone and sodium hypochlorite systems work together in practical application for pool cleanliness, sanitation, diver support, and new water treatment. Visitors have underwater viewing of the outdoor pool where clarity is affected by algae, natural debris, uneaten food, and animal waste. Proper chlorine and ozone levels are monitored by pH, free chlorine, total chlorine, and oxidation reduction potential of the water leaving filtration and coming back from the main pool. By alternating use of these two chemical filters, draining and deep cleaning of the exhibit pool and rockwork is unnecessary which saves time and resources.

Production of Microbubbles in Recirculating system Leads to High Seahorse Mortality
COLIN THOMAS
University of New England, 11 Hills Beach Road, Biddeford ME, 04005, USA

The Aquaculture and Aquarium Science program of the University of New England maintains an ornamental breeding facility for the purposes of education and training of its students. In this lab we house twelve breeding pairs of a diversity of clownfish as well as rabbitfish, corals, seahorses and others based on class projects. Recently, the tiger tail seahorses (Hippocampus comes) began experiencing high mortality. This seahorse tank is on a dedicating recirculating system that includes a protein skimmer, biofiltration, and UV sterilization. After observing the seahorses, diet and nutritional pathologies were ruled out as a cause and we began to inspect the system more closely. Symptoms exhibited by the seahorses (bloated pouches and inability to maintain position in the water column) appeared to be gas bubble disease. Upon further inspection, we determined that microbubbles were being created by an apparent clog in the line which was causing a vacuum and forcing cavitation from PVC joints. After the clog was removed and the PVC was glued, the microbubble production ceased.
Ozone Treatment versus Weather:

Algae Scrubbing Efficiency: The Impact of the Light Frequency Testing System on Microalgae Culture Density
DYLAN TURNER; EMILY VOLLMER
University of New England, 11 Hills Beach Road, Biddeford ME, 04005, USA

The LiFT (Light Frequency Testing) system flashes LED (light-emitting diode) bursts in a square wave pattern within certain parameters determined by the needs of the system. The LEDs are programmable for different wavelengths and frequencies within multiple testing chambers. Modern technology has made LEDs the most efficient light source, allowing us to control wavelength and frequency and monitor their respective impacts on phytoplankton growth trends and density. This experiment demonstrates what frequencies and wavelength of light best optimize algae growth. Photoinhibition is reduced under appropriate frequencies because light exposure is too short to cause damage, this results in an enhanced electron transfer rate. Additionally, less heat is given off by the LED if it is flashing, causing no increase in temperature which would cause a slowing down of the Calvin cycle. Electron transfer between photosystems I and II occurs at a specific rate, light (photons) only needs to be provided to match this rate. Flashing lights save energy and grow algae more efficiently by matching the rate of electron transfer. By supplying the least possible amount of light needed to optimize photosynthesis, energy can be saved. The results of this experiment could be used to increase the efficiency of algae scrubbing technology, promoting growth and therefore additional biological filtration within a concentrated area, creating a more ecologically sustainable system.