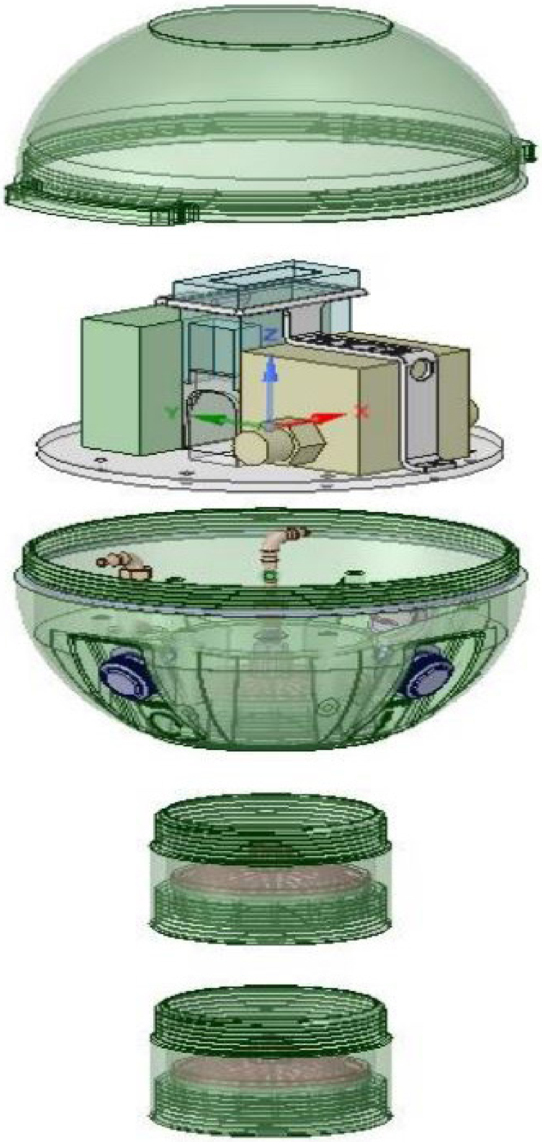
Aqualytical®

Redesigning for Functionality and Manufacturability

Aqualytical was founded to resolve water monitoring issues in relation to current field sampling techniques. The company now provides environmental testing laboratories with revolutionary devices for analytical water testing.



Challenge

The founders of Aqualytical determined traditional water sampling methods to be problematic in multiple areas. Grab sampling and automatic sampling both require the transport of bottles of water. Depending on the sample size, this can be heavy and expensive to ship, especially when considering that coolers are needed to keep the water at the desired temperature. Water samples like this are also only usable for an average of seven days after being taken from the field, so expedited shipping is often needed. With passive sampling, the need for bottles of water is negated, but this method can still weigh several pounds and need multiple days to set up.

Aqualytical wanted to revolutionize water testing by changing how water samples were collected, essentially solving all of these problems with traditional sampling techniques. Their answer to this was the Continuous Low-Level Aquatic Monitoring (or C.L.A.M.) device. This device would filter water through a solid phase extraction (SPE) disk and sequester pollutants for testing. Only the disk would need to be sent to testing facilities, eliminating the need for bottles, coolers, and more.

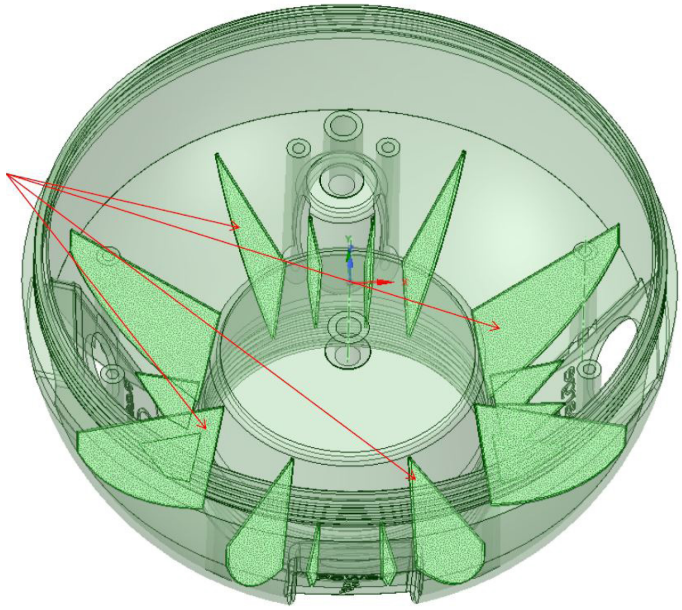
While the concept of the C.L.A.M. was solid on its own, Aqualytical soon encountered a problem. Their design could not be cost-effectively produced in mass numbers as designed. They then sought a vendor that could redesign, manufacture, and drop ship the device, which led them to find the perfect partner in 3 Space.

Solution

Using our team of engineers, in-house FDM 3D printers, and an injection molding partner, 3 Space was able to provide Aqualytical with a redesign that fulfilled all the requirements for their revolutionary C.L.A.M. project. We reworked the design and 3D printed as many prototype iterations as needed to bring the structure to perfection. Once the design was finalized, it was sent to be injection molded. Orders were processed and fulfilled by 3 Space.

Redesign

The primary goal of the C.L.A.M. redesign was to make it possible to mass-manufacture the units cost-effectively. The original prototypes that Aqualytical provided were pill-shaped and machined from plastic. Given the requirements of the project, however, it was decided that injection molding would be a better route. The provided design was not made for injection molding though and needed a ground-up redesign, which included changing the shape of the shell and rearranging many internal electrical components. Aqualytical also required that the device be designed to be waterproof, transparent, and lightweight.



The engineers at 3 Space met each of these needs through a careful design process. The unit's shell was changed from oblong to spherical, and handles were attached to make handling and securing the C.L.A.M. for deployment easier. The bottom shell half was designed to cradle the internal electrical components in a certain arrangement to control weight distribution while also assuring the proper placement of two buttons, a totalizer display, and a USB port. The internal components, which also included a lithium ion battery and a pump, would be potted with epoxy resin in post-processing assembly, and the two shell halves would be screwed and glued together. To make the unit even simpler to use, it was designed to never be disassembled. A cylinder was attached to the bottom shell half. This compartment would be where the SPE disks were placed, making them easily accessible without the need to open the shell.

Prototyping with 3D Printing

Our design process was greatly accelerated by the use of our in-house 3D printers. Instead of waiting on a third party vendor to make and ship our prototypes, we produced them on-site and were able to have them in hand within hours. This allowed us to make assessments and alterations rapidly.

We used our FDM 3D printers to print the C.L.A.M. shell pieces from ABS. These were printed in solid color filament because FDM does not print clear filament well and ends up translucent or opaque by the time the print is finished. Instead of the clear aesthetic, the focus of our prototypes was making sure the structure and function of the shell was correct. This included ensuring the shell halves sealed perfectly when fitted together as well as adding and altering posts, ribs, and sectional threads that would serve to boost strength and hold the electrical components and the SPE disk in place. At the same time, it was necessary to keep in mind that the printed ABS could not mimic the polycarbonate from which the units would eventually be molded. Further testing of the molded polycarbonate would be needed to test the C.L.A.M.'s strength against water pressure up to a depth of 20 feet as Aqualytical desired. However, with 3D printing, we were able to save valuable time and expenses by making most of the largest design changes up front before the mold was cut.

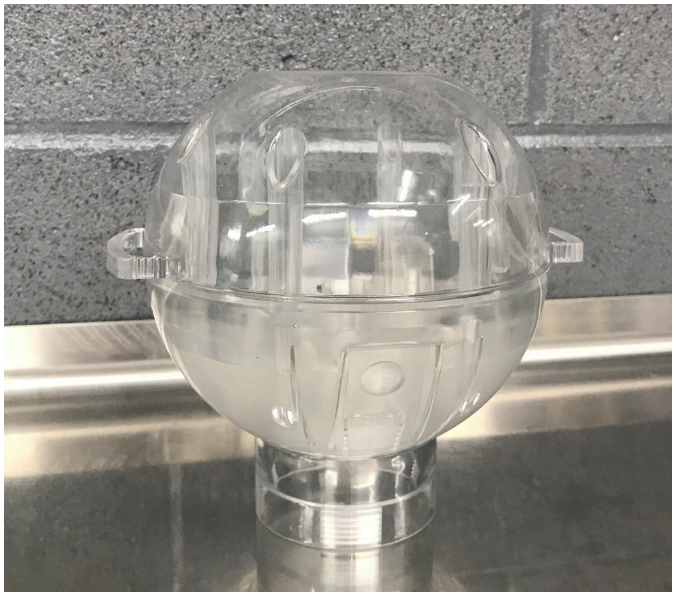
Manufacturing & Assembly

We used an injection molding partner to produce the C.L.A.M. units. Initially, we were sent samples to make adjustments as needed. These adjustments included items such as thicker posts to prevent breakage during injection, increased draft angle for ease of ejection, and more that involved both design and molding process. This was particularly true in the case of making sure the polycarbonate shell came out unblemished and clear every time. Batches of the final C.L.A.M. casings could then be sent to 3 Space for warehousing, assembly, and fulfilling orders via drop shipping.

Assembly includes potting the internal electrical components in epoxy resin. We designed and 3D printed a custom jig to aid us with this part of assembly. The jig holds the unit at a particular angle so the epoxy cures at the correct angle for even weight distribution and full coverage of all necessary components. After this, the halves are screwed together and glued to create a waterproof seal. The unit is shipped in a protective case.

The Final Product

The final design was a completely clear injection molded polycarbonate sphere that was 5.5 inches in diameter and featured a smooth polish finish. The sphere housed the multiple electrical components necessary to filter water and sequester pollutants while only weighing a little more than 1 pound. An attached cylinder on the bottom of the unit was the only portion not made waterproof since this was where the SPE disk was kept. The SPE disk was made to be replaceable and could be easily accessed without the need to dismantle the unit. A USB port for charging the battery and buttons for powering and resetting the unit were all made accessible from the exterior. The totalizer display could be viewed through the clear shell. Overall, the unit was made lightweight for the option to deploy it floating, partially submerged, or completely submerged up to a depth of 20 feet. A shore 40A rubber o-ring was used in conjunction with screws and glue to ensure a watertight seal.



Results

- 3 Space provided product development services to redesign the C.L.A.M. device for improved manufacturability while also ensuring it to be lightweight and waterproof.
- The new design was easy to operate and included an external compartment to swap out disks as needed, making field sampling simpler. The use of disposable replacement disks eliminated the need for bottles of water, cutting shipping expenses drastically.
- Multiple internal components were packaged into a small footprint and enabled the device to perform numerous jobs at once. This cut down on expenses of laboratory extraction and preparation before testing.
- 3D printing was used to accelerate the design process and aid in the assembly of completed units.
- 3 Space warehoused, assembled, and drop shipped the device to customers.