Designing a Soak Testing Chamber for the Testing of the Degradation of Liquid Crystal Polymer

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INTRODUCTION

While electrodes have historically been placed on a short-term basis in patients, the data provided by this has been highly limited. To expand the scope of data researchers procure from electrodes, long-term implementation is required. However the long-term degradation of these electrodes encapsulated in liquid crystal polymer is an unknown variable that requires testing. As such researchers have developed soak testing as a method to to soak the electronic in a phosphate buffered saline solution mimicking the salinity and temperature of blood to measure delamination of the liquid crystal polymer coating the electrode.

METHODS

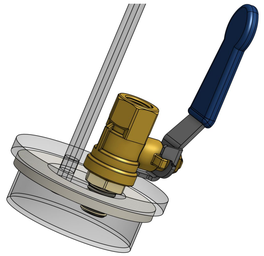
We simultaneously tested three independent designs for chambers and assessed each for pressure leakage, water height reduction, and other indicators of the chamber not being hermetic.

Our first design we tested was a sealed miniature vacuum chamber. We designed this by miniaturizing components of a traditional larger vacuum chamber. By using a silicone to rubber compound, we created a seal for our chamber and sealed the chamber by pulling [x] mmHg of pressure. We measured success of this chamber by taking pressure readings and tracking pressure of the chamber over time in both an accelerated heating environment and at room temperature.

Our second design was two cavities in acrylic pressed against each other and sealed with a plastic bonder. We measured success of this chamber by evaluating the water height. We solely measured this in an accelerated heating environment.

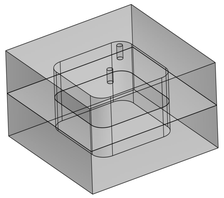
Our third design was a water canning method in which we placed a jar with our electrode in boiling water to seal it. We measured success of this chamber by evaluating the water height and pressing the lid of the chamber to assess if there was pressure leakage in both an accelerated heating environment and at room temperature.

TESTING METHODS



Method 1: Miniaturized Vacuum Chamber

Using a ball valve sealed onto an acrylic lid atop a borosilicate petri dish. Connected via rubber tubing to pressure sensor. Used vacuum pressure of [x] mmHg to seal it.



Method 2: Acrylic sealed with Silicone Sealant

Using two pieces of acrylics with cavities machined in, we sealed them together with plastic bonder and a silicone sealant. We drilled two holes in the top, one for ventilation as we used the other to fill the cavity with saline solution. We then filled those holes with a screw with a gasket as well as an O-Ring and sealed with liberal amounts of plastic bonder. We then tested our chamber in an oven heated to 80° C.

Method 3: Water-Bath Pressure Canning

Using a Ball jar filled with 240 mL saline solution, we water-bath canned the jar in boiling water in an oven. We submerged the jar and authenticated the presence of a strong seal by ensure the top of the jar does not flex.

DISCUSSION AND CONCLUSION

Method 1 went through a couple issues in creating the PLA mold for the silicone seal. The degassing process for this had to be heavily adjusted and we adjusted variables such as time and pressure and how to release the valves to ensure a bubble-free ring, good for sealing.

Method 2 while initially unsuccessful due to human error, was somewhat successfully implemented in the second stage of testing with a new iteration and design. This design featured water injection from the flat square surface on top of the cavity rather than injected through layers of silicone sealant. It remains to be seen how much of a long term solution this can act as, as testing was highly limited in the scope of time and various heat variables such as over-accelerated testing, testing at room temperature and more. We tested this chamber at room temperature and the next step for this would be to put it under accelerated heating. One possible limitation of this method is the secretion of material from the acrylic that has been noted in previous experiments by other researchers. It would require further study to determine if it poses as a compounding factor or if it is a safe side effect.

Method 3 was also initially unsuccessful with the seal disappearing less than 3 hours from sealing. We first sealed it with an oven temperature of 120° C for 30 minutes. Our next attempt, we increased the oven temperature to 160° C and submerged the jars for 30 minutes again. This has been successful thus far. There are some limitations to this method as for final soak testing, over a dozen electrodes will be tested simultaneously and the associated jar for this method are extremely large in comparison to the electrode and will present a space constraint in the future. This can be further studied by seeing how to miniaturize the container similar to the method used in Method 1, which was to miniaturize a pre-existing solution and customizing certain components.

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