Cornell Bioacoustics
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Hydrophone Fabrication

This document covers the fabrication of the lentil-shaped hydrophones using the SMT elements available from Hermes Electronics (as designed by Sippican).

1. Items needed

Vacuum chamber & pump
Mold rack & dehydrator oven
Electrical and duct tape
Conap EN-7 epoxy
Conap Release and primer compounds
Hydrophone elements
Cable, Belden type 8406
Molds (0.06" thick plastic)
2-1/2 qt (or larger) plastic paint mixing container
Electric drill and paint mixer attachment
Timer
Lots of paper towels.

2. Hydrophone Preparation

If the cables are used, inspect them for breaks or nicks, then perform an immersion test (immerse in a bath of water and check resistance from ground braid to the bath).

Cut the cable(s) to length. Strip and trim both ends. On the hydrophone end, the wires should be approximately 1/2" long and the ground braid should be trimmed back (it isn't connected on this end). On the connector end, the wire lengths can be cut to 2" initially, and trimmed later to the connector type.

Solder the cable to the hydrophone element. When looking at the element (piezo on top, terminals towards you), the pinout is as follows:

left = ground, middle = power, right = signal

Take the finished cable and dip each element (and the first 1/2" of cable attached) into the primer. Hang the units in or near the oven to dry (set temperature to mid range). Leave them until they are tack-free.

3. Mold Preparation

If you have raw 2-part molds, cut them apart and trim so they fit together. Also, cut the pour area.

Lay out the molds to expose the inside. With a 1" foam paint brush, apply the release compound over the entire *inside* of the mold pieces. Allow to dry completely.

Close the mold by taping with duct tape along each of the three sides (not inclusive of the pour spout). Affix binder clips along the two vertical edges (2 per side) to secure the tape and clamp the mold tight.

Insert the hydrophone element into the mold while gently prying open the mold at the pour area. The hydrophone cable should be clinched securely by the pour spout area. If not, warap some electrical tape around the cable to get a better grip. Note that it may be useful to use a marker such as electrical tape to position the hydrophone elements consistently at-depth in the mold.

Insert the mold with the element inserted into the mold carrier. Position cables and clamp to the metal cross bars with clothes pins.

4. Molding the Hydrophones

Note due to the bulk of the cable, the size of the vacuum chamber and the size of the mold carrier, it is recommended that you don't do more than 4 at a time. Also, once the epoxy's 2 parts touch, you should have poured it into the molds completely within 10 minutes!

Each mold will require 4-5oz of mixed epoxy. When casting 4 hydrophones, this equates to 500g part A and 90g part B of the Conap EN-7. Place the mold carrier part way into the oven with the hydrophone molds in place. Make sure to leave enough room to pour the epoxy into each. Recheck cables and element position within the mold (a flashlight might be helpful).

Using a 2-1/2 qt plastic container, weigh out the 2 parts of the epoxy. Start your timer (if count-down type, set for 11 minutes). Mix the epoxy thoroughly with a paint stirrer attached to an electric drill (for approximately 30" to a minute). Immediately place the container in the vacuum chamber and turn on the vacuum (make sure the outlet valve

is closed). Note that it is important to use the largest container possible to provide the greatest surface area for degassing and to prevent overflow as the epoxy foams up during degassing.

While the epoxy is being degassed, evacuate the air from the epoxy source containers and replace the seals securely. Back at the vacumn chamber; the epoxy should foam up, boil then collapse in roughly 3 minutes within the chamber. Should the epoxy look like it is going to overflow the container before it collapses, open the release valve *slightly* to maintain the epoxy level

When the epoxy has collapsed in the chamber, turn off the pump and slowly open the outlet valve to release pressure. When the pressure is completely released, remove the container and begin pouring it into the molds. Make sure you pour in one side of the pour area of the mold only, trying to pour it down the side to reduce the possibility of introducing further air into the mix. Continue pouring until both sides of the pour area are filled to the top.

Slide the mold carrier completely into the oven and turn on the oven to 150°F. Close the cover, allowing the cables to pass through at the top. Recheck periodically for mold leakage during the first half hour of the cure cycle (16 hours).

5. Finishing Up

Once the mold cure time (of 16 hours) has elapsed, turn off the oven and remove the mold carrier. After about 15 to 30' cool down time, pull each mold, remove the binder clips and duct tape, then pop each completed hydrophone element out.

Trim the completed elements with a band saw. Then remove any tape from the cable. Finally, using a bench sander, sand the edges and the top where the cable goes in.

Wipe the completed elements with lacquer thinner (or methylene chloride or ketone-based compound) lightly along the cut and sanded edges.

Immerse the cables and hydrophones (except the leads) into a tub for 15 minutes and perform a megaohm test to ensure air bubbles (or cable nicks) do not short the units electrically.

Remove the units from the bath and dry. Then perform an operational check using a 12VDC battery and an oscilloscope.

Finally; attach connectors and perform calibration / response checks as needed.

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