# NY-FACEMASK

Individual Analytical Analysis

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## Introduction:

The objective of this paper is concerning the process of making a plastic surface to use in the Capstone II project. The project is about making an advanced face-mask used in the long term with some requirements. Such as a speaker and microphone to allow the user to help in communications, a fan that can help in exhaling and exhaling, a battery that can help in powering all electronics, and a visible face-mask surface that can allow the user's face to be clear for better communications like smiling, etc. This paper's primary purpose is to talk about the team's steps to make that face mask surface. The materials that were porched and used in making the face of the mask are the fowling.

## Building steps:


Figure 2:  CPAP mask

We started with a CPAP mask because it had a nice shape to it. Unfortunately, it had a hole in the center that we will have to fill.

Figure2: CPAP mask being cut

First, we cut the edges of the mask to fit the shape of the face. Then we sanded down the flange around the hole in the center of the mask to make it as flush as possible.

Figure3: CPAP mask with the clay.

Then we started to form the clay inside the mask and outside the mask. The idea was to build up a flange in certain areas that fabric or foam will attach to and then make vents for the inlet fan and exhaust outlet.

Figure 4:  CPAP mask showing the hole.

We also had to round off the hole in the center. There are still some imperfections in the clay that the resin will likely pick up. Much of that will be sanded out after, but ultimately the way the mold will work defined detail shouldn't transfer to the thin plastic piece.

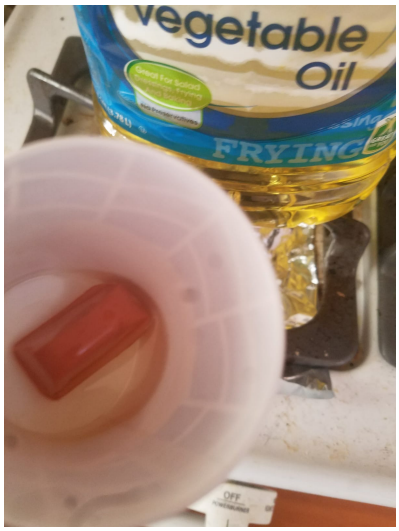


Figure 5: clay in vegetable oil

Figure 6: clay in clean cup

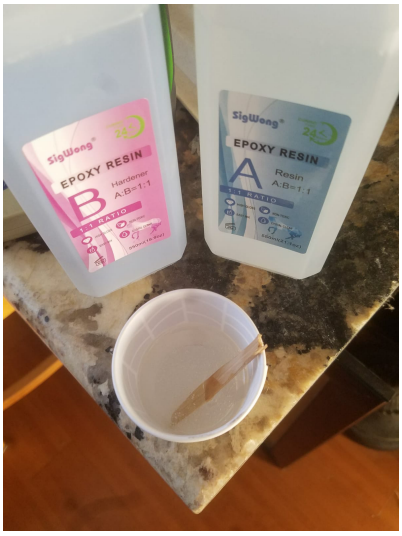


Figure 7: mixing two-part resin

We did a test pour to make sure that we will be able to remove the clay from the resin without too much of an issue. We soaked a small cube of clay in vegetable oil, as figure 5 shows. It was wiped off and then placed in a clean cup that is presented in figure 6. In figure 7, we mixed the two-part resin in equal amounts. Then the cube was completely submerged in resin. That needs to cure for 24 hours. Once that happens, we will attempt to remove the clay from inside the resin.

Figure 8: clay in the mold

As shown in the above figure, our clay test cube came out of the mold very easily without any problems after using vegetable oil as a releasing agent.


Figure 9, 10 and 11.

We created a perimeter around that mold using a paper cup that was cut and then hot glued around the mold, as figures 9,10, and 11 show. Then we use the vegetable oil again as a releasing agent. When the part was cured, we could release the sides of the part; they would come apart and did not bond in the curing process. However, the rest of the pieces bonded together. We were not even close to being able to get the pieces apart correctly. We are going to need to research a better releasing agent.

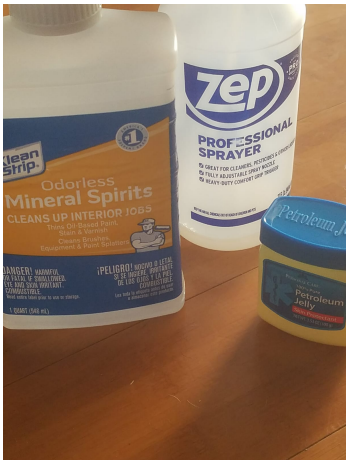


Figure 12, 13, 14 and 15.

Based on our research suggestions, the best release agent to make the silicone mold and to pour epoxy into the made silicone mold is Vaseline thinned out with mineral spirits[1]. We used a very rough ten parts mineral spirits 1 part Vaseline. We heated that up in a container using a separate larger container filled with hot water. That caused the Vaseline to dissolve after we stirred it for quite a while, heating it. We put that in a spray bottle.

Figure:16.

We used some strips of aluminum that we found to create a perimeter around the sculpted mask.

Figure 17: weighing the silicone.

We weighed equal parts of part A, and Part B silicone then stirred those together for 5 minutes..

Figure 18.

Taking a quick break during the stirring, we sprayed the sculpted mask with the releasing agent on a paper plate so that we didn't get releasing agent everywhere. Then we place the part back on our plastic plate with the perimeter around it. Then we use hot glue to secure the perimeter's base so the silicone wouldn't run out.


Figure 19.

Unfortunately, we didn't have enough silicone. To increase the volume and raise the mold level, we inserted clay to displace the silicone and raise it a little higher on the mask.

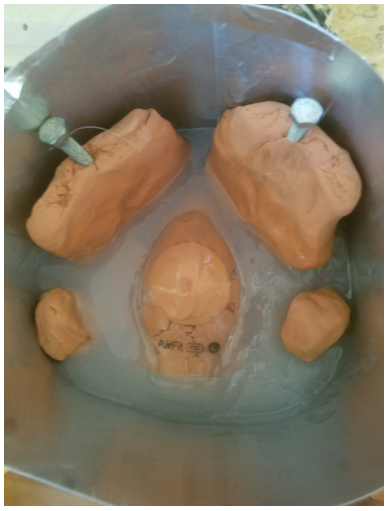

Figure:20

Figure:21

As presented in figure 20, we could not raise the level high enough to cover the entire mask, so we had to improvise. In figure 21, we created another perimeter around the missing section using foil tape, and then we filled it in with hot glue. This gave us a two-piece mold but, in the end, it worked just fine.

Figure 22.

After cleaning out the mold with soap and water, we got it ready along with the second hot glue piece to pour epoxy into it. First, we set the hot glue piece on a plate, then we placed the silicone mold on top of that, and it balanced very nicely. We then put foil tape all around the silicone mold to not deform with the weight of the epoxy. There's also a strip of tape that goes across it as well.

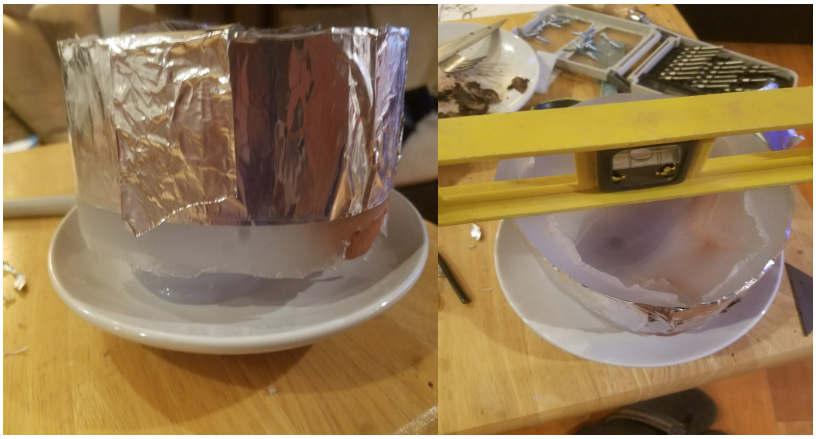

Figure 23 and 24.

We leveled the mold so the epoxy would not end up high on one spot and low on another. We then mix the epoxy in equal parts waited for 5 minutes. We sprayed the releasing agent with a light mist and wiped down the excess pooled in the bottom. Then we filled the mold completely full of resin.

Figure 25.

This figure shows the portion of the mold that was filled in with hot glue. It was the big reveal hoping that it would release properly and have a decent shape underneath. There was less concerned with the silicone portion and more concern with the hot glue.

Figure 26.

It turned out nice. There was a little bit of deformation, but ultimately we anticipated needing to sand and finessed the final form regardless. The important thing there were no substantial voids and was just excess material that will be sanded away.

Figure 27.

After sanding and filling in some voids with plaster, it is ready to be used for vacuum molding.

Figure 28.

We built the vacuum mold out of rigid purple foam that's about 1 inch thick. We made a simple box form, and then everything was glued together, and then we used aluminum tape to hold everything in place. Then a top piece of pegboard was added. Some holes were glued over the foam, so we drilled out the holes to make sure there was good airflow and added a few additional holes in strategic places around the mask form. The form was taped in place with foam mounting tape. We connected a vacuum by drilling a hole in the foam box. And these setup was complete.

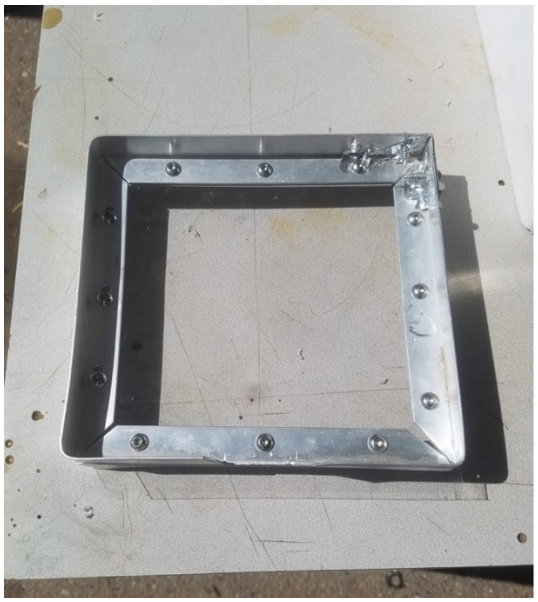

Figure 29.

We made two aluminum frames that had a center measurement just larger than our box. It was made with angled aluminum, and the two frames bolt together to pinch the plastic piece that is going to be formed in the middle.

Figure 30.

When we attempted this with the masks' material, we realized that the material was not the correct type for what we are doing. Instead of getting very pliable, it did the opposite and shrank and became hardened and also opaque. After research, we realized we purchased a PET product, but we need PETG to take shape and be a good thermoplastic for this project.

Figure 31.

We used an old toaster oven as our heating device to soften the plastic. Unfortunately, it didn't work with the material we had. We'll have to order new material and make another attempt.


Figure 32.

After getting the new material, we're ready for a second attempt. We did everything the same. We put the piece of plastic between the two aluminum frames and then inserted it into the oven. This time the plastic started to Sag as we anticipated, and when it seemed to be pliable enough, we removed it from the oven, turned on the vacuum, and placed it over the mask form.

Figure 33 and 34.

As it can be seen, it conformed perfectly to the shape of our task form. This time it worked exactly as it should.

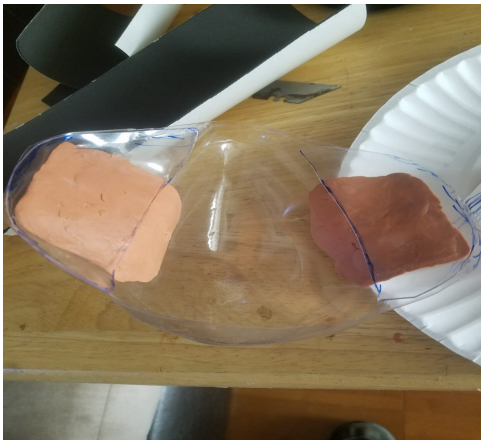
Figure 35.

The next step was to make the internal vents. The vents are essential to help keep the fan spaced strategically away from the face without the mask deforming into the face and causing the fan to possibly even hit the face. It also helps control where the air is going and diverts it from blowing directly onto the face. Instead, it should flow across the face. And then, on the exhaust side, the vent is shaped exactly the same, allowing space for the microphone and giving ample size as not to restrict the exhaust. This was done by placing clay in the shape that the internal vent will take. Then pieces of plastic were cut out in an oversized manner, heated up in the oven, and then formed by hand to fill in those particular shapes. After the pieces were cut to fit perfectly, they were glued into place. We now have perfect vents that have added structure to the mask.

## Conclusion

In conclusion, the face mask making was challenging; however, it was an interesting thing that was learned and practice. We learned how to make plastic using a few materials that were shopped online and others that can mostly be found at any house. We made the mask surface with the shape and measurements we wanted to fit into what was needed in the Capstone II project. We learned that it might take some time for some process to be done, and it might take up to two days to have the structure ready. We also learned that using a PET material instead of the PETG material can make the plastic's structure shrink and change the shape.

## Reference

[1]*Resinobsession.com*, 2021. [Online]. Available: https://www.resinobsession.com/forums/topic/using-vaseline-as-a-mold-release/.

[2]"How to Design a Mold using Polymer Clay with Adele Morse", *Mayku*, 2021. [Online]. Available: https://www.mayku.me/blogs/news/how-to-design-a-mold-with-polymer-clay-with-adele-morse.