

Progress Report #6

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COS120: Introduction to Research

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Objectives

Over the course of the past two weeks, we have prepared and cured a total of 9 cement samples. The samples include: control, graphite powder (1% wt.), iron oxide (1% wt.), fly ash cenospheres (1% wt.), and chopped carbon fiber. We have also prepared the apparatus for which the Seebeck effect will be tested. In addition, we tested our multimeter but found that it was not functioning. In the upcoming weeks, we plan to create more of our samples and collect data on their thermoelectric-generating properties.

Materials & Methods

We created our first concrete samples, consisting of our control, graphite powder, and iron oxide samples on March 10th. As these were our first samples, we decided to remove them from their molds just 2 days in to ensure that our methodology at the time did not hold any obvious issues. Upon inspection of these samples, we unfortunately found that the concrete had dried too rapidly, with too much water evaporating from the mixture during the curing process. This led to obvious cracks and air pockets in each sample along with some samples showing glossy tops for the iron oxide and control samples.

Figure 1.

Image of the first few cement samples.

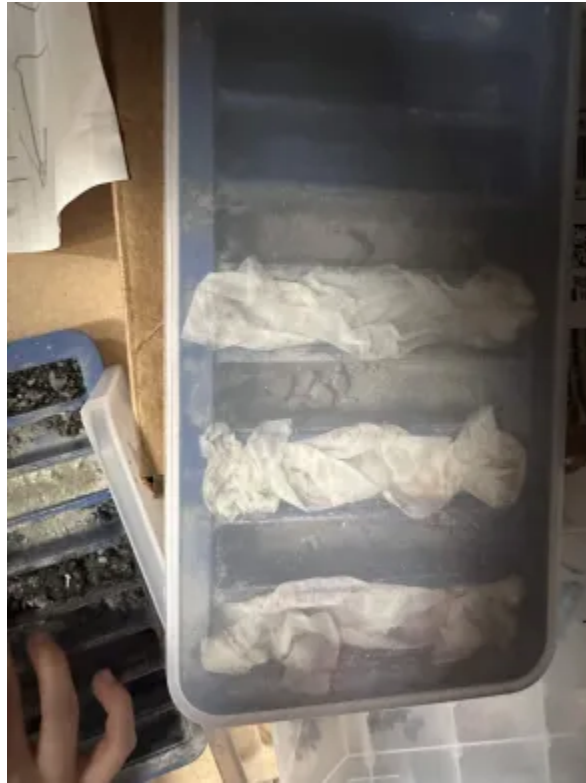


Note: Includes Iron Oxide mixed samples (red samples) and a simple cement control group (gray samples). Photo taken by author on March 12.

The graphite sample was so dry that it crumbled to pieces when we attempted to remove it from its mold. Other samples were also weak, likely due to a lack of curing time. This can easily be seen in figure 1 with the many cracks in the sample. These unfortunate deformities were likely due to the fact that we had simply let the samples dry without any cover or protective measure against the water's evaporation. Contrary to common misconceptions, the water in concrete is not meant to evaporate as it cures. Instead, the water becomes a part of concrete's structure, and it is crucial that the water initially added to the mix remains within the mixture as it cures. In order to prevent any dehydration or further uneven water distribution, we have opted for wet curing the concrete. This process consists of covering the concrete's surface with damp paper towels and sealing the container they were in to prevent any further water evaporation or water from pooling at the top of the sample. An image of this process is shown below in figure 2.

Figure 2.

Image of cement samples left to cure.



Note: Each sample is covered by a damp paper towel. Photo taken by author on March 12.

Originally, we had all of our cement samples adjacent to one another. As a result, some of the cement would sometimes spill over. In addition to preventing any contaminated samples in the future, we started spacing each sample in each slot from one another, alternating from sample to empty. This can be seen in Figure 2 with each paper towel covering the samples in every other space.

On March 17th, we began to build the apparatus, setting up the 500W lamp, the multimeter and the K-type thermocouples. While setting up the lamp, we had to use gloves since the oil within our fingers could damage the lamp. We tested our multimeter and found that we

were not able to collect viable data with it. In trial runs, it did not produce accurate measurements. Upon investigating this with a senior physics research group, we found that the multimeter was not accurate when they attempted to use it as well. In their attempt to use said multimeter, large amounts of sparks were produced and the multimeter acted strangely. We have located outside multimeters available for use through the physics senior team. Other parts of our apparatus seemed fine upon inspection.

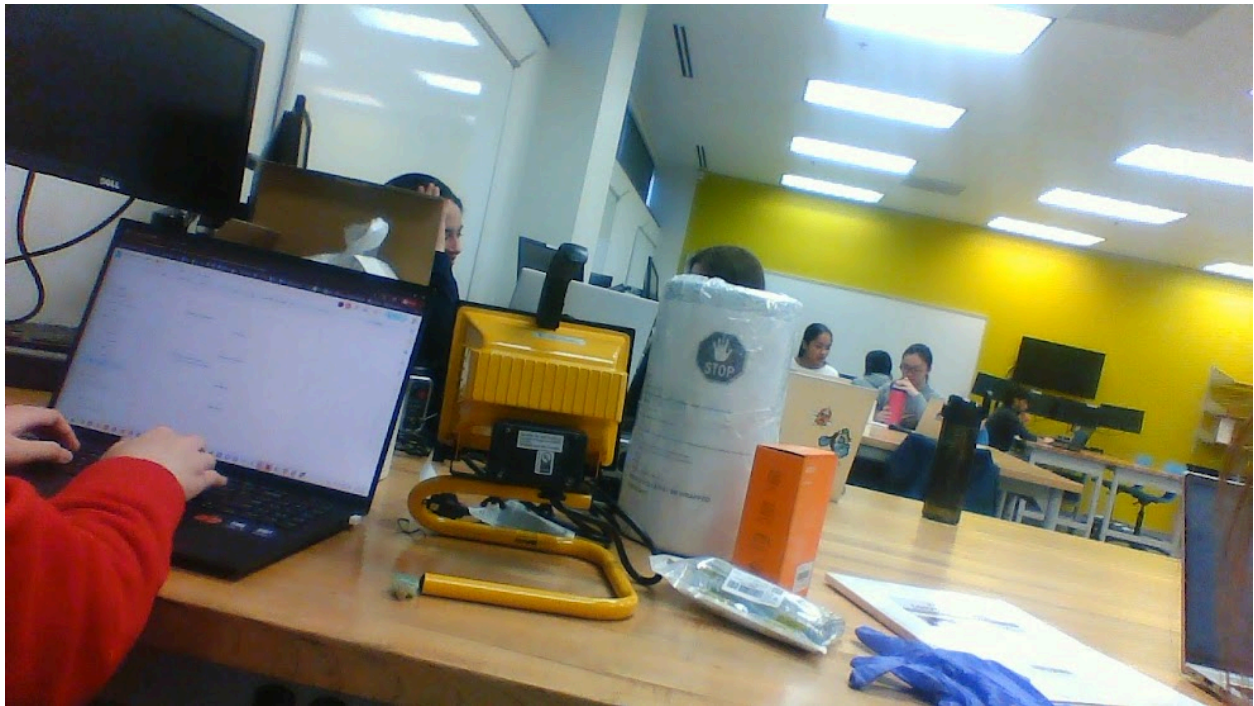


Figure 3. Pictured here is an image of the completed lamp as well as other materials for our apparatus including insulation, and the copper sheet.

Data/Results

At the current moment, we don't have much results since our original samples broke and our next set of samples are left to cure.

References

Carmody, M. (2025, October 27). Best practices for concrete curing: Concrete curing tips.

MudMixer. <https://mudmixer.com/blogs/news/best-practices-for-concrete-curing>