Progress Report #2

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COS120: Introduction to Research

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Objectives

In the past few weeks our team has been finalizing our supply list, calculating our appropriate budget, and ensuring that our methodology is properly suited to our resources and timeline. We have also created our research proposal presentation, which covers the key aspects and applicability of our research. Now that our zFairs forms are submitted, we are planning to order supplies and begin the process of preparing the cement samples in the following weeks.

Materials & Methods

Amazon

Company Name	Item #	Description	Price	Quantity needed	Total Price
Amazon	8 oz. Suplerplasticizer	https://a.co/d/7r8w0GJ	$12.59	1	$12.59
Amazon	5 pcs. K type Thermocouple P	https://a.co/d/3iiyro1p	$13.99	1	$13.99
Amazon	500 Watt Work Light	https://a.co/d/8GnYGBn	$22.69	1	$22.69
Amazon	4 oz. Graphite powder	https://a.co/d/b26aVAA	$9.99	1	$9.99
Amazon	Current Source	https://a.co/d/54MKrVS	$29.99	1	$29.99
Amazon	10 oz. Iron Oxide	https://a.co/d/7X1n5Aq	$11.99	1	$11.99
Amazon	Multimeters	https://a.co/d/j0s5nuw	$29.98	2	$59.96
Amazon	Thermal Insulation 1ft x 10ft	https://a.co/d/eStsaE4	$10.88	1	$10.88
Amazon	5 Pcs Copper Sheet	https://a.co/d/aBqv7Sa	$14.99	1	$14.99
Amazon	.125" Chopped Carbon Fiber	https://a.co/d/0vML3bJ	40.48	1	$40.48
Amazon	Fly Ash	https://a.co/d/frJovxE	$45.99	1	$45.99
Amazon	Cement Molds	https://a.co/d/aEOk3ba	$10	1	$9.99
Amazon	Big Bucket for mixing	https://a.co/d/1Fdp9PZ	$6.50	1	$6.50

Non-Amazon	Item #	Description	Price	Quantity needed	Total Price
Home Depot	80 lb. Concrete Mix	https://www.homedepot.com/p/SAKRETE-80-lb-Gray-Concrete-Mix-65	5.98	1	$5.98
Walmart	Cement Dye	https://www.walmart.com/ip/12-Colors-Cement-Water-soluble-Color-E	$11.20	1	$11.20

total	
Amazon	$290.03
Other	$17.18
total	$307.21

Figure 1. The image above shows a table with descriptions, links, and prices for each necessary item in the experiment.

After finalizing our supply list, we have decided to source the majority of our materials from Amazon. The Portland cement, however, will be most affordable when bought from Home Depot. Figure 1 shows the complete supply list for the experiment, with a total cost of $307.21. We have added some additional materials to our supply list, being a silicon cement mold, a bucket for mixing, and cement dye. The cement samples will be dyed black with Gypsum dye in order to increase the amount of heat absorbed. The Gypsum dye is a class 1A carcinogen and can cause cancer when inhaled. It is also a class 2 skin irritant and a class 2B eye irritant. As such, we will take heavy precautions in the cement-mixing process (Martin Marietta Manufacturing, 2018). We will wear respirators, protective goggles, gloves, and long sleeves to avoid skin damage. Our methodology has changed slightly as we finalized our budget. Due to budget issues, we have decided to not use Cuprous Oxide as a filler. We already have Fe_2O_3 as our choice of metal oxide filler. This leaves room in the budget to include Class C Fly Ash and Chopped Carbon Fiber. We have also decided to use two multimeters when acquiring data for electrical properties like resistivity. This is because we are using the four-wire method (Tektronix, n.d),

which will result in values that are much more accurate than with a traditional two-wire method of measurement.

Data/Results

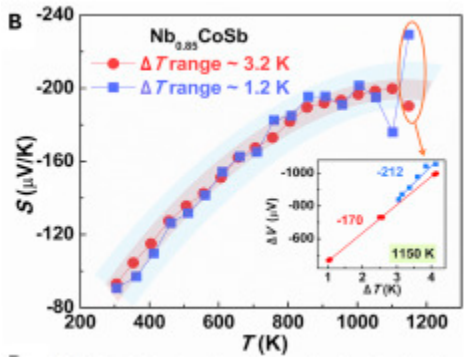

Figure 2. The image above, sourced by (Wei et. al, 2018) displays the relationship between absolute temperature and Seebeck coefficient.

We do not currently have any data or results as experimentation has not yet begun; however, we have developed our hypothesis that our addition of graphite and black dye will increase the amount of thermoelectricity that may be harvested from the concrete when heat is applied. The reasoning behind this is that graphite has been found to increase both the electrical and thermal conductivity of the cement while the color black is notorious for its heat-absorbing properties. In addition to measuring the amount of electricity that the concrete provides, showing data on the costs of each sample will allow us to showcase the economic viability of our solutions and thus its realistic applicability in infrastructure. Wei et. al (2018)'s graph shown in figure 2 shows the relationship between temperature and seebeck coefficient, with the shadows around the line being error for the measurements. At around 1,000 K of absolute temperature, error increases massively. Since the heat lamp we are using will not be able to get to that high of temperatures, we can be confident in error being minimized. The same study also notes that the

thermoelectric coefficient of the wires must be subtracted from the measured S value in order to obtain the material's true value. This correction is necessary since we do not have specialized equipment to measure Seebeck coefficient values. We will use MATLAB for analyzing and visualizing the data. We will also use a line graph for Seebeck coefficient vs. Temperature, and one for Conductivity vs. Temperature for each material.

References

Martin Marietta Materials. (2018). *SAFETY DATA SHEET (SDS) : GYPSUM SECTION I -IDENTIFICATION*. https://mcdn.martinmarietta.com/assets/safety-data-sheets/gypsum-sds-june-2018.pdf

Tektronix. (n.d.). *Two-Wire vs. Four-Wire Resistance Measurements: Which Configuration Makes Sense for Your Application? | Tektronix*. Www.tek.com. Retrieved September 21, 2022, from https://www.tek.com/en/documents/technical-article/two-wire-vs-four-wire-resistance-measurements-which-configuration-makes-s

Wei, T.-R., Guan, M., Yu, J., Zhu, T., Chen, L., & Shi, X. (2018). How to Measure Thermoelectric Properties Reliably. *Joule*, *2*(11), 2183–2188. https://doi.org/10.1016/j.joule.2018.10.020