



SAN DIEGO STATE UNIVERSITY

Tube Furnace Hot Press

Team "Too Hot to Impress" - Project 26

Sponsor:

Principle Investigator Dr. Olevsky

Point of Contact:

Maricruz Carrillo

Project Advisors:

Course Instructor: Dr. Shaffar

Professor and Expert: Dr. Morsi

Fabrication Support: Mike Lester

Powder Technology Laboratory



SAN DIEGO STATE UNIVERSITY
Mechanical Engineering



SAN DIEGO STATE UNIVERSITY
Research Foundation

Project Overview

The team has been tasked with the design and integration of a Hot Press system utilizing an Instron machine and a vertical tube furnace that can reach up to 1500° C. The Hot Press system will be able to consolidate powdered metal and ceramic materials for research purposes in the Powder Technology Laboratory. Uniquely, the two machines making up this system must also be able to be used for their individual purposes.

Major Requirements and Constraints

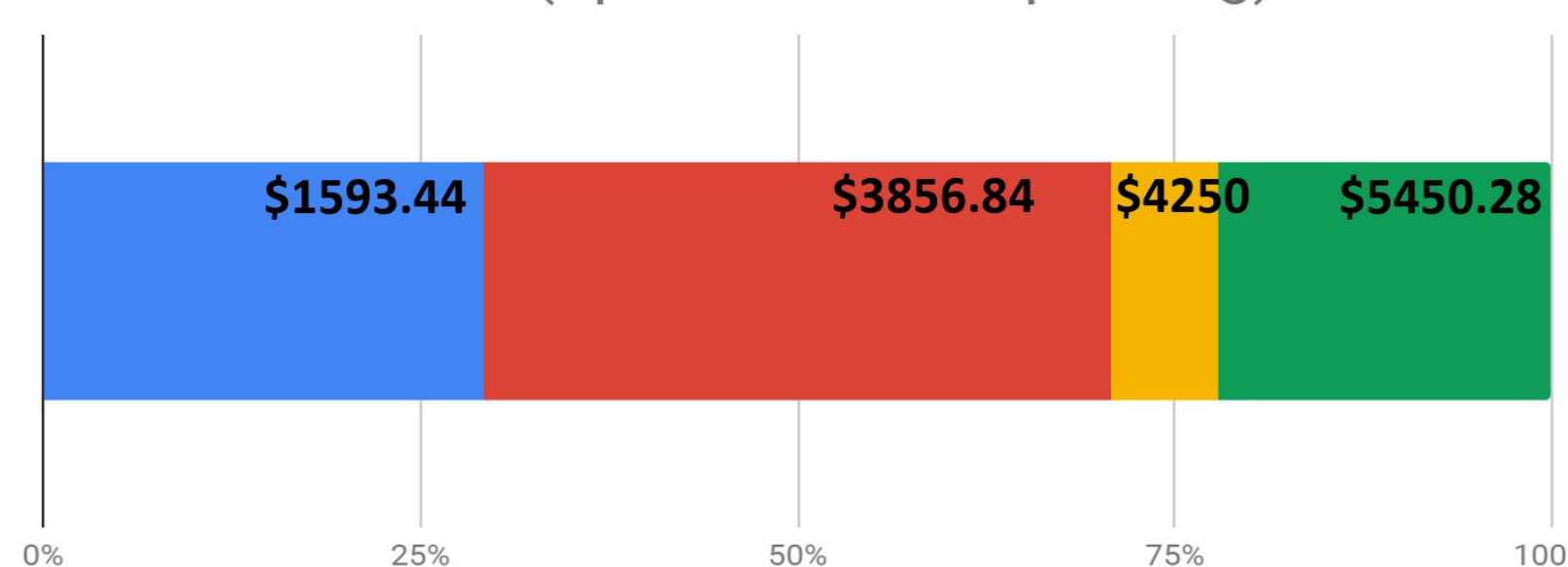
The essence of our design is based on the following challenges:

- 1) The Instron machine and tube furnace must be allowed to be used for their individual purposes. No permanent connections allowed.
- 2) Tooling components inside of the furnace must withstand extreme conditions of up to 1000°C and applied pressure of up to 400 MPa.
- 3) The lack of a vacuum chamber around our tube furnace means that many materials will rapidly oxidize at high temperatures.

Budget

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Spent Future Spending Allocated Total (Spent + Future Spending)



Only \$1590 was spent on material procurement before the campus shut down due to Covid-19 pandemic.

Future spending includes Silicon Carbide plunger material upgrade when 1500°C testing is required.

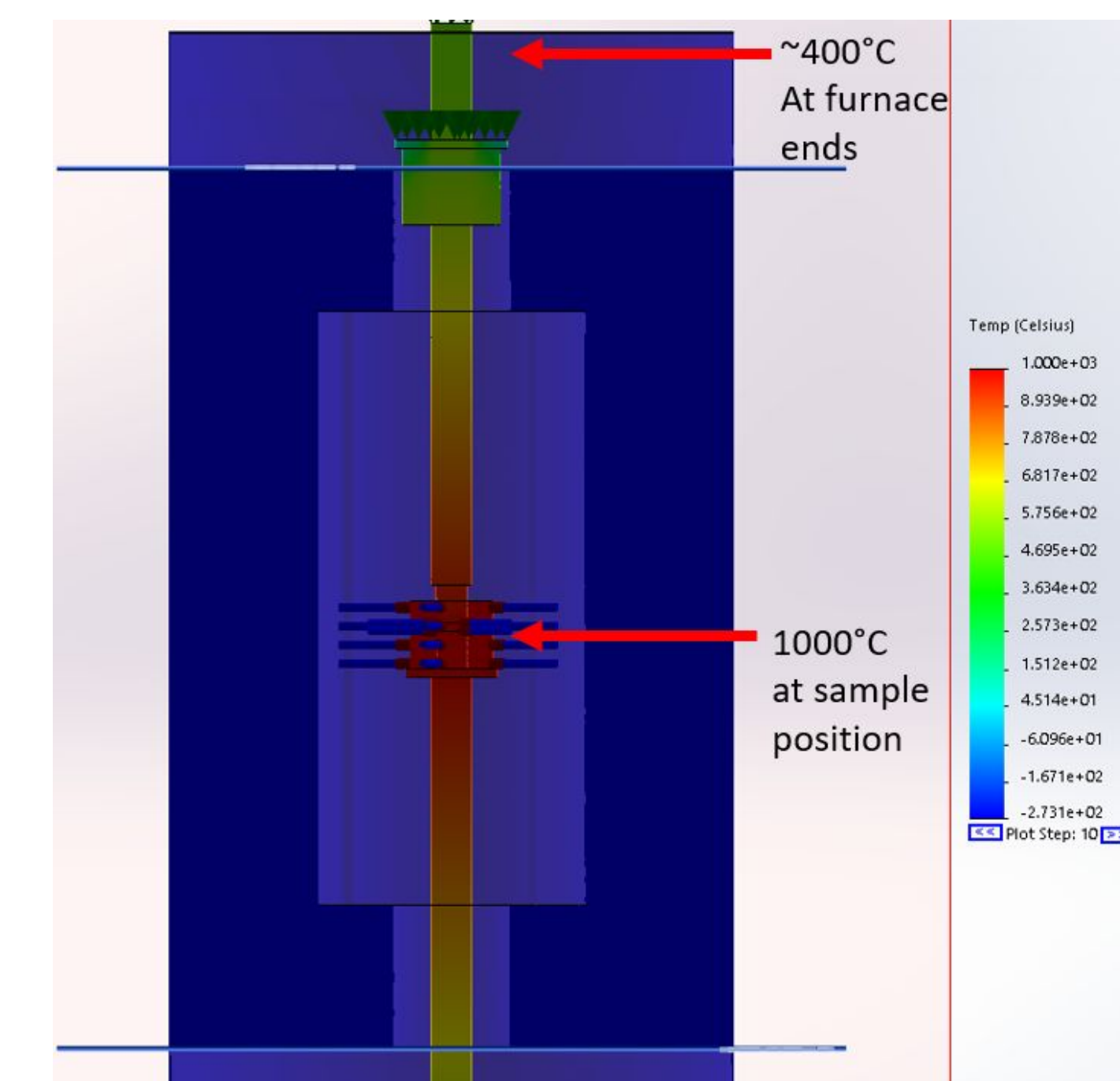
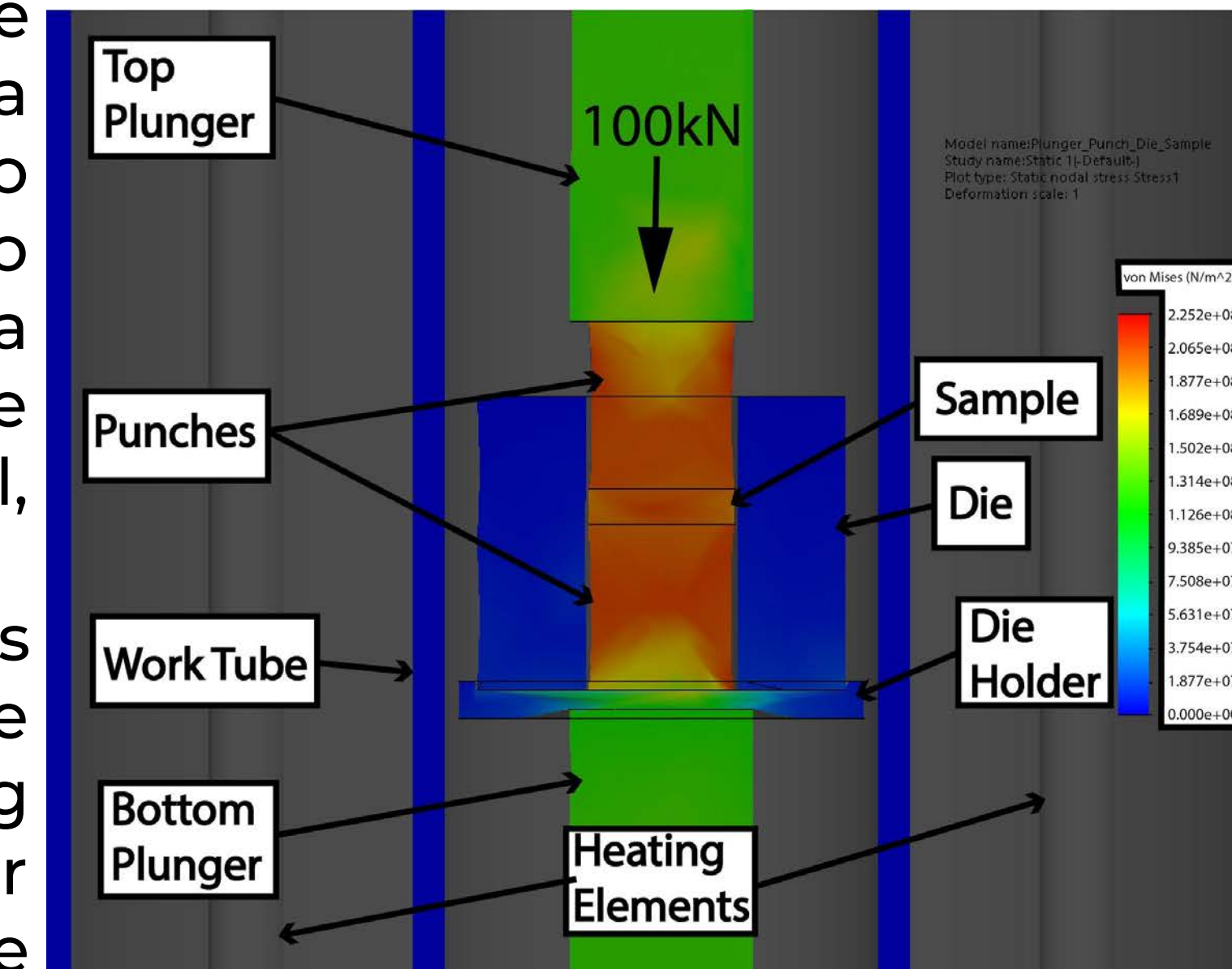
Future Use

This Hot Press system will be used in the Powder Technology Lab by researchers such as Maricruz Carrillo to assist in the advancement of experimental material characterization.

Examples of these materials include: hydroxyapatite, stainless steel 316, zirconia, and brass (among others).

Analysis

During usage, the transfer bar applies a load of 100 kN onto the plunger rod to apply a 200 MPa pressure onto the sample material, effectively consolidating it. This pressure can be modified by using various diameter sized punch and die sets.



Once the furnace reaches an internal temperature of 1000° C, this is the resulting temperature distribution on the systems components. This is a typical distribution for any temperature, due heat dissipates quickly in air and the long heating time.

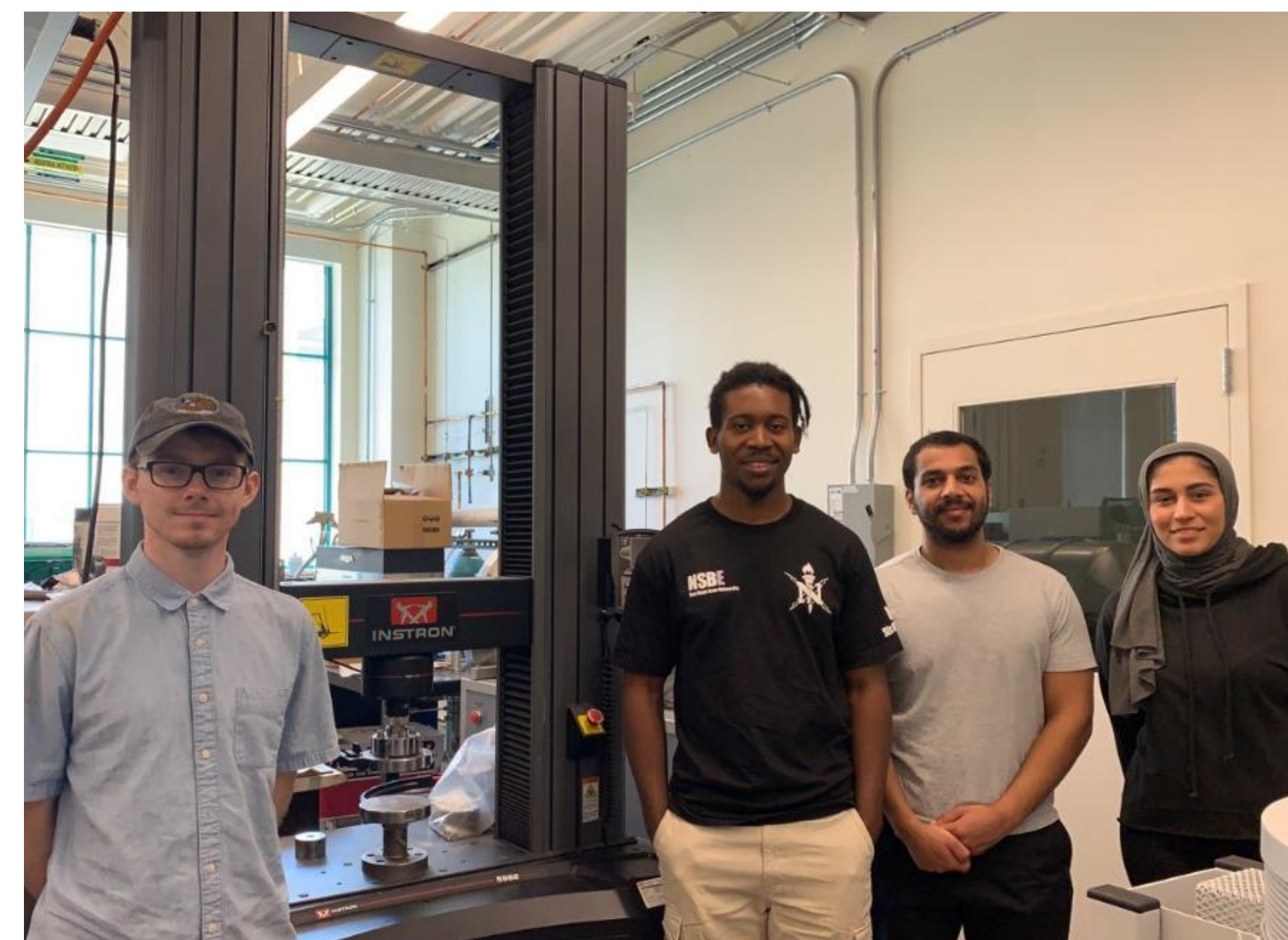
System Specifications

The Hot Press has been designed to consolidate powdered metal and ceramic materials at 1000°C, achieving a pressure ranging from 200-400 MPa depending on punch and die set. System is portable and compartmentalized for separation from Instron machine. Winch lift is rated to 500-lb capacity. RA-253 alloy plungers are rated up to 1370°C.

The Team

Left to right:

- Josh Brennan
- Nnamdi Nzeadibe
- Mesab Alasfour
- Esraa Alsaad



Note: Photo taken before social distancing guidelines

System Level Diagram

