Green Iron Briquette Optimization

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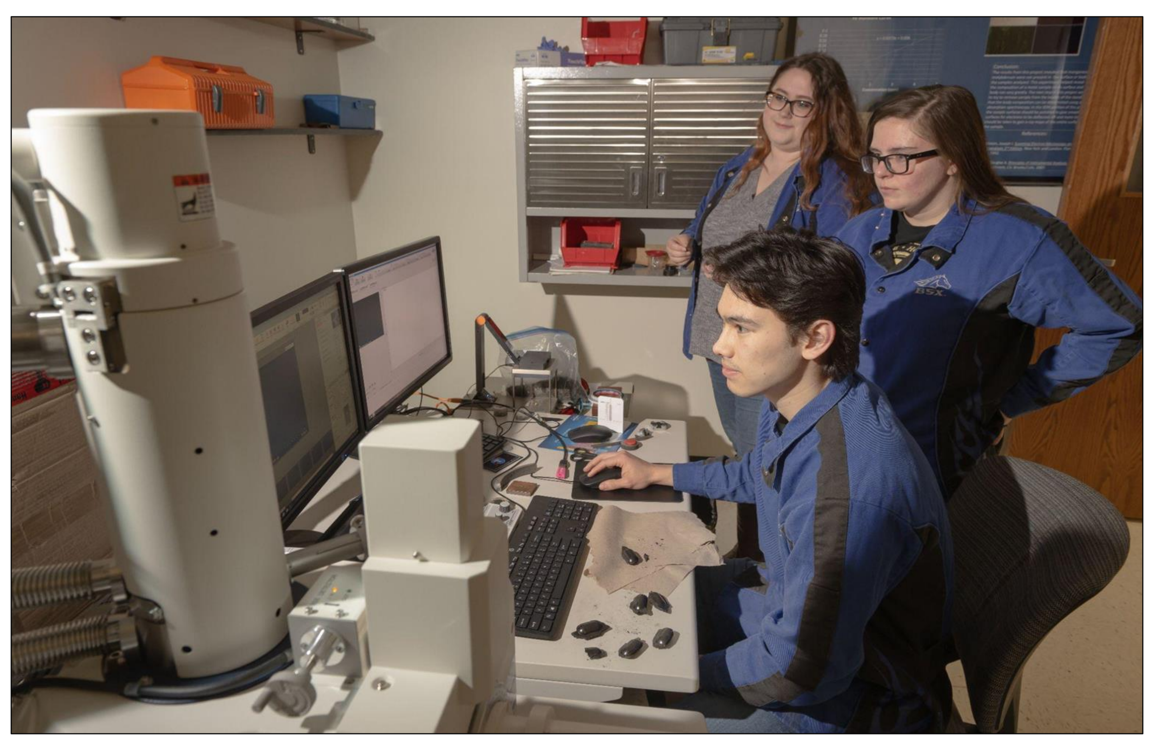
Abstract

We will be optimizing Iron Dynamic's iron briquetting system by adjusting variables of produced briquettes such as temperature and run speed. Optimizing the briquettes will lead to cost benefits and better reduction of metal in downstream processes. Variables will be tested and optimal briquette conditions will be chosen based on the hardness, moisture content, and uniformity among briquettes to ensure melt consistency.



Performing a microstructure uniformity test using a Scanning Electron Microscope

Pictured front to back: Takeshi Alvarez, Eden Watson, Caterina Staton

Experimental Methods

Testing Conditions

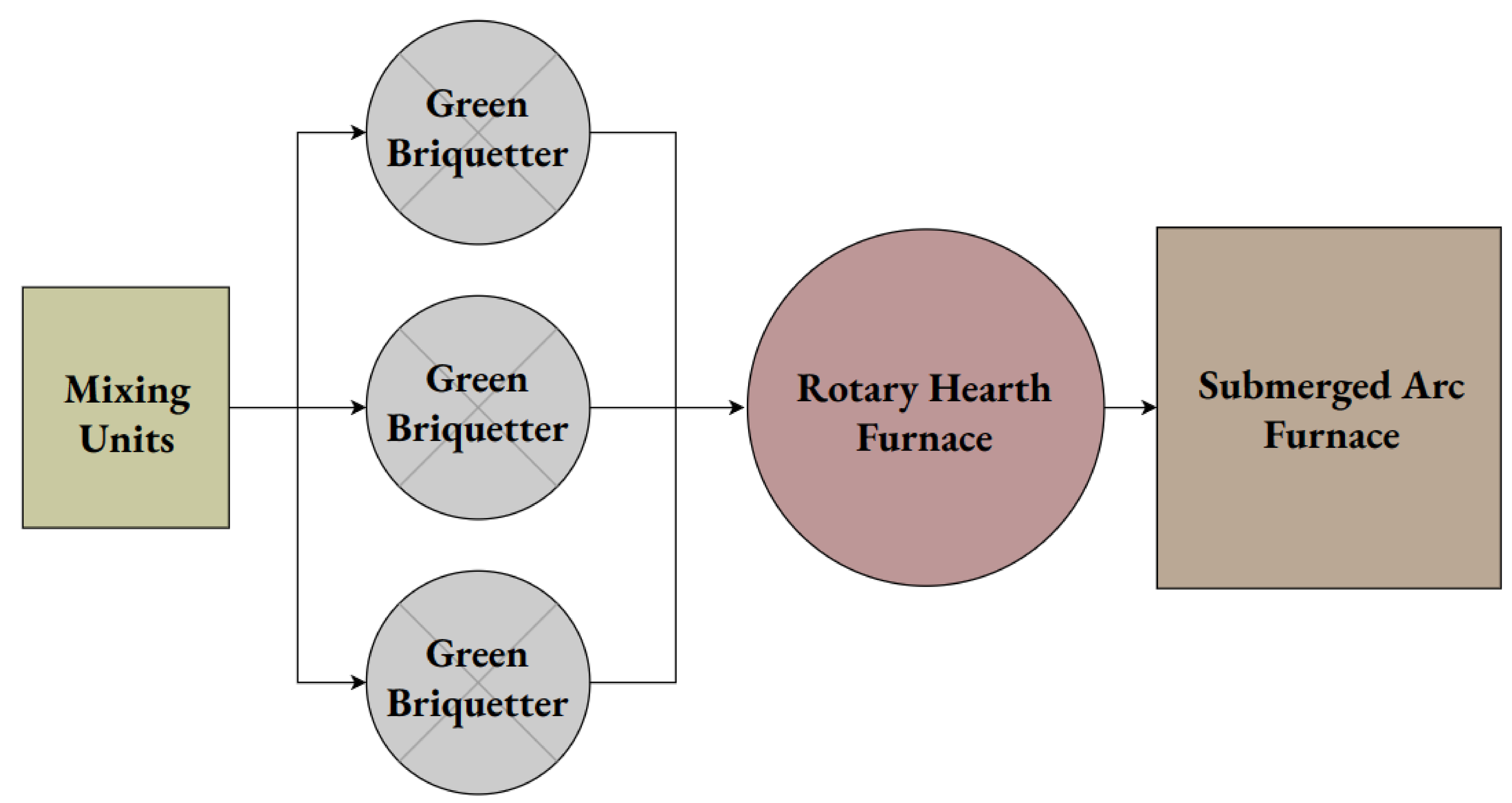
Control Group 1	Low Speed	High Speed	Control Group 2	Low Temp.	High Temp.
Temp: 15 °C Speed: 2.67 rpm Binder: Type 1	Temp: 15 °C Speed: 1.88 rpm Binder: Type 1	Temp: 15 °C Speed: 3.46 rpm Binder: Type 1	Temp: 15 °C Speed: 2.67 rpm Binder: Type 2	Temp: 1.3°C Speed: 2.67 rpm Binder: Type 2	Temp: 18 °C Speed: 2.67 rpm Binder: Type 2

Testing Methods

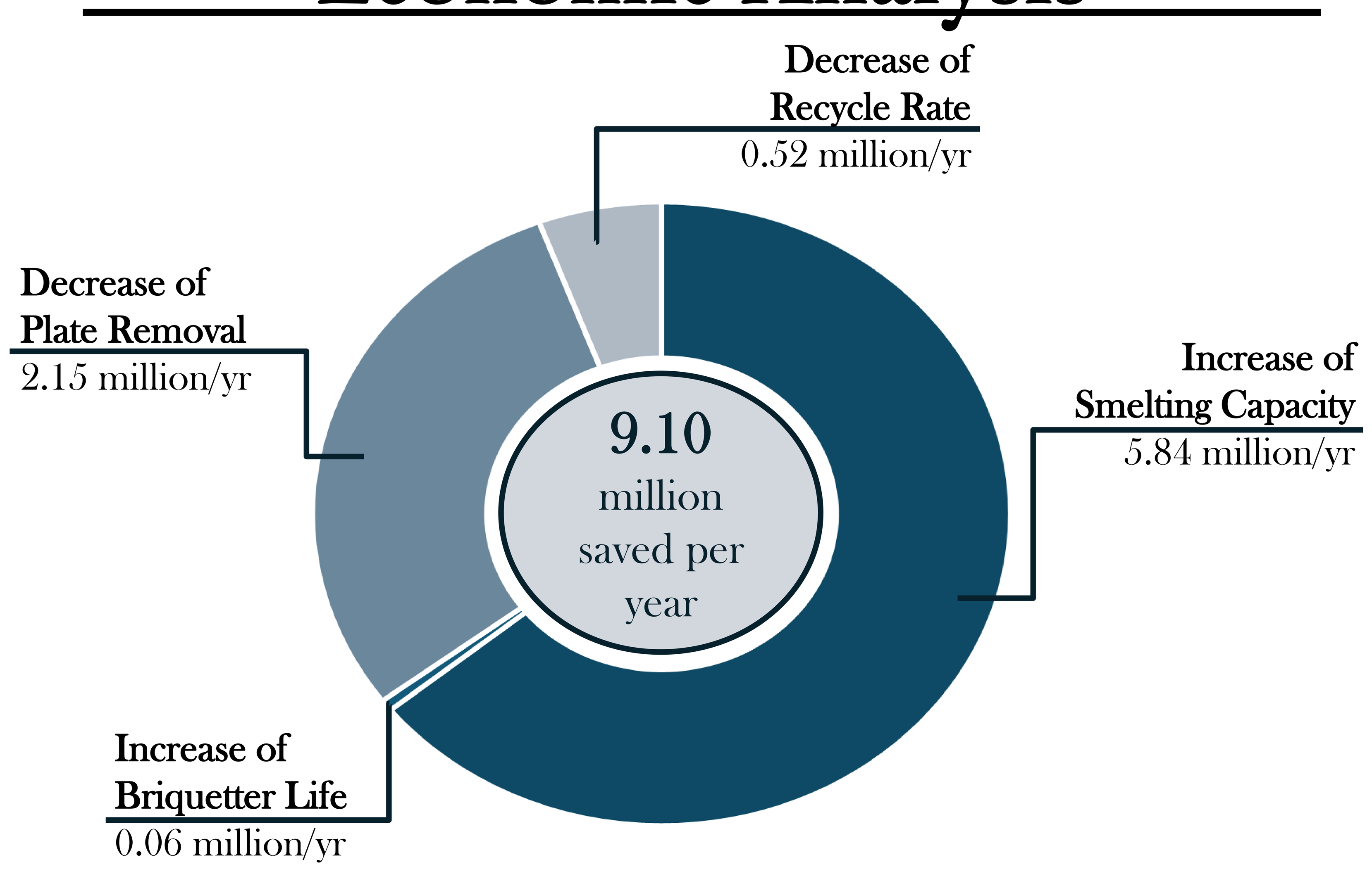
Briquette Strength	By using a hardness tester, multiple briquettes from each group were crushed using the instrument. The average hardness per test group was found and compared.
Moisture Content	Moisture content was found for multiple briquettes by quickly drying the sample with a moisture content analyzer. The percent of moisture was recorded and averaged per test group.
Microstructure Uniformity	Using a scanned electron microscope (SEM), the microstructures of multiple briquettes were analyzed and compared. Impurities and discontinuity was noted.

Optimum Briquettes

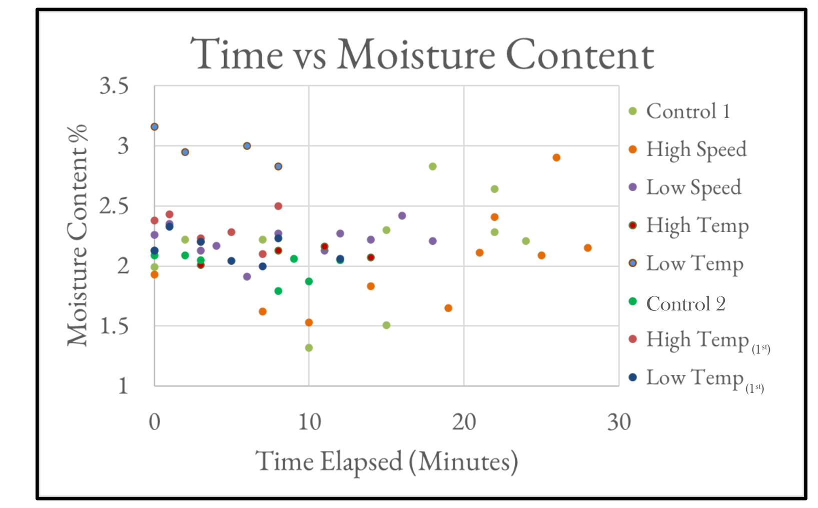
The optimum batch of briquettes for Iron Dynamic's downstream processes has a few ideal specifications, including, a strength measurement above fifteen pounds-force, a consistent microstructure, a moisture content below 2.5 %, and the lowest amount of dust production within the produced briquettes. The produced briquettes that most represented the ideal specifications were formed by decreasing the speed of the briquetter rolls while keeping the system's current temperature.



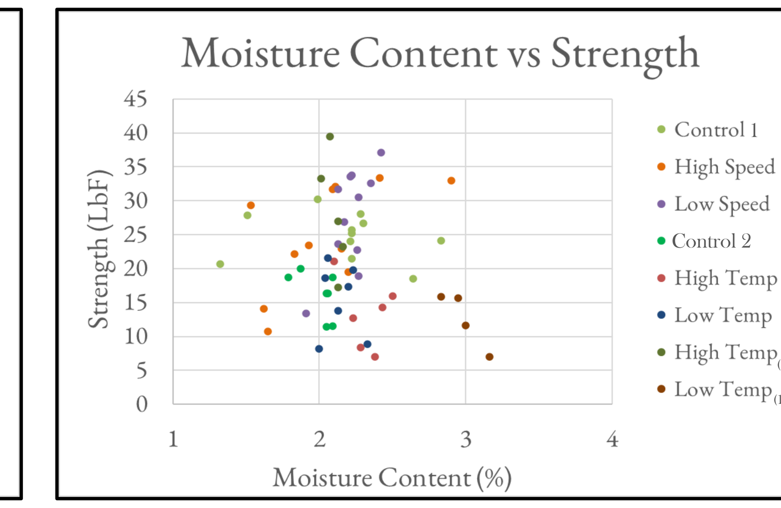
Economic Analysis



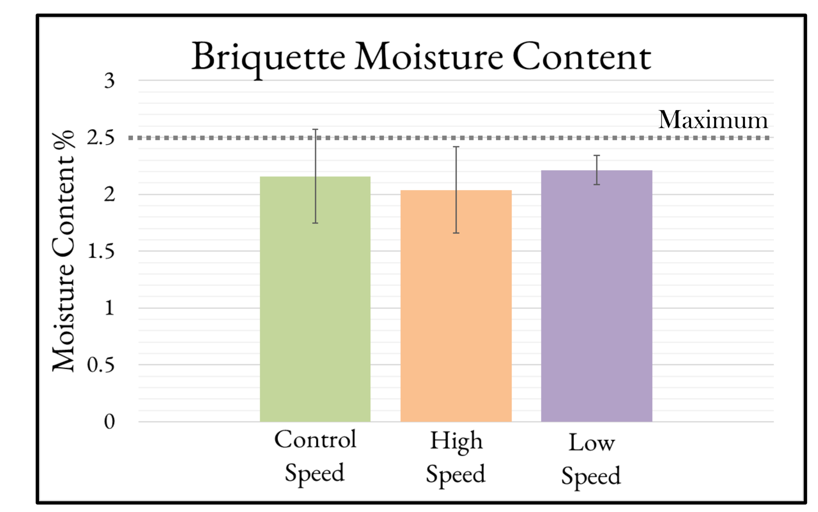
Data Analysis



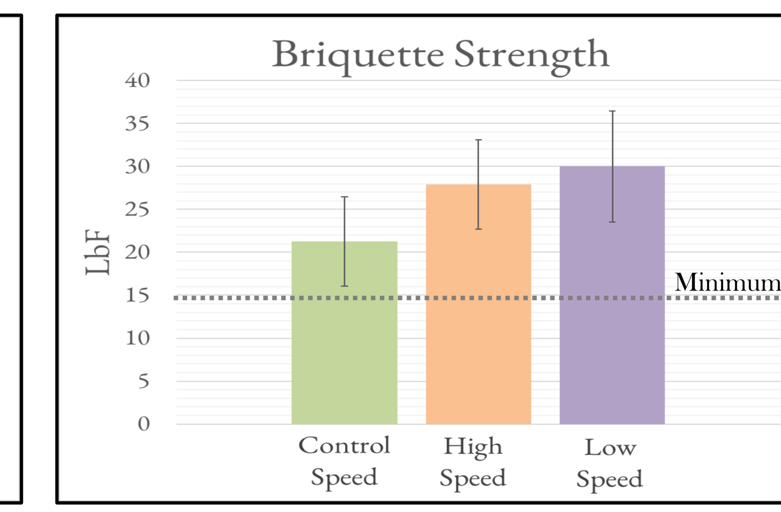
The chart above shows that the briquettes were not drying during our testing period. That means that all the data procured during testing was not affected by drying or loss of moisture.



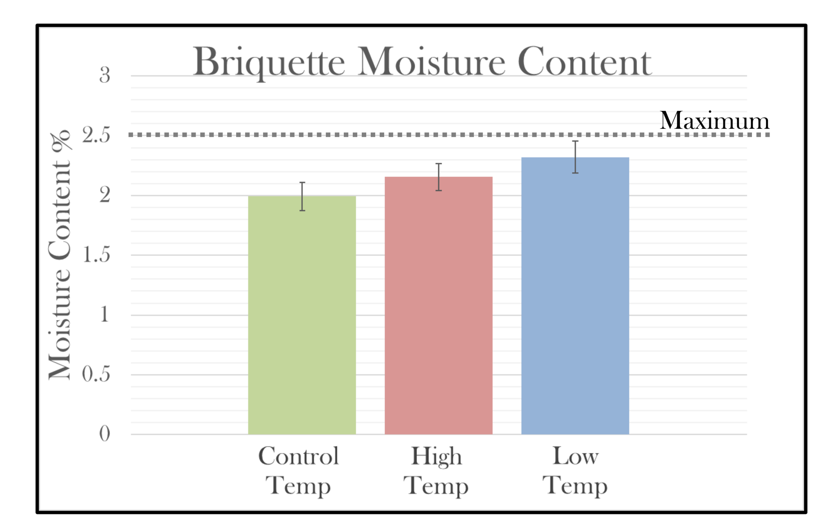
The chart above shows that the briquette's strength and moisture content had a direct inverse correlation. This was proposed as a possibility in pre-experiment discussion but needed to be confirmed.



The graph above shows the briquette moisture content data for control, high, and low speeds along with the maximum safe moisture content for Iron Dynamics's Rotary Hearth Furnace.



The graph above shows the briquette strength data for control, high, and low speeds along with the suggested minimum for strength to reduce breakability.



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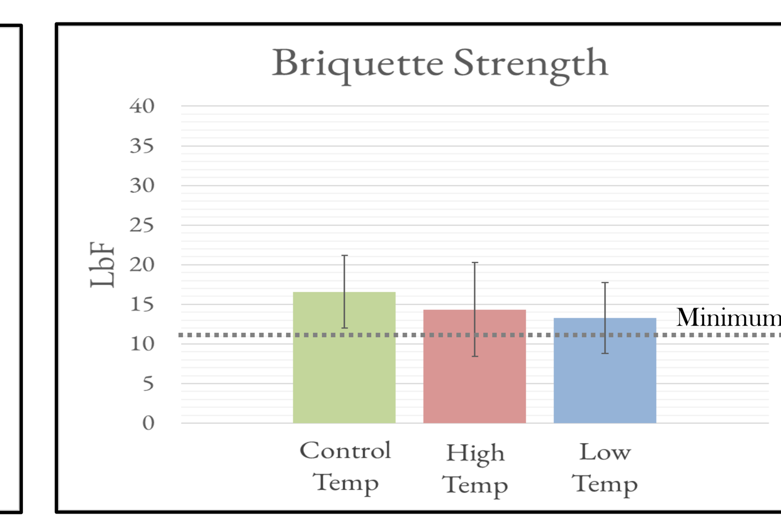

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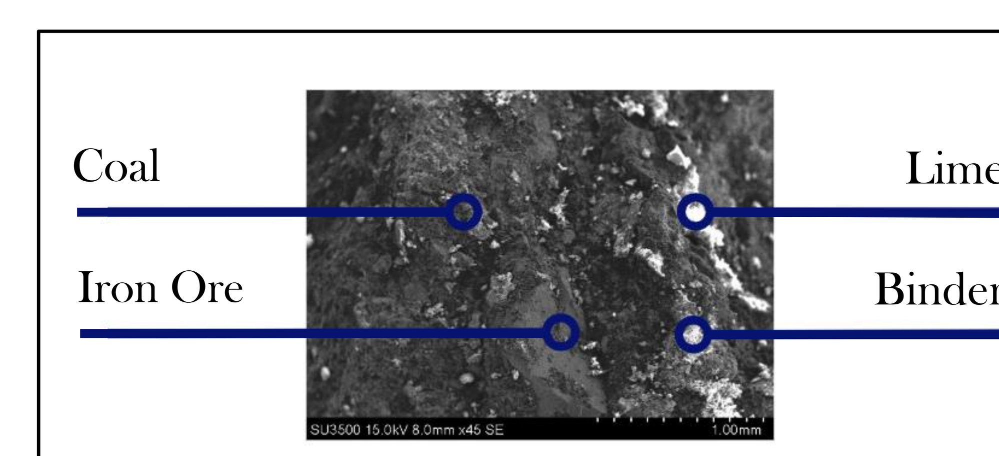

This labeled scanned electron microscope result shows the different materials utilized in making briquettes and the overall nonhomogeneous mixing that occurs. Multiple scanned electron microscope images were captured for each trial to insure appropriate mixing. A direct correlation was found between the distribution of large particle sizes and higher strength results.