Partnered with: ArcelorMittal

Team 5: Spectroscopic Separation & Sorting

Engineering Design 100

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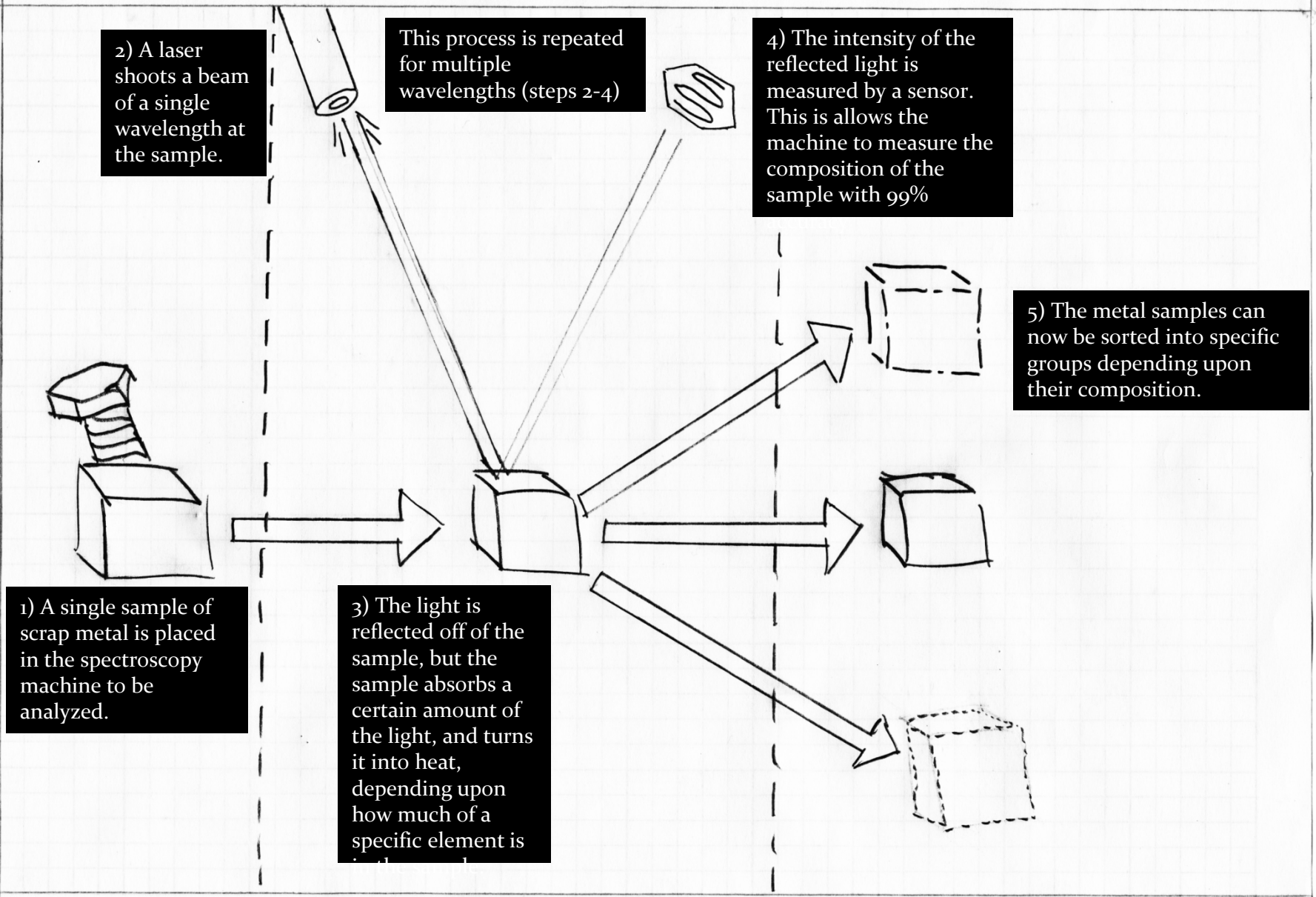
Two Priority Tasks

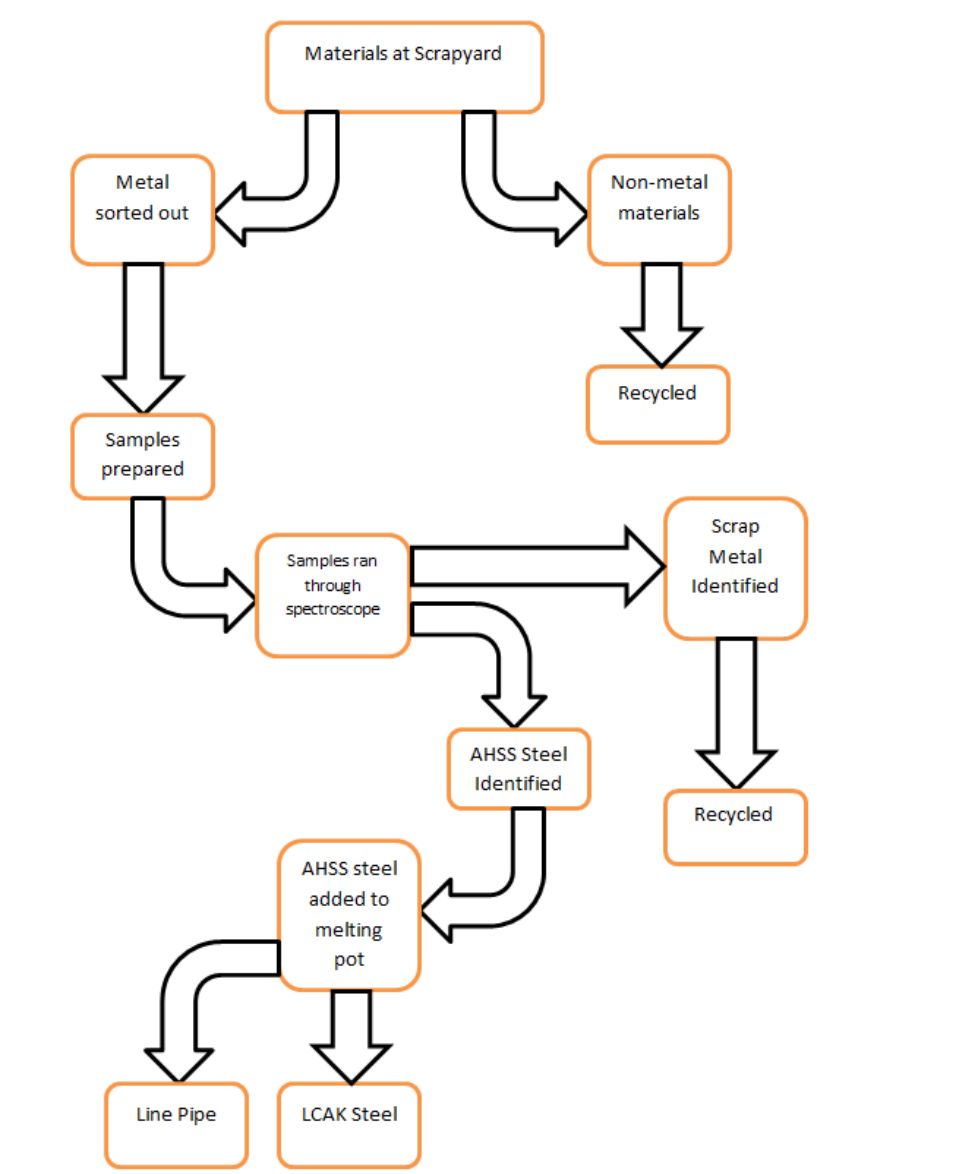
1. Priority Task: **Prevent Off-Chemistry Steel -- (Creating LCAK Steel)**
   - Create a scrap separation technique that will allow us to identify an accurate quantity of maximum scrap steel that can be thrown into the melting pot / oxidizable charge of Iron Oxide & Scrap mix
2. Secondary Task: **Decrease Alloy Costs -- (Creating Line Pipe)**
   - Calculate the maximum amount of scrap that can be implemented to create line pipe (which has a higher alloy content, particularly in Manganese, than LCAK)

Preliminary Solutions

- Hardness: Strength Testing
  - Standardization of Slabs
- Conductivity: Mass Spectrometer
  - Massive Magnetic Field, unreliable transfer of charge
- Multi-Step Chemical Analysis
  - Multi-chambered reactions, large complex, highly specialized, time consuming
- X-Ray Spectroscopy
  - Scanning Technique, somewhat lengthy procedure


2) A laser shoots a beam of a single wavelength at the sample.
This process is repeated for multiple wavelengths (steps 2-4)
4) The intensity of the reflected light is measured by a sensor. This is allows the machine to measure the composition of the sample with 99%
5) The metal samples can now be sorted into specific groups depending upon their composition.
1) A single sample of scrap metal is placed in the spectroscopy machine to be analyzed.
3) The light is reflected off of the sample, but the sample absorbs a certain amount of the light, and turns it into heat, depending upon how much of a specific element is

Process Diagram



The Proposed Solution

- The incredible accuracy of the spectroscopy process registers results reliable to 99% according to Thermo Scientific, manufacturer of spectroscope machines.
- Thermo Scientific ARL 4460 OES
- $12,000 analysis machines
- 50-second analysis

The Bottom Line

- The high accuracy allows a full 15% scrap charge of 99% pure AHSS.
- This automatic process can continue sorting metals according to AHSS, LCAK, Line Pipe, etc. and store indefinitely until needed.
- High Efficiency, most 'bang for your buck'
- Prepares you for the next 'AHSS' problem – spectroscopy allows you to identify any type of element or compound.

Overall Process

- The scrap material would begin at the scrapyard. The ferrous materials (steel, etc.) are then separated from the nonferrous materials (plastics, glass, etc.) using a magnetic separator. Once that separation is complete, samples are prepared from the ferrous metals to be ran through the spectroscope. The spectroscope will identify the metal and its alloy with 99% accuracy. This will allow us to identify the AHSS steel and separate it from all other metals. The AHSS steel can then be used to form LCAK steel, to form line pipe, or for anything else the company may desire.