CANFSA

Center for Advanced Non-Ferrous Structural Alloys
An Industry/University Cooperative Research Center

Project 62-L: Maximizing Scrap Recycling by Designing Cu Tolerant Steel Compositions

Semi-annual Spring Meeting

April 2022

- Students: Henry Geerlings, Lionel Promel (Mines)
- Faculty: Dr. Kester Clarke , Dr. Jonah Klemm-Toole, Dr. Amy Clarke, S. Seetharaman (Mines)
- Industrial Mentors: Paul Mason (ThermoCalc), Andrew Kustas (SNL)
- Other Participants: Evraz, Vallourec, Timken Steel, Gerdau, NREL

COLORADO SCHOOL OF MINES NSF IOWA STATE UNIVERSITY

Project 62-L: Maximizing Scrap Recycling by Designing Copper Tolerant Steel Compositions

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- Student: Henry Geerlings, Lionel Promel (Mines)
- Advisor: Kester Clarke, Amy Clarke, Jonah Klemm Toole (Mines)

Project Duration
PhD: August 2021 to August 2024

- Problem: Scrap steel recyclability is limited by the increasing amount of residual copper concentration in secondary steel.
- Objective: Increase amount of residual copper in steel that can be tolerated without causing hot shortness during hot forging.
- Benefit: Increasing copper tolerance in scrap steels would yield significant savings for steelmakers while modeling decarbonization efforts in a common metals process.

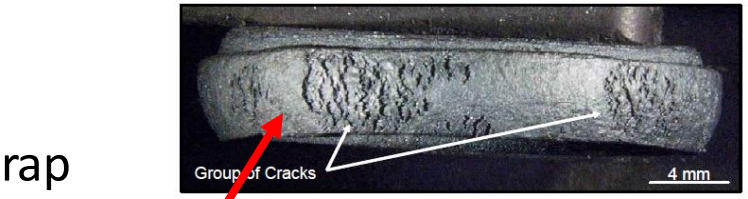
Recent Progress

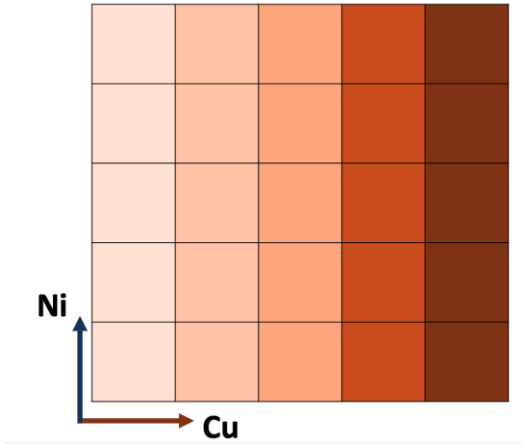
- Obtain 2 out of 4 steel products with varying copper contents.
- Scaffold review paper for hot shortness during TMP
- Measure chemistry and begin machining of samples
- Began Gleeble simulations on copper enriched steel products

Metrics		
Description	**% Complete**	**Status**
1. Literature review	35%	●
2. Material procurement	40%	●
3. Machining and related sample prep	15%	●
4. Gleeble, dilatometry, hot rolling trials	5%	●
5. Drafting of review paper	20%	●

Project and Poster Overview

- Primary goal of this work
  - Increase copper tolerance in secondary/scrap EAF steel products
  - CANFSA focused on Tasks 4-5
- Metallurgical lens
  - This is a hot shortness problem
    - Residual copper rejected from oxide can lead to cracking during hot forging
  - Exploring chemistries, microstructures, and heat treatments that can mitigate this
- Upcoming experiments
  - Compositionally graded AM build
- Come check us out!





Data and knowledge generation related to how scrap blend chemistry affects:

Task 1: Scrap supply chain analysis (year 1-3)
Cost and availability

Task 2: Melting in in EAF (year 1-3)

Task 3: Hot-shortness casting and direct hot charging (year 1-3)

Task 4: Hot-shortness during thermo-mechanical processing (year 1-3)

Task 5: Hot-shortness during Forming, coating and welding (year 1-3)

Task 6: Machine Learning Platform(year 2-3)

Task 7: Techno-economic analysis (year 2-3)

References

[1] L. Garza, C. Van Tyne, *Surface hot-shortness of 1045 forging steel with residual copper.* Journal of Materials Processing Technology, 2005.