Bachelor-/Student work

Mechanical Characterisation of Iron-Rich Metallurgical Residue Agglomerates via Biochar and Organic Binders

Keywords: Iron-containing residues; Biochar; Organic binder; Compressive strength; Circular metallurgy

Research Background:

The steel industry is constantly evolving towards a circular economy and carbon neutrality. The aim of this work is to valorise iron-rich residues (slag, dust, sludge) by producing self-reducing agglomerates using sustainable biochar

Challenges:

Direct charging of fine-grained residues in smelting furnaces is only feasible to a limited extent for technical reasons. Stable agglomerates are required that can withstand the mechanical stresses of transport and furnace charging.

1) Binding agent
   - Traditional cement-based binders: Low raw material loading and Increased slag volume
   - Feasible solution (Organic binder): Higher raw material loading and lower slag formation
2) Drying condition
   - Thermal sensitivity: Organic binders like starch and molasses require precise temperature control. Over-drying can lead to thermal degradation, while insufficient drying results in reduced bond strength
   - Porosity: The drying process must be optimised to ensure structural integrity while maintaining the internal porosity necessary for self-reduction reactions.

Student's Research Tasks

1) Recipe Optimisation: Find the optimal ratio of residue, biochar, and organic binders based on mass balances
2) Mechanical Testing: Evaluate mechanical properties and durability under various drying conditions
3) Self-reduction Simulation: Test the self-reduction ability using thermodynamic simulation software

Requirements

1) Academic Background: Metallurgy, Chemical or Materials Science/Engineering
2) Thermodynamic knowledge
3) Enjoy practical work

The work will take three months to complete. After consultation with the supervisor, the content can be adapted for use in a dissertation or master's thesis. You can start immediately.

Further Information:

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