Briquette Feed Compressibility Optimization

Alex Davidson, Jake Doyle, Annamarie Hartman
Chemical Engineering
Advisors: Dr. Jacob Borden

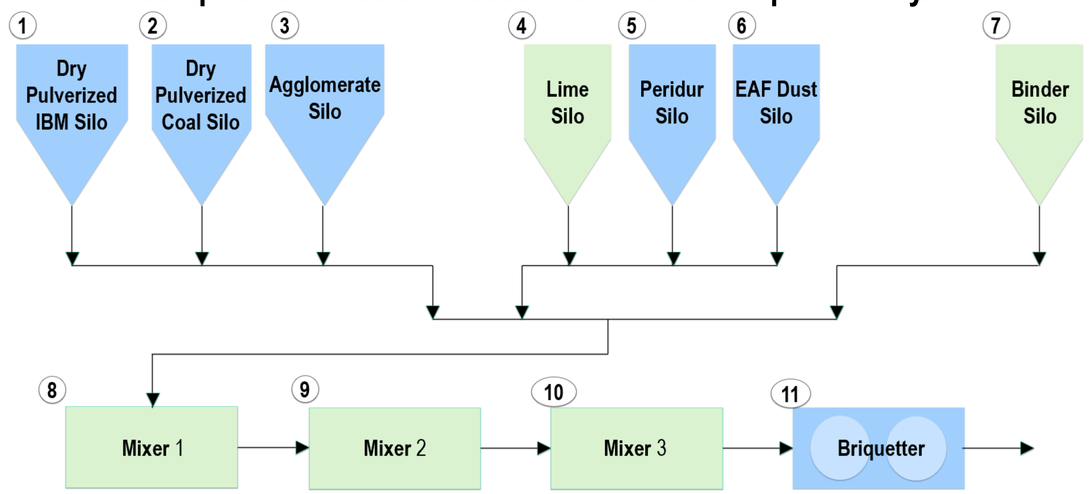
Introduction

The Iron Dynamics Department of Steel Dynamics produces briquettes of "green" unreduced iron to later be reduced and further melted to nearly pure molten iron.

Through identifying the lime types and composition that optimizes the briquette feed-mixture compressibility, we hope to achieve an increase in the process throughput capabilities, thus increasing the profitability and efficacy of the iron making process.

Objective

Characterization of binder-lime molecular interactions and optimization of lime composition effects on cost and mixture compressibility.



Economics

Lime Costs:

- Hydrated Lime (H)
  - **$220/ton**
- Dolomitic Lime (D)
  - **$420/ton**
- Calcium Carbonate (C)
  - **$180/ton**

Lime Composition	Cost ($/ton)	Est. Cost/yr ($)
100% H	220	1.73 million
100% D	420	3.31 million
50% D 50% H	320	2.52 million
50% C 50% H	200	1.58 million
50% C 50% D	300	2.36 million

Methods

- Generate mixtures of varying lime types
  - Hydrated lime
  - Dolomitic lime
  - Calcium carbonate
- Mix dry materials in the mixer for 5 minutes
- Heat binder & water to 90 F
- Add binder and water
- Mix for five additional minutes
- Perform compression testing
  - 100 cm^3 sample
  - 57 lbs. force applied

Results

Lime Types:

- Hydrated Lime (H)
- Dolomitic Lime (D)
- Calcium Carbonate (C)

Lime Composition	Pressure (psi)	$\Delta\rho_i$ (lb/ft^3 psi)	$\Delta\rho_{aged}$
100% H	72.6	0.28	0.10
100% D	72.6	0.34	0.24
50% D 50% H	72.6	0.27	0.20
50% C 50% H	72.6	0.33	0.26
50% C 50% D	72.6	0.41	0.30

**Mixes were aged 6 days prior to retesting*

Compressibility:
50% Dolomitic
50% $CaCO_3$
Immediate Use
Economics:
50% Hydrated
50% $CaCO_3$
Recommended:
75% Hydrated
25% $CaCO_3$
Immediate Use

Conclusions

The mixture yielding the highest compressibility is not feasible economically and would require too drastic a change to the chemical process.

As such, it is recommended to alter mix conditions from the current 100% hydrated lime to a mixture of 75% hydrated lime and 25% calcium carbonate at the current ratio of 1.30 weight percent of the total feed mixture. This would reduce the lime cost from $220/ton to $210/ton while increasing the compressibility of the feed mixture, improving briquetting rate and quality.

Acknowledgements

We would like to thank our SDI project mentors, Lachlan Richards, Jarrell Crutcher, and Stephanie Anderson for their support throughout the process.