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MATERIALS AND MANUFACTURING ACADEMY
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The Effect of Coal Volatile Matter on Blast Furnace Top Gas Carbon

Project Background

- Increasing the efficiency of coal injection fuelling of the blast furnace, reduces cost and improves environmental impact from ironmaking
- Efficient combustion relies on total consumption before leaving the raceway as per figure 1. Some coal leaves the furnace in the flue dust as char as per figure 2
- Identifying and quantifying carbon sources present to make improvements in coal injection and combustion conditions within the furnace

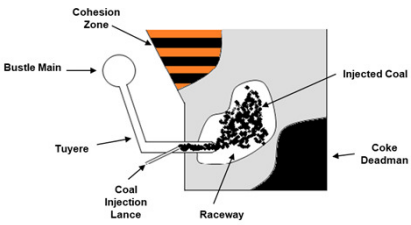


Figure 1: Schematic of blast furnace raceway

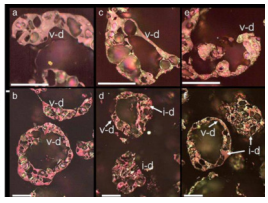
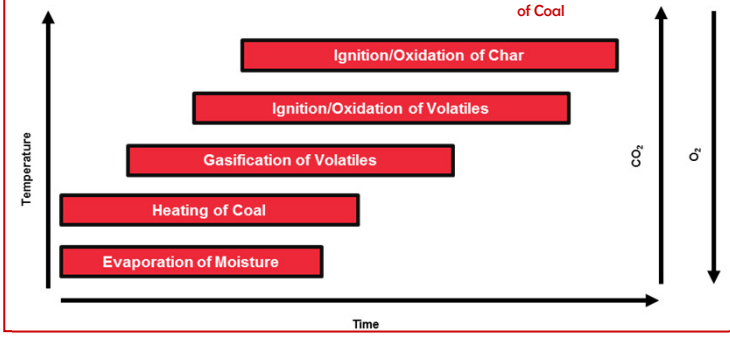


Figure 2: Char particles in flue dust as identified with optical microscopy with lambda retarding and polarised light. (Pohlmann, 2010)

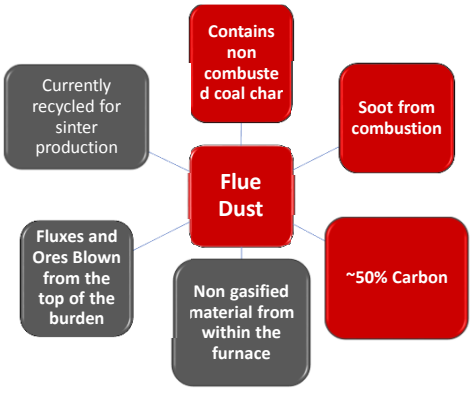
Coal Injection

- Injection coal is processed at the granulated coal injection plant.
- Reduces the fuel cost of the furnace
- Cools the flame front of the furnace in the raceway.
- Allows for oxygen enrichment.
- Increases productivity of the furnace
- Improves overall furnace efficiency
- Required to fully gasify within the furnace as per figure 3. Otherwise it leaves the furnace as dust in the gas stream

Figure 3: The combustion evolution of Coal



Flue Dust Constituents



Thermogravimetric Analysis

- Activity profile of a flue dust sample in figure 4
- Heating profile can detect the presence of two forms of carbon
- Despite long testing and hold times, there is an overlap between carbon types. MPI Normalisation to reduce this effect
- Quantification will rely on further testing of potential flue dust constituents.
- Carbon attributed to mass loss using FTIR – CO_2 detected during combustion

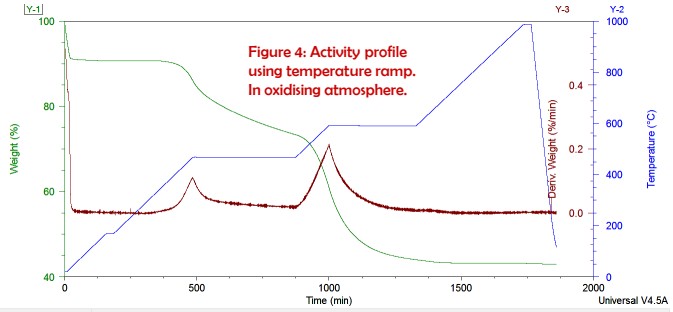


Figure 4: Activity profile using temperature ramp. In oxidising atmosphere.

Interpretation of Results

- Figure 5 shows the constituents of flue dust on a given day
- Cases of high, low order carbon (Coal Char) to be further investigated.

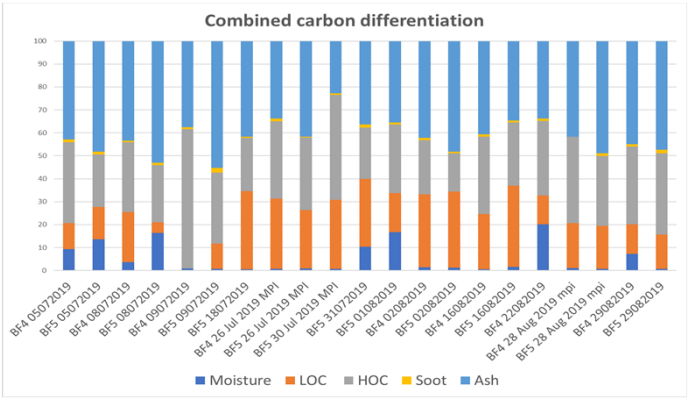


Figure 5: Flue dust constituents as per thermogravimetric.

SEM EDS Analysis

- Used to detect alternative constituents in the flue dust as per figure 6
- Help to evaluate the TGA data and understand mechanisms of reaction during test cycle

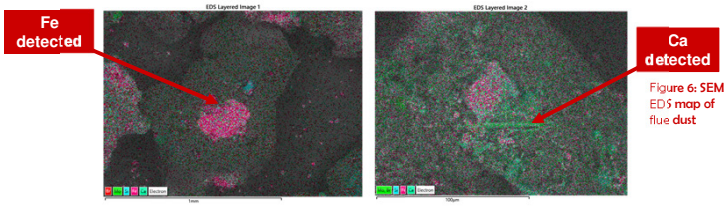


Figure 6: SEM EDS map of flue dust

Ongoing and Future Work

- Correlate data with live plant data
- Identify total carbon output on the furnace
- Tracking Fe/C ratio in the furnace
- Experiment the effect of CO_2 on the analysis
- XRD work ongoing for graphite identification

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