SUCCESS STORY

FFG
Promoting Innovation.

K1-MET
Competence Center for Excellent Technologies in Advanced Metallurgical and Environmental Process Development

Programm: COMET - Competence Centers for Excellent Technologies

Programme line: COMET-Centre (K1)

Type of project: Project 1.2, 01.07.2015 - 30.06.2019, strategic, multi-firm

P1.2 - REDUCING AGENTS

TOWARDS COMPREHENSIVE PULVERIZED COAL EVALUATION FOR BLAST FURNACE INJECTION

Project 1.2 is a 100 % strategic project and focuses on the identification of suitable raw materials to be utilized as reducing agents in the ironmaking process.

Injection of pulverized coal (Pulverized Coal Injection = PCI) as an auxiliary reducing agent is a prominent way to increase both, the economic, and the operational efficiency of blast furnaces and smelter gasifiers. However, the behavior of PCI coals in blast furnaces and smelter gasifiers is still under research and not fully understood. The number of possible influencing parameters is large and includes e.g. chemical and elemental composition, ash and impurity content, and particle size. There is no publicly available method to identify suitable coals for PCI to iron ore reduction plants under blast furnace conditions.

Identifying key parameters for thermo-chemical coal conversion was the first step of project 1.2. Therefore, modelling studies of coal conversion in the raceway of a blast furnace were performed.

Fig. 1 visualizes such a study resulting in the identification of following key parameters for thermo-chemical coal conversion in the raceway of a blast furnace:

- (Blast) temperature 1 200 °C
- Heating rate 10^5 - 10^6 K/s
- Pressure up to 5 bar
- Gas-particle relative velocity up to 150 m/s
- Residence time 20 - 50 ms

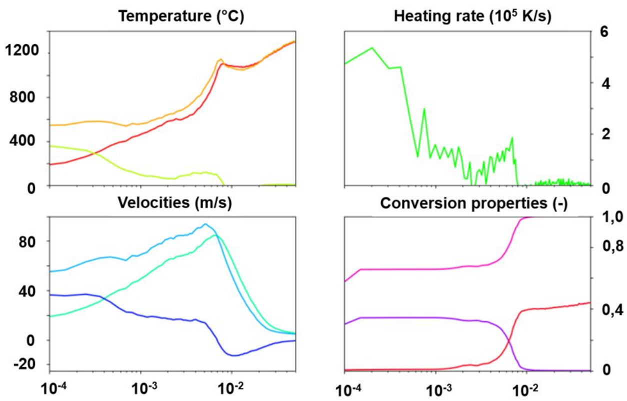

Figure 1: Modelling results of pulverized coal conversion behaviour in the raceway zone in dependence on reaction time Harasek, M., Maier, C.

The second step was to gather current concepts for characterizing pulverized coal for an injection into the blast furnace from current literature.
Reactor types, which have been found to be commonly used are drop-tube furnaces (DTF), flow reactors (FR), injection rigs (IR), thermo-gravimetric analysis (TGA), and wire mesh reactors (WR). A thorough review of the reactors revealed, that none of them is capable to fully reproduce raceway conditions and are therefore at the risk of neglecting important conversion phenomena.

As a result, a new reactor concept has been developed, which is capable to reproduce raceway conditions.

Impact and effects

The new concept is a mixture between DTF and FR. The key element to achieve the required heating rates is a porous burner holding a flat flame (cf. **Fig. 2**). The alternative reducing agents are introduced through an injection hole in the burner's center, while hot co-flow surrounds the burner.

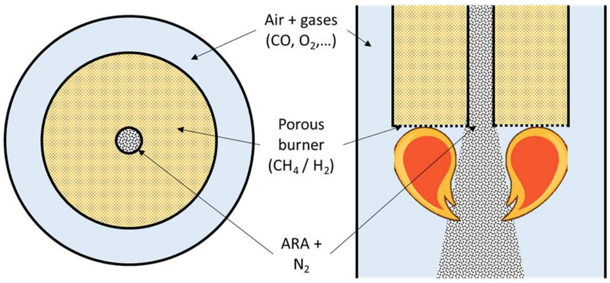

Figure 2: Reactordesign © TU Wien

Sampling ports along the reactor length allow time resolved burnout ratio measurements, while the coflow ensures short residence times. Residual particles are quenched and sampled at the reactor exit. Sight glasses provide optical access along the center axis for in-situ conversion characterization. The whole reactor shall be covered by a pressure vessel to allow absolute pressures up to 5 bars.

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