Calciner Technology for Oxyfuel Process

Conclusions

- Higher temperature is required for oxyfuel calcination in comparison to existing operational experience of industrial calciners operated with air;
- Average temperature increase is in the range 50-70 K.
- The actual level of temperature increase depends on the heat transfer characteristics. The entrained calcination tests performed during this study showed that a temperature up to 940 °C is required.
- The short term tests did not show increased tendency of raw meal coating/sintering even at elevated oxyfuel temperature. However, this phenomenon needs further study regarding long term behaviour in industrial scale calciners.

Calcination Process for Cement Clinker Production:
- Chemical decomposition of limestone; endothermic reaction
  \[ \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2 \]
- Equilibrium temperature: depends on partial pressure of \( \text{CO}_2 \), which changes from air fired process to oxyfuel process from 20 to 80 vol.-%

WP8-Research

Experimental Setup for calcination in industrial relevant oxyfuel conditions

- Tests performed in an electrically heated entrained flow reactor (see Fig. 1)
- Two calciner operation scenarios for:
  - firing with air: 20 vol.-% \( \text{CO}_2 \) (AF) and oxyfuel process conditions: 80 vol.-% \( \text{CO}_2 \) (OF)
  - Heat input either electrically heated (w/o fuel) or with addition of fuel to the calciner (w/ fuel)

Test Results

- The temperature increase observed for oxyfuel calcination (Fig. 2) is in line with findings in comparable studies
- Lower calcination temperature with(w/) fuel is due to improved heat transfer (Fig. 2)
- Increased temperature is mandatory. An increase in residence time alone could not improve calcination (Fig. 3)

Industrial Oxyfuel Calciner Operation

- Operational issues at elevated oxyfuel temperature requires long term investigation to evaluate the impact of sulfur and alkali cycles (associated with fuel impurities) existing in the preheater-calciner-kiln system
- To keep the calciner outlet temperature in the range of existing operational experience (≤ 900°C) there are two possible solutions :
  - Shifting a certain level of calcination towards the kiln entrance
  - Improving the heat transfer to raw meal particles inside the calciner itself to lower the difference between equilibrium temperature and actual entrained temperature required for calcination