# Cement oxyfuel technology from a supplier perspective

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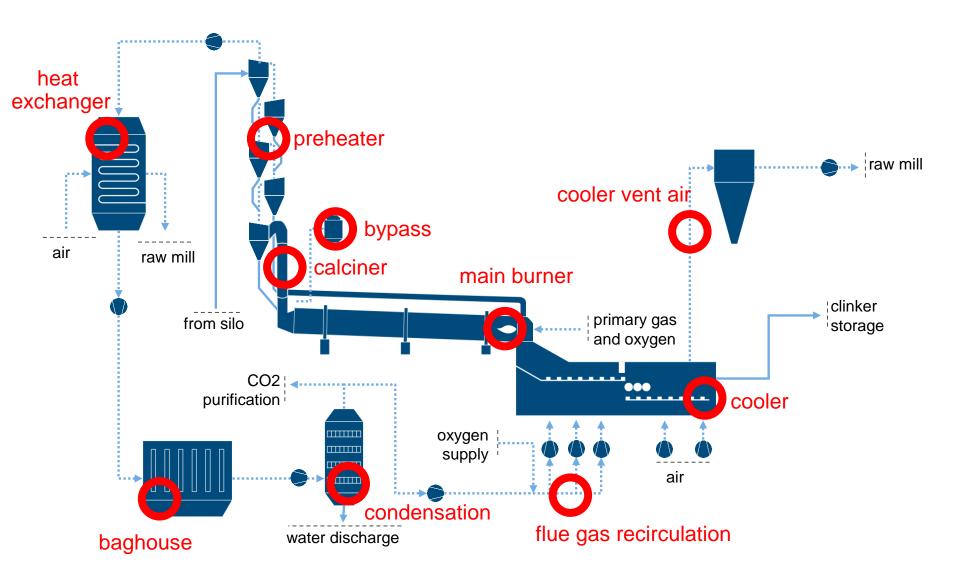


"Oxyfuel clinker burning – substitute nitrogen by carbon dioxide, everything else stays the same..."

"We are ready to build a plant and everything will be a bit different."

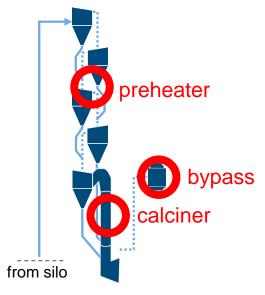


# Oxyfuel clinker kiln





#### Preheater and calciner

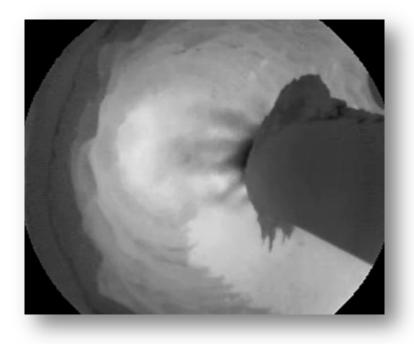


- Increased heat capacity alters the preheater temperature profile
- Retrofitted plants require a flue gas recirculation for temperature control and to ensure the material lifting
- Calciner temperature is raised by 50...100 K due to increased CO<sub>2</sub> partial pressure
- Acceptable sulphur and chlorine levels will change
- Bypass rate needs to be adjusted
- Bypass gas should be returned to the process



## Rotary kiln and main burner





- Existing burner design can be used for oxyfuel as well
- Recirculated flue gas is used for fuel conveying
- Reduced recirculation rate could require fuel shift from the main burner to the calciner

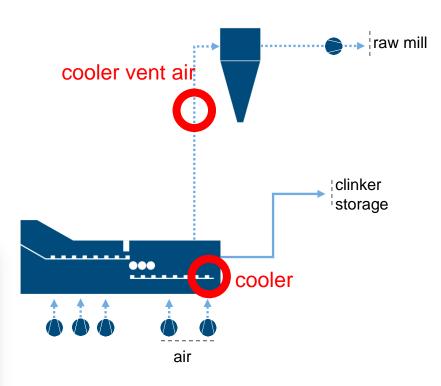


#### Clinker cooler

- Cooler vent air is utilized for raw grinding
- Grate area of cooler is separated into CO<sub>2</sub> and air compartment.
- Air must not enter the CO<sub>2</sub> section

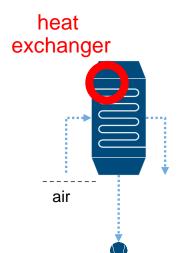
Modified control loop for cooling

fans

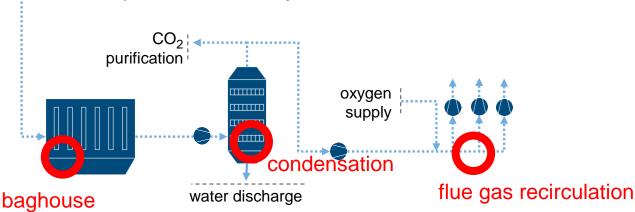




### Flue gas treatment and recirculation



- Excess heat from the raw gas is transferred to the raw mill or WHRPG via heat exchanger
- Recirculated flue gas is cleaned and dried
- Additional fans reduce air inleakage
- Recirculation gas cooling reduces the plant efficiency

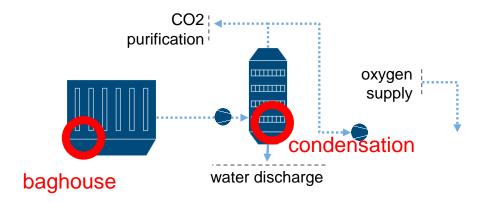






#### Process control and utilities

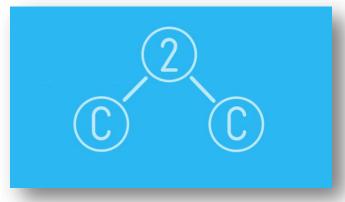
- Oxyfuel clinker line requires two grids for pressurized air and pressurized CO<sub>2</sub> (for air cannons, baghouse cleaning, fuel conveying etc.)
- For startup, fresh air is used until sufficient flue gas can be recirculated
- Reducing the recirculation rate will increase CO<sub>2</sub> concentration and make the process control easier
- Necessary auxiliary equipment is state-of-the-art and available on market





# CO<sub>2</sub> utilization

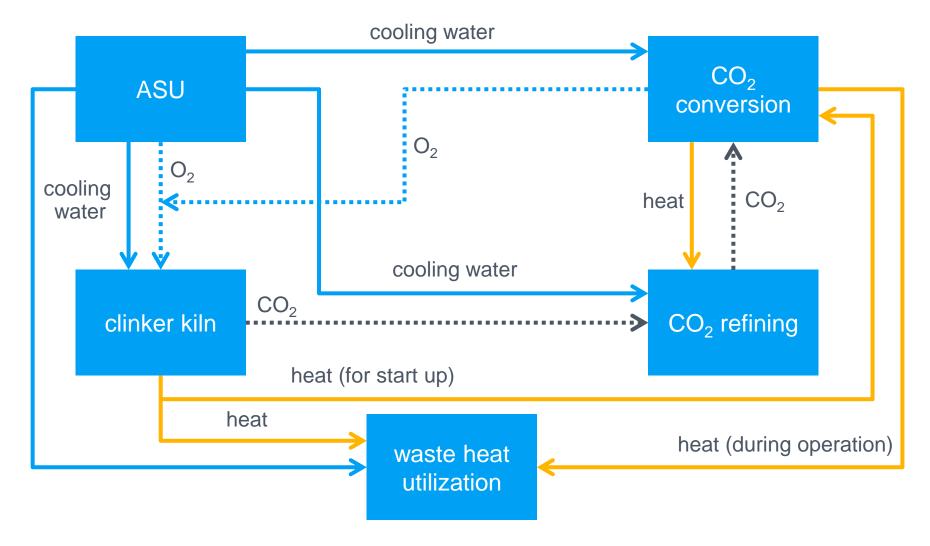
- CO<sub>2</sub> utilization often cause strict limits on certain gas components (SO<sub>x</sub>, HCl, HF, heavy metals)
- Subsequent utilization may have an impact on the oxyfuel process design due to
  - Possible heat integration
  - Hydrogen production also releases oxygen which could be used in the oxyfuel kiln
- Overall optimization of the CCU chain could cause increased energy use or fuel cost for clinker burning due to
  - Higher bypass rates
  - Flue gas limits



thyssenkrupp Carbon2Chem project



## Integration potentials





## Summary and outlook

- Retrofitting existing plants is technically viable
- All unit operations are well proven technology

As the complete plant is affected by the oxyfuel operation, the experience

from a first demonstration plant will be quite important

 Demo Plant experience will enable to test optimization approaches and will be beneficial for the layout of new oxyfuel project.

