CO2GeoNet winter webinar - 2nd February

Calcium Looping technology demonstration in industrial environment: status of the CLEANKER pilot plant

Fulvio Canonico
Buzzi Unicem SpA
Buzzi Unicem SpA – Cement plants location and capacity

Cement plants location and capacity

As of 31 December 2019

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Increased use of alternative fuels

- Technology already demonstrated and widely developed
- Depend on availability of secondary fuels
- Authorisation and social acceptance are crucial
- Positive economic effect on the clinker making process
- The quality of the clinker need to be verified

Reduction of the clinker content in cement

- Technology already demonstrated and widely developed
- Depend on the availability of Supplementary Cementitious Materials
- Standardisation and Concrete exposition classes need to be verified
- Durability aspects of concrete need to be verified
- Innovative SCMs and low clinker cements are under investigation (calcined clay, CEM II/C and CEM VI)

Ultra High Performances Concrete (UHPC)

- High strengths cement proposed to reduce the size of concrete structures (higher dosage of cement/m³ but less volume of concrete)
- Innovative admixtures
- Innovative «fabbrication» technologies

Carbon Capture and Storage

Approach for CO₂ reduction in cement sector
Decarbonation of cement industry

Summary Carbon Capture and Storage in cement plant

• Main technologies for CO₂ capture in cement plants:
  o Post-combustion solvent systems
  o Oxyfuel
  o Calcium looping

• CLEANKER project
  o Project objectives
  o The consortium
  o CaL integrated configuration
  o CLEANKER demo system
  o CLEANKER project timeline
  o CLEANKER communication and dissemination strategies
Main technologies for CO₂ capture in cement plants

**Post-combustion capture by solvents**

- CO₂ capture by solvents
- Heat recovery
- 

**Oxyfuel combustion**

- Oxyfuel combustion
- 

**Calcium Looping**

- CO₂ lean flue gas
- CO₂ rich gas to sequestration
- Heat
- CaO

**Calcium Looping – tail end**

- CO₂ capture by solvents
- Heat recovery
- 

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Main technologies for CO\textsubscript{2} capture in cement plants

Calcium Looping

- **Integrated CaL:**
  - CaL carbonator highly integrated within the preheater, captures CO\textsubscript{2} from rotary kiln gas
  - CaL calciner coincides with the cement kiln pre-calciner -> no double calcination, lower fuel consumption
  - Calcined raw meal as CO\textsubscript{2} sorbent in the carbonator instead of high purity limestone
  - Sorbent has small particle size (d\textsubscript{50}=10-20 μm) -> entrained flow reactors

Turrado et al., 2018. Ind Eng Chem Res, 57, 13372-13380.
De Lena et al., 2019. Int J Greenh Gas Control, 82, 244-260.
The consortium of Cleanker project

Starting date: October 1st 2017
Duration: 4 years
Total budget: € 9.237.851,25
UE co-financing: € 8.972.201,25
Chinese government founding: 265.650 €
Partner: 13 from 5 EU member states + Switzerland and China
Calcium looping in cement industry – integrated configuration

**CaL cement plant**

**CO2 to storage or utilization**

- **Calciner:**
  - CaCO$_3$ (fresh + from carbonator) + heat \(\rightarrow\) CaO + CO$_2$
  - Raw meal CaCO$_3$
  - Flue gas (poor in CO$_2$) to the environment

- **Pre-calciner:**
  - CaCO$_3$ + heat \(\rightarrow\) CaO + CO$_2$

- **Carbonator:**
  - CaO (from calciner) + CO$_2$ (from kiln fuel) \(\rightarrow\) CaCO$_3$
  - Recarbonated sorbent (CaCO$_3$ - rich) + fresh preheated raw meal \(\rightarrow\) calciner

- **Rotary kiln:**
  - CaO (from calciner) + heat \(\rightarrow\) clinker + flue gas
  - Clinker cooler
  - Clinker to rotary kiln (CaO-rich)

- **Flue gas (with CO$_2$) to environment**
- **Existing pre-heating tower**

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CLEANKER project

CLEANKER demo system

Preheater tower
CLEANKER – timeline

17-18 October 2017
Kick-off meeting (Piacenza)

July 2018
Raw meal characterization

June 2018
Measuring points and instrumentation

July 2018
Final Plant layout

2017

2018

2019

2020

2021

March 2020
Erection

November 2020
Running tests

March 2019
Main items fabrication

September 2020
Inspection

April 2021
Casting concrete results and full economic analysis of cement plant with CaL

September 2021
Final conclusions

30th September 2021
The demo plant in place at Vernasca plant Buzzi Unicem (Italy)
Opening event – 9° October at Vernasca plant Buzzi Unicem (Italy)
CLEANKER – Communication and dissemination strategy

www.cleanker.eu

https://www.youtube.com/watch?v=7X8YJeR65cM&t=33s

26° August 2020, RAI1, SUperQuark, Piero Angela - https://www.youtube.com/watch?v=oQcrWfrBFJg

CLEANKER community in Zenodo: https://zenodo.org/communities/cleanker?page=1&size=20

https://www.youtube.com/watch?v=RlXDjW LJPrA
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www.cleanker.eu
Twitter: @CLEANKER_H2020
LinkedIn: www.linkedin.com/company/14834346

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