Leilac

Low Emissions Intensity Lime and Cement

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654465

LEILAC overview

October 2019

- Around 60% of total CO_2 emissions from the cement and lime industries are released directly, and unavoidably, from the processing of limestone:

$$Ca\,CO_3 \xrightarrow{\text{Heat}} CaO + CO_2$$

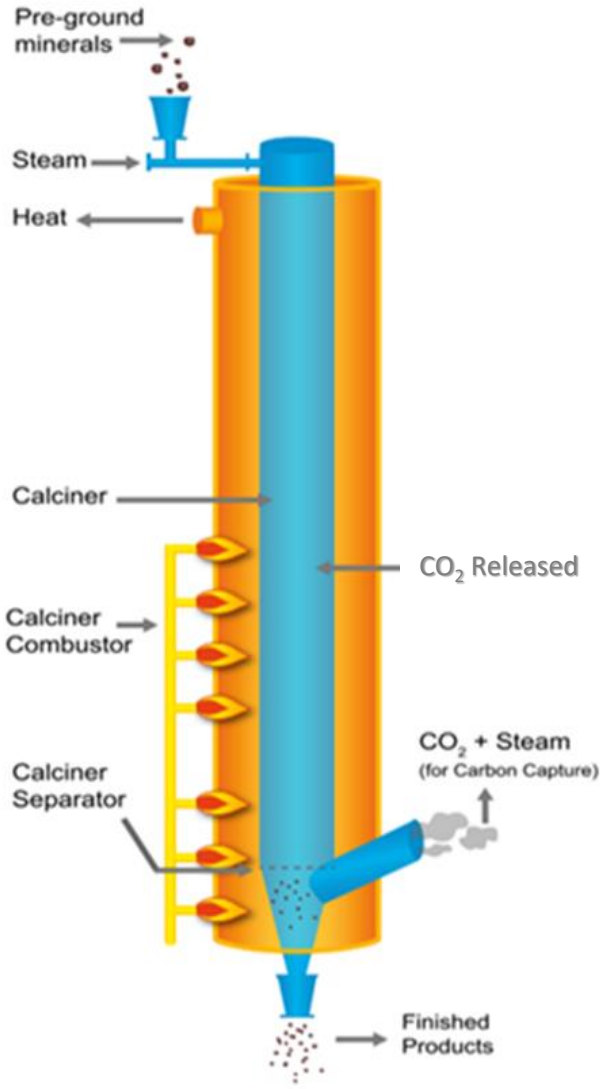
1 Tonne Limestone	*~0.56 Tonne Lime*	*~0.44 Tonne CO_2*

- CCS will need to be applied to 59% of European cement plants to meet the EU's emission reduction target

- The cement and lime industries are under intense competitive and cost pressures

Calix's Patented Direct Separation Technology

- Indirect heating through central tube
- Direct separation of process-related CO_2
- Current plant at Bacchus Marsh – Victoria, Australia
- 22m tube length, calcines magnesite to (very high surface area) magnesium oxide
- 25kTpa product capacity



The LEILAC (Low Emissions Intensity Lime And Cement) Project Vision is to future-proof the cement and lime industries without significant impact on operability, capital intensity or efficiency…

Planned pilot plant in Lixhe, Belgium

- 95% direct separation of pure CO_2
- Lime application 8tph input
- Cement application 10tph

€12m H2020 grant plus € 9m in-kind

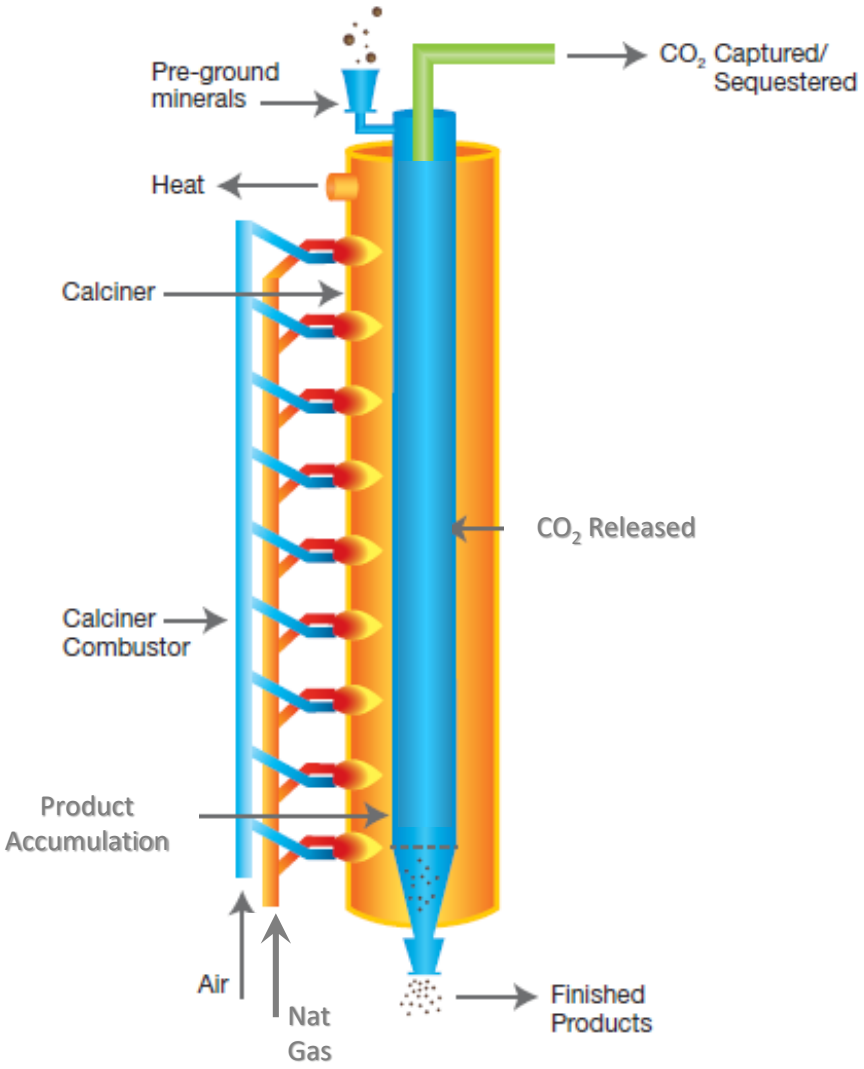
- 5-year project, started in 2016

LEILAC Consortium

External Advisory Board

Key challenges being addressed in LEILAC…

- Scale-up of temperature (tube length to 34m)
- Corrosion and scale formation
- Calcination level and throughput
- Capital cost of the pilot
- Future scale-up and integration studies

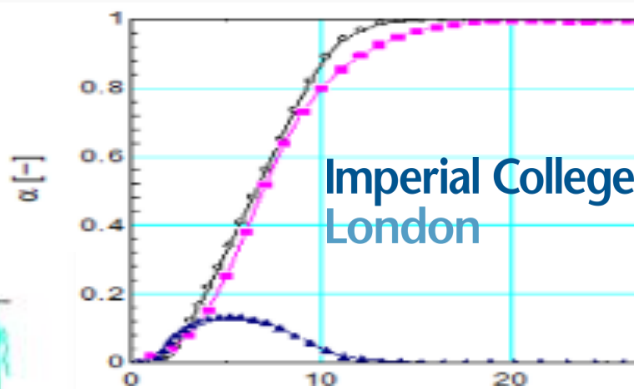


Successfully reduced all the **major risks**:

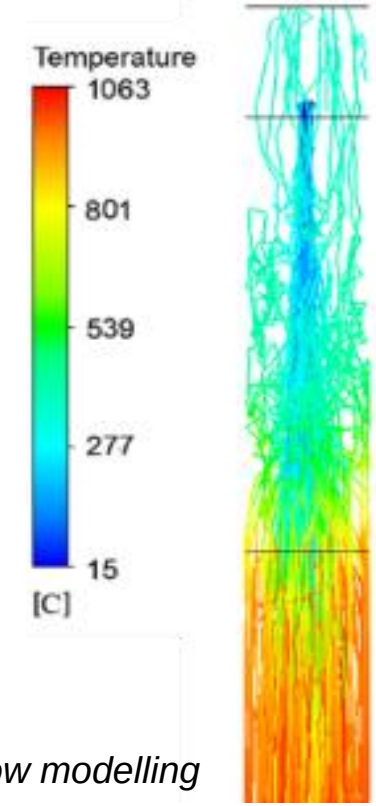
- A good understanding and characterisation of the meals
- Confidence in the design and outputs, based on significant process, kinetics, and CFD modelling and physical verification
- Informed choices of materials and equipment for the reactor
- Understanding of the corrosion and scale risk and development of mitigation strategies

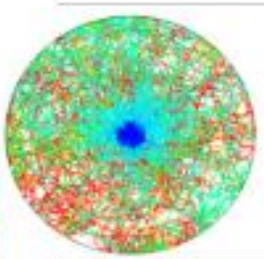
TNO innovation for life

Tube materials testing



Kinetics modelling



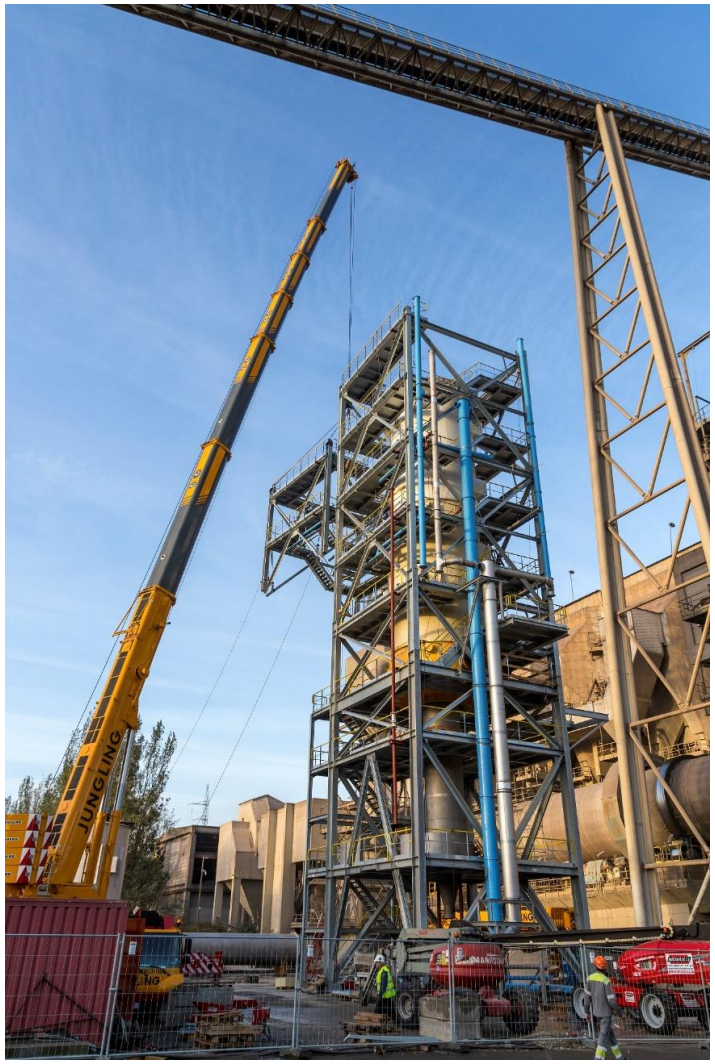


CEMEX

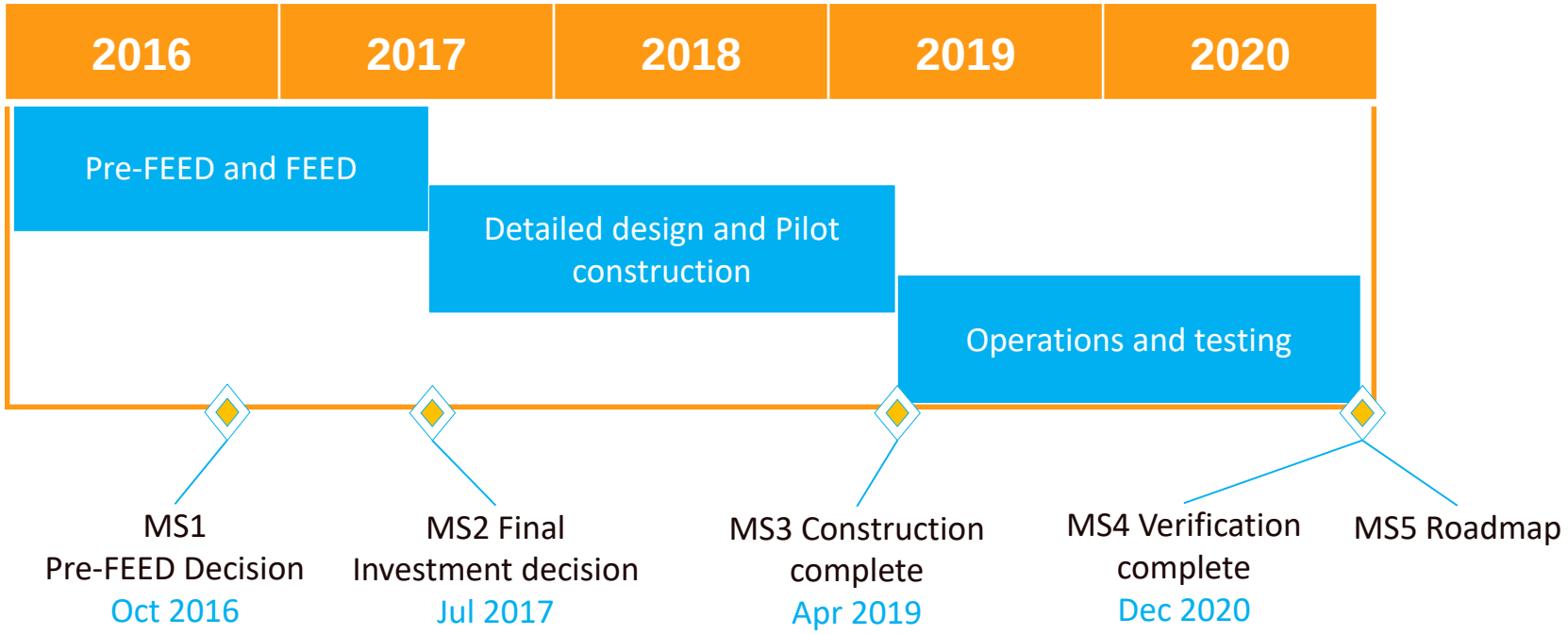
Flow modelling

Building the pilot

- The project completed the **pre-FEED** in 2016, with a ±30% cost estimate for approval.
- The **FEED** was completed in 2017, culminating with a ±15% cost estimate was generated for approval.
- The **EPCm** phase (led by HeidelbergCement and supported by Calix), undertook all detailed engineering, procurement and construction of the 60m tall pilot.
- Comprehensive safety and environmental risk assessments undertaken
- Pilot was built safely without incidents.
- Pilot has been built **on budget** and **on schedule**



Current project status

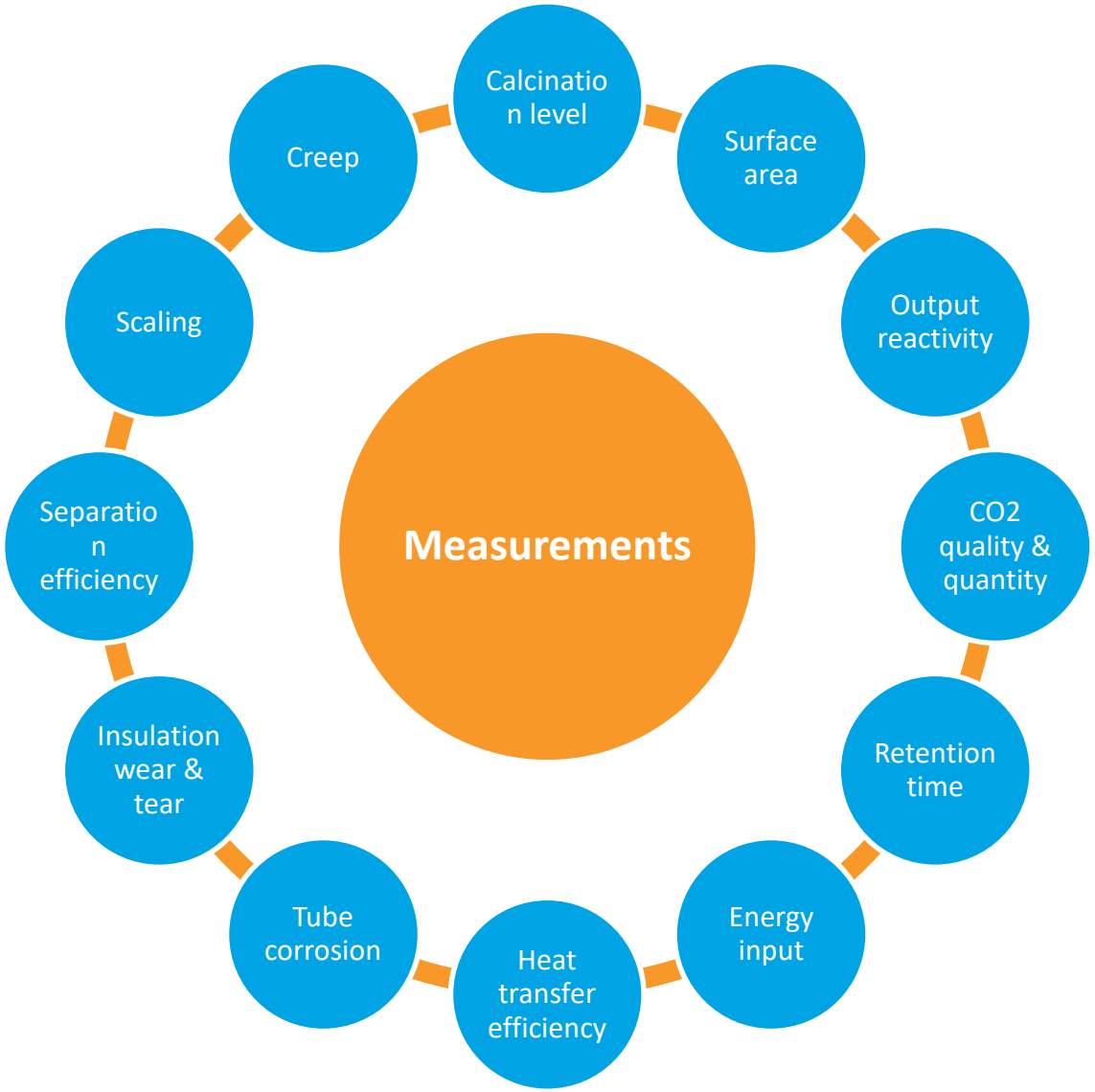


This first-of-a-kind plant has been built under budget and on schedule

Time lapse video (separately available)

- A plan for measurement and observation of the plant is in place

- An experimental matrix has been developed in collaboration with other partners



- Operations started in May 2019 and will run until the end of 2020.

- Safety has been, and is, the highest priority – with multiple, comprehensive HAZOP studies conducted for the construction of the pilot, and ongoing risk reviews during its operation.

- Challenges faced:
  - Feeding of raw material to reactor required correction, as the dosing fluctuations limited the throughput. This has been rectified.
  - Transport of hot product back to the host plant needs modification to reach design capacity; this should not be an issue for a full-scale cement application as cooler should not be used. A new design is being installed.
  - Several thermocouples inside the reactor tube have failed. They are currently being replaced.
  - Some coating appears on the reactor tube but it is not deemed to be critical.

- The reactor is working as expected, albeit not yet pushed to maximum capacity:
  - Successful demonstration of CO_2 separation
  - Successful demonstration of calcination of both limestone and cement raw meal
  - Pre-heating of the raw material with hot CO_2 gas;
  - Good performance of the reactor and bellows, including rapid ramping between ambient conditions and 1000°C;
  - Demonstration of the benefits of ceramic fibre insulation for lower weight, cost and reduced temperature ramp times.
  - There have been no negative impacts on the host plant, and no impact on clinker production.
  - The pilot is safe and easy to operate, with no safety incidents.

LEILAC Technology - Summary

Output

- High Purity CO_2 stream
- High quality product

Features

- Retrofit (replaces existing calciner) or new-build
- Can be built to handle variable mineral input streams
- Can use a variety of fuels, including electricity (including partial/flexible use for load balancing).
- Accurately controlled temperature and reactor residence time minimises sintering (loss of activity)
- Can handle fines that cannot be processed by conventional lime kilns.
- Enhances other CO_2 abatement technologies (e.g. oxyfuel or amines)

Cost

- a new calciner design that could separate unavoidable CO_2 emissions for potentially comparable operating and capital cost to conventional cement and lime plants – there are no added chemicals or process steps.

Follow LEILAC's progress…

www.project-leilac.eu

Follow us on twitter: @ProjectLEILAC