Solid Life: When Sustainability Meets Profitability

The project will contribute to the European Union's efforts to reduce greenhouse gas emissions, identified as a priority under the LIFE15 Program.

An Ambitious Project which gathers a complementary set of competences and expertises all around the world

3 Main Partners & 5 Nationalities

LafargeHolcim, a world leader in building materials

LCR: LafargeHolcim Research Center, project leader

LZW. Lafarge Zementwerke (Austria)

Lafarge S.A. (Poland)

TCEA: Technical Center Europe Africa (France)

CTEC: Customer Solution Centre Mannersdorf (Austria)

Building Research Establishment, the UK's leading centre of expertise on building and construction

Solidia Technologies, a cement and concrete technology company

Project budget : 3,8 M€
Start date : 15/06/2016

Project funding : 2,2 M€
End date: 30/10/2018

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With the contribution of the LIFE financial instrument of the European Community

www.solidlife.eu

Solid Life Project

SOLID LIFE

Solidia low CO_2 cement : from cement production to precast industry

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SOLID LIFE Project: A new class of lower-carbon products

The Solid Life project intends to show industrial feasibility to produce cement and concrete products offering equivalent cost, superior performance and unprecedented reduction in CO_2 emissions compared to conventional Portland cement within existing industrial installations.

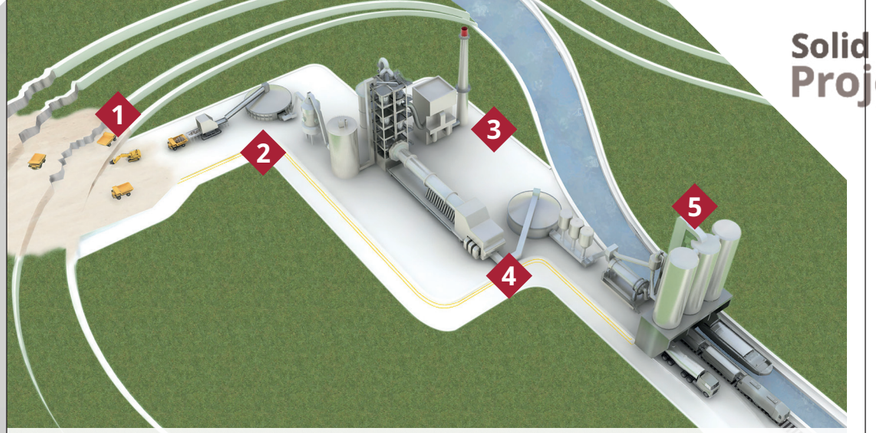
This project will make an immediate, positive impact on the European cement industry and its GHG emission. The development of these novel products, hereafter referred to as Solidia CementTM and Solidia ConcreteTM, offer the potential to **reduce the CO_2 footprint of cement and precast concrete manufacturing by up to 70%.**

This new technology consists in a breakthrough solution in the construction materials sector: a revolutionary carbonatable calcium silicate binder, coupled to a new curing process in presence of CO_2. Strengths acquisition is obtained thanks to mineral carbonation, which means a conversion of gaseous CO_2 into a permanent and durable rock.

The main technical objective of the project is the confirmation of CO_2 savings, observed at laboratory scale, **within pilot and industrial trials** in real cement production facilities and in precasters production facilities.

Project Objectives

- **To demonstrate and optimize the Solidia clinker & cement production at pilot and industrial scale**
- **To apply the technology at several precast plants**
- **To obtain European Teachnical Assesment, CE labelling**
- **To replicate and develop business model**
- **To elaborate a circular economy approach**



Solid Life Project

From the Cement plant ....

1 EXTRACTION OF RAW MATERIALS

The main raw materials required to manufacture traditional, Ordinary Portland Cement (OPC) are limestone and clay. Rocks are extracted from a quarry by blasting and then routed to the nearby cement plant on a conveyor belt.

Project Solid Life:
The main raw materials required to manufacture Solidia Cement™ are a source of CaO (e.g., limestone) and a source of SiO_2 (e.g., clay or sand).

2 GRINDING AND STORAGE OF RAW MATERIALS

The minerals from the quarry are routed to the grinding plant where they undergo initial milling before being reduced to a fine powder. The raw materials (80% limestone and 20% clay for OPC) are then stored in a pre-homogenization pile. This mixture is called « raw mix ».

Project Solid Life:
The ratio of the raw mix components used to produce Solidia Cement clinker is different than that used in traditional OPC. In particular, Solidia Cement has a lower limestone content, which is balanced by a higher clay or sand content.

3 THE FIRING OF RAW MATERIALS

For the production of OPC, the raw mix is fed into a preheating tower and then enters a horizontal rotary kiln heated to approximately 900°C. The temperature is then raised to 1450°C. Combustion causes a chemical reaction called « decarbonation, » which releases the CO_2 contained in the milestone. The fired materials take the form of hard granules called « clinker ».

Project Solid Life:
The lower proportion of limestone in the raw mix used to produce Solidia clinker results in a significant reduction of CO_2 emissions. The clinker of Solidia Cement is produced at a temperature of about 1200°C, which is roughly 250°C lower than the sintering temperature used in OPC clinker manufacturing. **The resulting process emits 30% less CO_2.**

4 STORAGE AND GRINGING OF CEMENT

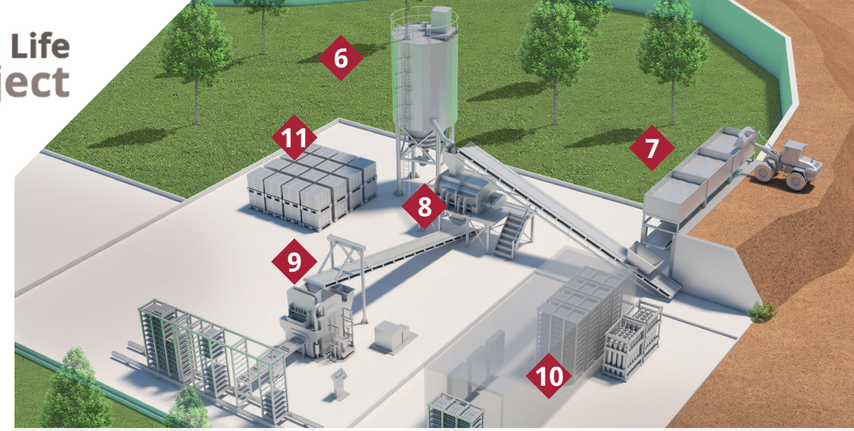
Following re-cooling, the clinker is stored in silos, then transformed into cement according to production requirements. During the final manufacturing stage, gypsum is added to the clinker, in a proportion of 3-5%, and the mixture is finely ground.

Project Solid Life:
Solidia Cement does not require any additional materials. Conventional cementitious materials can be added to further reduce the CO_2 footprint of the cement.

5 PACKAGING AND SHIPMENT

The cement is stored in silos before being delivered in bulk using tanker trucks or packaged into 25-35kg bags and stacked on pallets. Various means of transport may be used according to the local infrastructure and topography.

Since the market for construction materials is a local market, transportation distances are relatively short.



... to the Precast plant

6 CEMENT STORAGE AT PRECAST PLANT

At precast plant, the cement is stored in silos.

Project Solid Life:
A dedicated cement silo is needed for Solidia Cement storage. Solidia Cement only reacts with CO2, unlike OPC, which reacts with water.

7 PREPARATION OF RAW MATERIALS FOR CONCRETE

Concrete raw materials are fed into hoppers and added to the mixer.

Project Solid Life:
Solidia Concrete™ uses the same raw materials as OPC.

8 CEMENT AND RAW MATERIALS MIXING

Raw materials, cement, water and admixtures are introduced and homogenized in the mixer.

Project Solid Life:
The same process is used to produce Solidia Concrete.

9 PRECAST PRODUCTS FORMATION (PRESS)

Precast products are prepared in a press machine. The concrete is vibrated and packed in molds to create multiple pavers on a board. The boards are then stored on racks.

Project Solid Life:
The same process is used to produce Solidia precast products. Prior to carbonation, imperfect Solidia products can be broken up and recycled back into the mix to be reformed, reducing waste and saving money for precasters.

10 PRECAST ELEMENTS CURING

Once prepared, the OPC precast products are cured in curing chambers at the specific temperature and humidity conditions needed to speed up strengthening and hardening. After a given time, they are taken out of the chamber.

Project Solid Life:
Solidia Cement only reacts with CO_2, unlike OPC, which reacts with water. During the curing process, which uses the same temperature and humidity atmosphere as OPC, CO_2 – from waste flue gas – reacts with Solidia Cement to form calcium carbonate. It is permanently transformed from a gas to a solid that resembles natural limestone. When the reduced CO_2 emissions associated with Solidia Cement production are considered along with the ability of that cement to sequester CO_2 during concrete curing, the carbon footprint associated with the manufacturing and use of cement can be reduced by up to **70% compared to OPC**. *This reduction is equal to 550 kg of CO_2 per tonne of cement.*

11 PRECAST ELEMENTS OUTSIDE STORAGE

OPC precast products can require many days to achieve full strength. Manufacturers store them during this process before they are sold and shipped.

Project Solid Life:
The CO_2 curing process allows Solidia Concrete products to gain **full strength in just 24 hours**. *Solidia's precast products can be shipped immediately following the curing process, reducing the need for storage space and strengthening time, thereby saving manufacturers time and money.*