

# Cementir's Futurecem™ vision

Cementir Group is pursuing a clear strategy for climate change focussed on reducing CO<sub>2</sub> emissions per tonne of cement by 30 per cent by 2030. A total of €100m is dedicated to green investments by 2022. A pivotal role in CO<sub>2</sub> reduction will be played by FUTURECEM™ - Cementir's proprietary technology that uses limestone and calcined clay to such an extent that it significantly reduces the amount of clinker in cement.

■ by *Stefano Zampaletta, Michele Di Marino and René Fich Jespersen, Cementir Group, Italy and Denmark*

Improving the overall CO<sub>2</sub> footprint is a priority for the Cementir Group, but clearly, a carbon-neutral future is not achievable by acting alone. At the end of 2019, Cementir Group accepted an additional challenge via its daughter company Aalborg Portland, supported by the Danish government in the most ambitious CO<sub>2</sub> reduction project ever sponsored by a country, to provide its expertise and technology. In autumn 2019 the Danish government adopted a new binding climate law with the target of reducing Danish CO<sub>2</sub> emissions by 70 per cent by 2030.

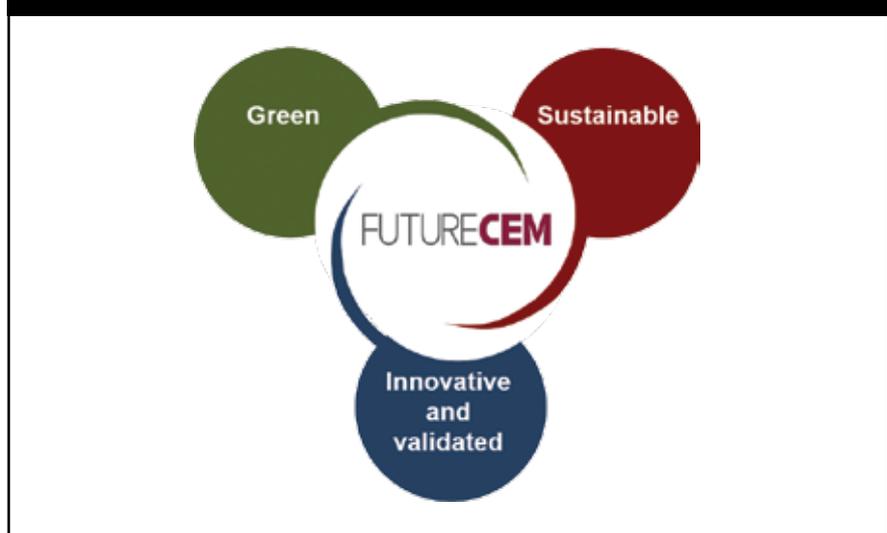
The target will be achieved through greater use of alternative fuels (approximately 80 per cent of the total required to produce grey cement by 2030) and renewable resources, as well as the reduction of thermal consumption and the clinker ratio of cement. A number of projects have been initiated and are progressing. A pivotal role in CO<sub>2</sub> reduction will be played by FUTURECEM™ - Cementir's proprietary technology developed internally and patented worldwide - which allows over 40 per cent clinker replacement in cement.

## **FUTURECEM technology towards sustainable building solutions**

FUTURECEM is the result of extensive applied research that has been developed over recent years at the Cementir Group Research and Quality Center in Aalborg, Denmark. The research covers the entire value chain: from raw materials assessment, through manufacturing technology and up to concrete technology.

The FUTURECEM technology's novelty is the synergy between calcined clay and limestone filler that enables more than 40 per cent clinker replacement, whilst keeping the same performance of Portland cements. It can be used as a standard

Figure 1: FUTURECEM™ – an innovative, validated solution for green and sustainable solutions



product with or without additions for concrete manufacturing.

This unique synergy was discovered approximately 20 years ago by Cementir Group researchers and then developed when an increased focus on sustainable solutions and climate change required new cement types with a reduced CO<sub>2</sub> footprint. Thanks to its novel synergy, FUTURECEM technology is granted for patent in the US, Canada, Mexico, Europe, India, China and Australia.

In short, FUTURECEM technology enables the production of both greener and more sustainable cements (see Figure 1).

The greener footprint is linked to a potential 30 per cent CO<sub>2</sub> reduction in production emissions compared to ordinary Portland cement (OPC), as calcined clays are activated at a lower temperature than clinker with around 55 per cent of emission savings.

Better sustainability relies on its main constituents (ie, limestone and clay), which are widely available. In today's industry this is a key factor to ensuring long-term, stable supplies. Fly ash and blastfurnace

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slag, the supplementary cementitious materials mostly used for cement/concrete production, are limited in quantity and availability. They are expected to decrease further as a result of CO<sub>2</sub> emissions compliance by coal-fired power plants and the steel industry. Notably, in Europe fly ash shortages are beginning to be felt as coal-fired power plants are being shut down, while blastfurnace slag is almost



Figure 2: road bridge on Lolland, Denmark

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Figure 3: railroad bridge, Lolland, Denmark



Figure 4: the Danish Technological Institute's new HQ

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fully utilised, with no plans to increase steel production.

FUTURECEM technology is fully acknowledged as a solution for clinker ratio reduction as described in the roadmap for a 'Low carbon transition in the cement industry' by the International Energy Agency (2018), and in Cembureau's 'Cementing the European Green Deal' (2020), making Cementir Group the frontrunner.

A milestone within the development of FUTURECEM technology has been the Danish Green Concrete II (Green Transformation of Cement and Concrete Production) project, concluded in 2019. The full value chain of construction and building materials, as well as universities and research institutes were actively involved.

Cements based on FUTURECEM technology as well as concrete recipes have been developed and tested at full-scale constructions: ie, infrastructure

elements (two bridges) and an indoor floor and wall in the new concrete laboratory at the Danish Technological Institute (see Figures 2-4).

To also test and document durability in aggressive environments, a number of long-term exposure sites have been established, along with extensive laboratory testing. These demonstration structures have shown that FUTURECEM is an effective solution for implementation in the concrete industry using conventional production and technologies, as well as demonstrating high resistance to the most aggressive environmental exposure classes, which is fundamental for concrete durability.

Beyond cement, FUTURECEM technology has applications in the manufacture of binders and can be used as an addition to concrete.

FUTURECEM technology is the "core" stream for the Cementir Group innovation

process, as the company aims to enhance its portfolio with value adding and innovative products/solutions while pursuing the challenging journey towards sustainability.

Within this stream of activities, Cementir Group has already launched two greener building solutions on the market based on premixes under its InWhite Solution™ platform:

- Aalborg Extreme™ (launched in autumn 2018)
- Aalborg Excel™ (launched in autumn 2019).

These ultra-high performance concrete (UHPC) solutions are ready to be used (just add water), shrinkage reduced and self-compacting. Aalborg Extreme is suitable for structural applications (eg, structural building elements, balconies, bridges), while Aalborg Excel is for decorative applications (eg, facade cladding, urban furniture).



Figure 5: at Aalborg, Denmark, the aim is to market the first grey cement based on FUTURECEM™

### FUTURECEM hits the runway

In accordance with Cementir's customer-centric approach and representing a group strategic initiative, tailored product development projects have been launched across regions, aiming to examine market requirements in several applications prior to market launches.

Currently, the main focus is northern and western regions in Europe with two leading projects at Aalborg Portland in Denmark and CCB in Belgium.

At Aalborg (see Figure 5), where FUTURECEM takes its roots, the purpose of the project is to market the first grey cement based on FUTURECEM.

The entire Cementir Group, with cross-functional/cross business unit teams, is working together to reach the milestones in the roadmap that cover the full value chain from raw materials, through cement and concrete production and up to final application.

The first full-scale production trial was successfully performed in 2019, testing all parts of the manufacturing process. For further fine-tuning, from September 2019 to spring 2020 additional trial productions were successfully carried out. This phase ended with a great achievement – in March 2020, Bureau Veritas certified the first cement based on FUTURECEM with the designation of CEM II/B-M(Q-LL) 52.5N, in accordance with European cement standard EN 197-1:2011.

In the same period, internal sampling/testing within group company Unicon was carried out, focussing on ready-mixed applications and scanning all the most relevant features requested by standard and final customers. The aim was to

extensively apply FUTURECEM in the most commonly-used mixes and for the most relevant end-applications at job sites (see Figure 6).

These full-scale trials have confirmed the full suitability for implementation in the concrete industry using conventional production and execution technologies with very minor adjustments.

Based on these results, lifecycle analyses have been performed, documenting around 20 per cent CO<sub>2</sub> reduction compared to conventional concrete and an estimated six per cent CO<sub>2</sub> emissions reduction

on standard building. This chain of CO<sub>2</sub> emissions reduction is fully aligned with European cement association CEMBUREAU's 5C approach, covering cement, concrete and construction.

As a part of Cementir Group's customer-centric approach, deliveries are planned in the 3Q20 to a select group of customers to carry out further testing on different materials and to extend the coverage of end-applications. During this testing, customers will be supported by a technical sales team as well as by research and quality centre experts. The experiences and lessons from the tests, along with other inputs from internal trials, will be considered for the further development of FUTURECEM.

A fundamental milestone is the inclusion of FUTURECEM cement into the Danish annex for European concrete standard DS/EN 206 DK. For this reason, FUTURECEM cement is undergoing a large testing programme at the Danish Technology Institute (DTI) to document its durability performances against aggressive agents. So far, results have been very promising.

The first cement based on FUTURECEM technology is expected to be launched on the market by the end of 2020. According to the group and initial market expectations, cement based on FUTURECEM will become the reference cement in Denmark, as market demand for greener solutions is continuously growing in all construction

sectors, from buildings to infrastructure.

As far as the project at Cementir's Belgian subsidiary CCB is concerned, in June 2019 the group started the assessment on FUTURECEM's feasibility in terms of production, sourcing and standards. This project is expected to be completed by mid-2021 and then the same roadmap applied at Aalborg will be followed.

From 2021 similar projects are scheduled to start in other plants, including white cement.

### Moving forward

Innovation never stops at the Cementir Group, with plans for the continuous development of FUTURECEM technology to address the challenges for a greener and more sustainable transition in the construction sector.

At its Aalborg-based research and quality centre the group has already been working on further developments. With this in mind, Cementir (as part of a consortium that covers relevant stakeholders from the entire value chain) has founded the CALLISTE project (CALcined clay LImeStone Technology Extention) in Denmark. This project aims for further CO<sub>2</sub> emissions reduction (with up to 50 per cent of clinker replacement) and extension in the applications such as in the precast industry.

The Cementir Group is also participating as a main player in an international initiative promoted by the Global Cement and Concrete Association (GCCA): Innovandi – the Global Cement and Concrete Research Network. Innovandi ties together the cement and concrete industry with scientific institutions to drive and support global innovation with actionable research. Calcined clay is considered a key strategic technology and Cementir Group is leading the way. ■



Figure 6: full-scale trials at Unicon

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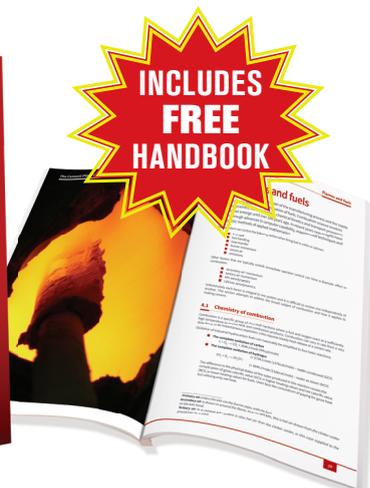
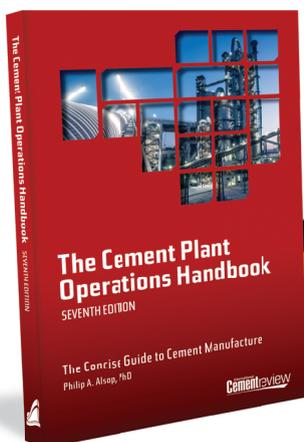
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