CEMENT COMPLETELY REIMAGINED

Small steps – long lever

An interview with Dr Hendrik Möller, Managing Director of Celitement GmbH.

Dr Möller, what is the exact origin of Celitement GmbH and the unusual name?
Celitement GmbH was founded in 2009 in the context of a cooperation between research – represented by the KIT – and industry, in this case SCHWENK Zement KG. The name Celitement, which refers to the company and the product, is not always that easy to pronounce. The double usage also causes some confusion.

Our original name logo started with a C with a triangle below it. That is the symbol used by geochemists for CO_2. The "lite" in blue and vertical: like Cola light stands for light or virtually free – referring to CO_2. The "ment" at the end indicates the product group, i.e. cement. To write it like this is not particularly practical. In the end we simply inserted the "lite" into the middle of the word "cement". The result is Ce-lite-ment. Our products – the Celitements – are high quality hydraulic binding agents which are manufactured using a patented, energy-efficient process. Compared to Portland cement clinker, they are characterised by a specifically lower use of limestone and lower process temperatures in manufacturing. Celitements are thus a new type of hydraulic binding agent. They have been developed with the objective of creating marketable products and contributing to reducing the CO_2 intensity in cement manufacturing.

What exactly is the difference between a classical Portland cement and Celitement?
The manufacture of a tonne of Portland cement clinker releases an average of 840 kg of carbon dioxide. Around 67% of this results from the deacidification of the main raw material, limestone, i.e. $CaCO_3$. Less limestone is required for the manufacture of Celitement. As a result less CO_2 is released. In addition to cement clinkers, modern cement also contains additives such as gypsum, limestone meal, granulated slag, fly ash or natural pozzolans. These additives can also be combined with Celitement and enable the CO_2 intensity to be reduced even more.

How much better is the CO_2 balance of Celitement compared to Portland cement?
That is difficult to answer. Start with the basis of the comparison: what sort of cement are you thinking of? The European cement standard includes 27 types of cement, soon to be 30. Even if there are still no solid numbers from measurements at an industrial Celitement plant, in our opinion pure Celitement is now at least 30 percent better that an average European ground clinker. Greater savings to about 50 percent are possible depending on the recipe of the starting raw materials and how we can optimise the process in the future. However, ultimately the volume of CO_2 per tonne that a single binding agent emits is not really relevant. What is relevant is the total CO_2 burden of the structures or building products manufactured with it. This is where the efficiency and technological performance becomes crucial, where the "green" cements or special binding agents such as Celitement can still have some advantages.

The principle of Celitement seems quite simple, so why was this idea not developed earlier?
The Celitement project is an excellent example of how a marketable product can be developed from fundamental research. The researchers at the Karlsruhe Institute of Technology were originally working with the reaction mechanism of the most important mineral phase of Portland cement clinker, tricalcium silicate (Ca_3OSiO_4 or abbreviated to C_3S). They then noticed that during the process of hydration to the end product C-S-H, i.e. calcium silicate hydrate (the "glue" in mortar and concrete), passed briefly through a previously unknown intermediate phase. The next proposal was to manufacture a pure form of that respective intermediate phase and use it as a "semi-finished" binding agent. Finding and precisely analysing this reactive and otherwise only briefly existing intermediate phase of cement hydration requires specialised expertise and analytical techniques. Even the largest cement manufacturers do not have these facilities in their laboratories. In general, the cement industry only has plant laboratories oriented to production and applications. We have never had the interdisciplinary working groups and the analytical scale required in fundamental research with their very expensive and specialised machines and systems.

Why has SCHWENK become involved in this project and even taken over the company completely in 2020?
SCHWENK is convinced of the principle of Celitement as a binding agent. The former company structure could not provide the substantial financial support for a required expansion of the pilot plant nor for the subsequent business operation. SCHWENK offered to acquire all the shares in Celitement GmbH from the former partners in order to continue the successful work of the past few years and to be able to

complete the project. The acquisition of Celitement GmbH retroactively to 1 January 2020 enabled the project to be continued. The acquisition also protects a planned, but not yet released, major investment by SCHWENK in the first industrial reference plant.

You said you would like to expand the pilot plant. How many tonnes does the plant currently produce and how much do you plant to produce in future?
Since the first mill was commissioned in the pilot plant at the end of 2013, we have been manufacturing approximately 10 tonnes a year of a wide range of Celitements or their intermediate products. But this was over a very long period and with very many different processing parameters and variations in recipes. After the expansion, we are planning to produce 2-3 tonnes a week "in one batch" in what we refer to as routine operation, in which we will attempt to manufacture the same material at a constant consistency over an extended period.

When do you think Celitements will be available for purchase in the market?
Our planned industrial reference plant is designed for a maximum annual capacity of 50,000 tonnes. We plan to establish standard operation and issue further licences from 2026. This may seem a long time. However, it is very ambitious when you consider the preliminary work, practical experiments and studies that will be required.

Dr Möller, thank you for the interview. We look forward to seeing the first tonnes manufactured in the reference plant.
It has been a pleasure.

Interview: April 2020

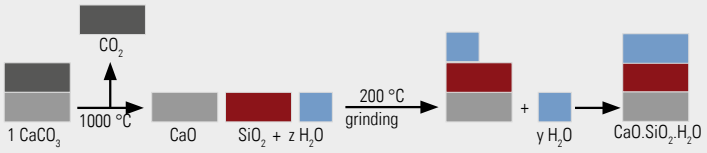
Picture: Dr Hendrik Möller | SCHWENK

Picture: Pilot plant | Celitement

Picture: Celitement office | Celitement

Legend

Manufacture of Celitement



Manufacture of clinker or C_3S