Factsheet

Low-Carbon Concrete

Can concrete become greener?

Due to its good mechanical and physical properties, concrete is one of the most important construction materials for buildings, roads, tunnels, bridges, foundations, dams and many other kinds of structures. Concrete contains cement as a binding agent, however, and the production of cement is responsible for large amounts of CO2 emissions, making it a major contributor to climate change.

As concrete will continue to play an important role in construction in the future, the industry urgently needs to find more climate-friendly solutions.

STRABAG is working on finding these solutions – by carrying out research and launching pilot projects on low-carbon concrete, by systematically scouting for technologies to reduce the amount of carbon in concrete, and by engaging in new partnerships with concrete manufacturers and clients. And this is just the beginning! We want to gradually use low-carbon concrete in ever greater quantities wherever we can and are permitted to do so. To achieve this, we need clients who are willing to work with us on progress together.

1 Low-carbon concrete being used during the construction of the Innovation Center.

How can we reduce the amount of CO_2 and other greenhouse gases in concrete?

Low-carbon concretes are concretes that have a lower Global Warming Potential (GWP)[1] compared to standard concretes. About 80 % of the greenhouse gas emissions of common standard concretes come from the Portland cement clinker[2] used in its production. The key to reducing emissions here is therefore to lower the percentage of clinker used.

Possible ways to reduce the amount of cement clinker in concrete:

- Reducing the cement content of concrete
- Using low-clinker cement
- Finding alternative binders with a low Global Warming Potential

STRABAG's competence centre for building materials technology – TPA Gesellschaft für Qualitätssicherung und Innovation – is researching all three alternatives.

Innovation Center: low-carbon concrete in building construction

Sustainability starts at home! During the construction of the new Innovation Center at the ZÜBLIN campus in Stuttgart, our STRABAG teams were hard at work on building the future. In addition to numerous other sustainability measures, the project marked the first time that we exclusively used low-carbon concrete for all cast-in-place concrete components and temporary construction elements – in this case, around 9,200 m^3 of the CEM III/B low-clinker, blast-furnace cement. Over the course of the project, the STRABAG experts performed countless analyses and suitability inspections and gathered extensive experience and knowledge in building with low-carbon concrete.

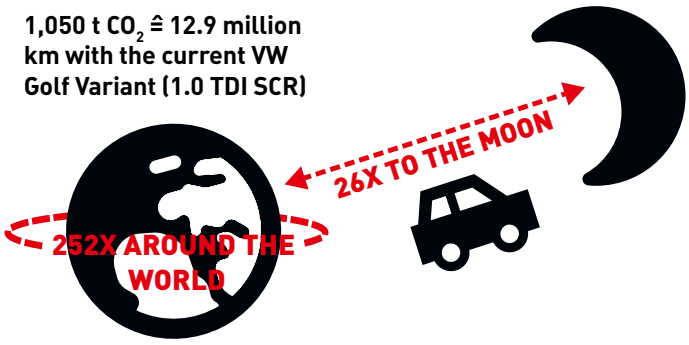
1+2 During the construction of the new Innovation Center, STRABAG is gaining extensive experience in the use of concrete with clinker-reduced cement

More than 50% fewer emissions

The use of low-carbon concrete in the Stuttgart project allowed us to cut emissions by 1,050 t of CO_2-equivalent compared to the average values from the ÖKOBAUDAT platform of the Federal Ministry of Housing, Urban Development and Construction.[3] This corresponds to a reduction in emissions of more than 50% during the structural works.

Savings potential illustrated as vehicle kilometres travelled

1,050 t CO_2 ≙ 12.9 million km with the current VW Golf Variant (1.0 TDI SCR)



Concrete with low-clinker cement: enormous potential, few limitations

With the appropriate configuration and construction method, the use of low-carbon concrete can cut CO_2-equivalent emissions by between 30% and 50%, depending on the basis of comparison used. The advantage: Low-carbon concrete can be used without additional testing or approval. In combination with additional measures, for example in the planning and choice of construction type, this could result in far-reaching material and carbon reductions in the future. With regard to the quality of the installation and processing of the concrete, no constraints or drawbacks were registered during the Innovation Center Stuttgart project. It was even possible to produce concrete of visual quality. One challenge, however, is the delayed early strength development of low-carbon concrete. This could lead to delays in building construction operations that must be planned for in advance. As a result, the use and availability of low-carbon concrete needs to be assessed on a project-by-project basis. The sustainability advantages seriously outweigh the disadvantages, however, especially with massive building components. In order to benefit from these advantages and to significantly reduce greenhouse gas emissions today and immediately, we need clients who are willing to contribute to climate protection for a relatively low additional cost. The STRABAG Group has the experience and knowledge to make this happen.

Dipl.-Ing. Torsten Dölle, Business Unit Lead, Concrete Technology International, TPA GmbH

> The Innovation Center project impressively shows that we can already cut large amounts of greenhouse gas emissions today – just through our choice of concrete. To realise more projects like this in the future and so reduce emissions even more, we will need the support of our clients.

[1]GWP = Global Warming Potential. The global warming potential is the potential contribution of a substance to warming the atmospheric layers close to the ground, i.e., the contribution to the greenhouse effect. This contribution is stated as a GWP value relative to the greenhouse potential of carbon dioxide (CO2). [2]Source: InformationsZentrum Beton GmbH: Umwelt Produktdeklaration – Beton der Druckfestigkeitsklasse C25/30 [Environmental Product Declaration – Concrete of Strength Class C25/30], Erkrath, 2018; InformationsZentrum Beton GmbH: Umwelt Produktdeklaration – Beton der Druckfestigkeitsklasse C45/55 [Environmental Product Declaration – Concrete of Strength Class C45/55], Erkrath, 2018. Both available at: https://ibu-epd.com/veroeffentlichte-epds/ [3]The CO_2 emission avoidance figure of about 1,050 t was obtained by taking the following parameters into account: The GWP values for the lean concrete types (corresponding to C8/10 and C12/15) were provided by the concrete supplier; the GWP values of all other types of concrete correspond to the EPDs (Environmental Product Declaration) from the ÖKOBAUDAT reference year 2018 for concrete of the compressive strength classes C30/37 and C50/60 as unreinforced structural concrete according to DIN EN 206-1; the installed concrete types contain small amounts of accelerator admixtures, which, due to their effects, were not shown separately; the installed reinforcing steel is not covered by this analysis; any influencing factors from the construction process, such as higher formwork costs (additional transports, etc.) do not form part of this CO_2 analysis.

Concrete with reduced cement content: Basecrete & Topcrete

Low-carbon concrete is already being used not only in building construction but also in several different projects in ground engineering, for example for diaphragm walls and bored piles. These activities involve a joint in-house development by the STRABAG subsidiaries ZÜBLIN and TPA. The cement content in the concrete is reduced by adding fly ash – a cheap industrial by-product. This alternative has also already been used for floor slabs. The STRABAG products Basecrete (for civil engineering) and Topcrete (for building construction) have general building authority approval – although there are some restrictions with regard to the availability of fly ash. The products are used wherever the market, the project and the components allow.

Alternative ingredients: reducing the carbon footprint in concrete

STRABAG is conducting research into concretes with cement-free binders. The Group is also investigating the use of materials that permanently store greenhouse gases from the atmosphere while at the same time reducing the amount of cement in the concrete and thus lowering the environmental footprint already in the product. This includes, for example, the use of materials produced during the further processing of biomass as a substitute for cement and the storage of CO_2 in concrete waste and rubble. Technology scouting at STRABAG screens the market for suitable technologies, evaluates their potential and supports the operating unit in their use in practice.

1 Concrete mixing plants of Group subsidiary ROBA Transportbeton

Comprehensive know-how in the field of concrete production

The corporate subsidiaries ROBA TRANSPORTBETON GmbH, Asphalt & Beton GmbH and MOBIL BAUSTOFFE GmbH produce concrete in concrete plants worldwide. In addition to the standard production of concrete with low-clinker cement, the Group subsidiaries are also working on practical testing of concretes with alternative ingredients.

Dipl.-Ing. Rudolf Kauper, Subdivision Lead RD and Managing Director MOBIL BAUSTOFFE GmbH

"In the future, we want to convince our clients even more strongly of the sustain-ability potential of our low-carbon products and to join us in finding new ways to reduce emissions in construction. Because climate protection can only succeed if construction companies and clients work closely together."

2 CO_2-reduced concrete was successfully used in the SOLEY residential construction project. © Office Le Nomade

Reduced carbon concrete: lower CO_2 emissions, same performance

An important step on the way to the widespread use of CO_2-reduced concrete is a binding legal regulation. As a basis for this, the RCC (Reduced Carbon Concrete) project was intended to demonstrate the equivalent performance to conventional concrete mixes. The eponymous RCC concrete was put to practical use for this purpose. The scenarios investigated for the Taborama residential project in Vienna by STRABAG Real Estate (SRE) resulted in a CO_2 reduction potential of between 13 and 20%. The selected concrete mix design had a clinker content of only 50%, while conventional types such as CEM I contain 91% or CEM II/A 77%. Tests showed that wall and floor elements made from RCC concrete are on a par with those made from conventional concrete. Flow behavior and strength are comparable, but the early strength at low temperatures varies. RCC concrete has already proven itself in practice in the SOLEY residential construction project by SRE in Vienna.

The follow-up project RCC2, which was supervised by Maximilian Schwarzbauer (SRE) from STRABAG, involved extensive test series under summer and winter conditions, each with three concrete mix designs: Standard concrete, CO_2-reduced (RCC2) and CO_2-reduced with technical carbon (RCC2+). All components were monitored and documented using the Concremote concrete monitoring system. Winter tests at low temperatures showed that heatable formwork made by Doka can improve the strength development of RCC concretes and prevent damage caused by low temperatures. Clinker-reduced concrete, especially with technical carbon, significantly reduces CO_2 emissions, with up to 80% for ceiling elements without heating and 67% at winter temperatures with heatable formwork.

> By proving in practice that CO_2-reduced concrete performs just as well as conventional concrete, we are creating the basis for the wide use on the construction sites of the future.

DI Lukasz Kujawa,
Head of Residential Construction
STRABAG Real Estate

1 The scenarios examined showed potential CO_2 savings of up to 20% for the Taborama residential tower. © PicMyPlace

Kontakt

STRABAG SE
Donau-City-Str. 9
1220 Vienna
Austria
Tel. +43 1 22422-0
pr@strabag.com