



Green Sense[®] Concrete

The Concrete Technology
for Sustainable Construction





Constructing Tomorrow's Buildings

Sustainability is a key issue in the construction sector. Increasing demands on material properties, diminishing resources, and environmental issues present major challenges to the industry.

Master Builders Solutions has long realized this: The Company is promoting the development of innovative solutions and is looking for answers to today's urgent questions. One central goal in this regard has been to improve the eco-balance of buildings in a quantifiable way. Here, the composition of the concrete plays a major role: With its Green Sense® Concrete technology, Master Builders Solutions provides concrete producers and contractors with custom-tailored concrete solutions to make construction more eco-friendly and cost-efficient, to make sustainability quantifiable and to achieve better results when obtaining Green Building Council certification.





Concrete – The Key to Sustainable Construction

For durable and economically viable structures, concrete is an invaluable constituent. In terms of the overall quantities of a material used globally, concrete is only second to water. There is no other construction material that, on a global scale, would be able to replace concrete in terms of availability, durability and flexibility of use.



In Master Builders Solutions' laboratories, scientists are constantly refining concrete admixtures to make them more efficient.

The production of concrete contributes to environmental impacts that cannot be ignored. For example, the manufacturing process for the cement used in concrete generates approximately eight percent of global CO₂ emissions.

Behind Green Sense Concrete technology is an innovative concept for improving the eco-balance and technical performance of concrete and, as a consequence, the structure created with it. The cornerstone of this new technology is the individual, project-specific consultation by our experts from Master Builders Solutions – a brand that stands for more than a hundred years of experience in the construction industry. Identifying the best-possible concrete mix design for every construction project,

our experts optimize the concrete using admixtures that range from our MasterGlenium hyperplasticizers to our Master X-Seed accelerators. In this way, they improve the workability of the fresh concrete as well as the properties of the hardened concrete, making it both more environmentally friendly and durable.

In addition, Master Builders Solutions has developed the Life Cycle Analyzer, a software tool that quantifies the environmental impact of concrete. Calculating and comparing both the ecological and economical parameters of concrete mixes, the Life Cycle Analyzer creates transparency – a key criteria in obtaining Green Building Council certification.



A Concrete with Significant Advantages

The Green Sense Concrete technology ensures that the concrete used for a construction project is optimally suited to its purpose. It also makes the construction process more predictable and creates significant benefits for concrete producers, specifiers, contractors and owners.

Optimizing the concrete mix in terms of raw materials and composition improves the properties of both the fresh concrete (more efficient installation) as well as those of the hardened concrete (increased durability and improved surface finishes).

Additionally, the use of locally sourced and resource-saving constituents has a positive impact on sustainability and economic viability. Such an approach creates benefits for everyone involved in the construction value-added chain – from owners to specifiers and contractors to concrete producers.

The benefits of Green Sense Concrete

For concrete producers:

- Creates comparability in terms of the environmental indicators and economic viability of concrete mix designs
- Provides answers to customer enquiries on the life-cycle data of concrete
- Adds value to the concrete

For specifiers:

- Adds value to the building by quantifiably improving its sustainability credentials
- Provides specification data (eco-balance)

For contractors:

- Simplifies and accelerates concrete installation
- Saves time and money
- Increases concrete quality (visible surface finishes and durability)

For owners:

- Improves the results of building certification
- Adds value to the property
- Ensures a durable, low-/no-maintenance supporting structure
- Provides relevant data for leading Sustainable Building Certification schemes (BREEAM®, DGNB, LEED, HQE)



One World Trade Center, New York

Challenges

Sustainability was a crucial element in the construction of the new, 541-meter-high One World Trade Center. The New York/New Jersey Port Authority had imposed strict requirements regarding the replacement of Portland cement with supplementary cementitious materials (e.g. fly ash, ground granulated blast furnace slag). Furthermore, in order to achieve the specified compressive strength of up to 97 MPa, a particularly high quality concrete was required.

Result

Using the Green Sense Concrete technology, 71 % of the Portland cement could be replaced with selected supplementary cementitious materials such as fly ash or ground granulated blast furnace slag. All construction requirements were achieved.

The environmental impact of the sustainable concrete was determined through an eco-efficiency analysis. Using a method recognized by NSF International – an independent public health and safety organization – to compare the concrete used with a reference concrete, the analysis highlighted ecological and economical benefits.

Products used

MasterSure

- Optimal consistency retention
- Prolonged workability
- High early and final strength

MasterGlenium

- Significant water reduction
- Long workability
- Accelerated strength development

MasterSet

- Optimizes setting time for each individual project
- Controls consistency for long-distance transportation
- Controls cement hydration

MasterLife

- Increased durability
- Exceptional corrosion protection
- Increased sulfate resistance

The use of Green Sense Concrete technology saved:

25,402,200 kilowatt hours of energy
15,000,000 kilograms of CO₂ equivalent
504,000 kilograms of fossil fuel



Using Green Sense Concrete in the construction of the One World Trade Center in New York served to significantly reduce the environmental footprint of the building.



BASF's office building D 105 in Ludwigshafen, Germany has been awarded a preliminary gold certificate by DGNB.
© Architekturbüro HPP International, Düsseldorf



Office Building D 105, Ludwigshafen, Germany

Challenges

The construction of BASF's new office building in Ludwigshafen marked the first use of Green Sense Concrete technology in Europe. Set for completion in 2015, the 35,000-square-meter, seven-story building has already been awarded a preliminary gold certificate by DGNB (German Sustainable Building Council). To achieve this, the building as a whole has to meet a strict criteria with regard to its construction, service life and dismantling. The DGNB system takes into account all essential aspects of sustainable construction across the entire life cycle of the building. The evaluation process covers six topical areas: ecology, economy, socio-cultural and functional aspects, technology, processes, and location of the building; throughout, economical and ecological aspects of sustainable construction are given equal importance.

Result

The preferred use of a highly flowable concrete of consistency class F6 over conventional F3/4 concrete resulted in the following benefits:

- Non-segregating, high-flowability concrete without the need for any additional water
- Efficient, low-noise installation (less personnel; very little manual compaction; less monitoring required)
- Durable concrete with aesthetically pleasing surfaces

Products used

MasterGlenium SKY

- Significant water reduction
- Long workability
- Accelerated strength development

MasterMatrix

- High durability
- No manual compaction; no loud noise
- Up to five-fold increase in work productivity

Reductions achieved by the use of Green Sense Concrete technology:

45 %

CO₂ reduction in comparison to concrete with CEM I Portland cement

30 %

CO₂ reduction in comparison to average concrete datasets from the German Ökobaudat database

50–70 %

less manual compaction in comparison to conventional concrete



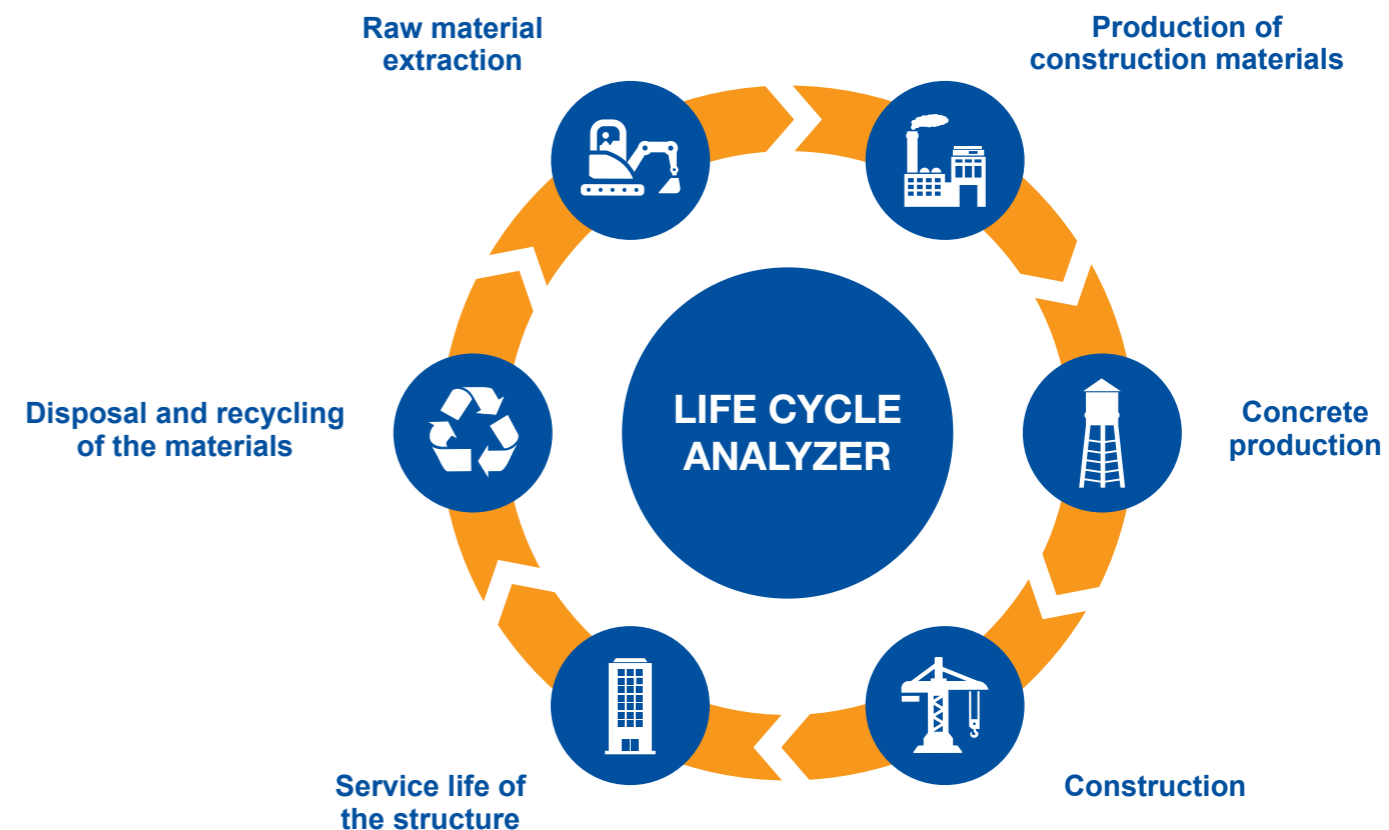
Making Sustainability Quantifiable

Only quantifiable improvements in sustainability are relevant for Green Building Council certification. To translate the environmental impacts of concrete into comparable figures, Master Builders Solutions has developed the Life Cycle Analyzer. The software tool calculates and compares the economical and ecological parameters of concrete mixes. Factors that go into the calculation include: costs, raw material extraction, energy for mixing and heating, transportation, recyclability and disposal of the concrete. The entire life cycle, from raw materials to recycling or disposal, is taken into account. Master Builders Solutions emphasizes the importance

of not limiting this to single indicators, such as CO₂ emissions, but incorporating as many factors as possible and cross-referencing them. The result is a comprehensive ecological and economical life cycle analysis that shows how concrete can improve sustainability and provides relevant data for leading Sustainable Building Certification schemes (BREEAM®, DGNB, LEED, HQE).



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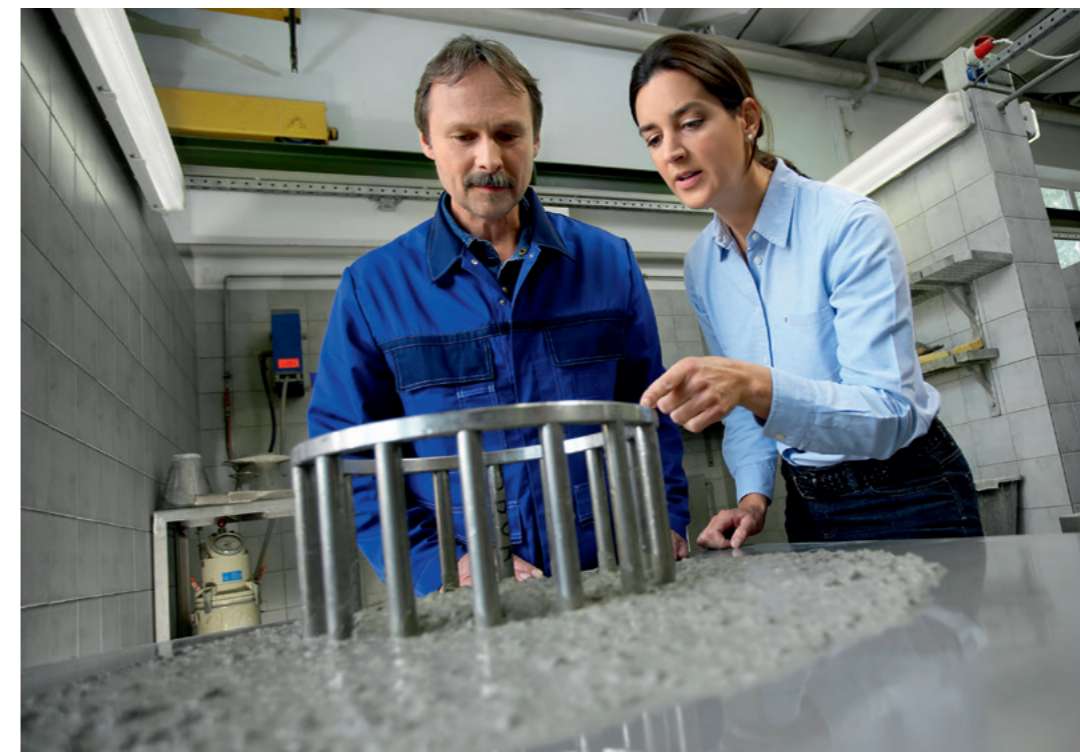




The Ideal Concrete

Concrete comes in numerous varieties. A good quality concrete makes construction projects more predictable, more efficient and more eco-friendly; it lowers costs and increases the durability of the building. For concrete to deliver such advantages, intelligent concrete technology is required. Here, concrete admixtures play a crucial role: They allow the modification of concrete properties as needed and their adjustment to the specific requirements of any construction project.

For instance, concrete admixtures can increase the flowability of concrete to such an extent that it can be pumped vertically to heights in excess of many hundreds of meters, decrease hardening times when speed is of the essence, and adjust the material's properties to enable smooth application in both extremely cold and hot environmental temperatures. The ideal concrete does not exist – what does, however, is a concrete composition that is optimally engineered to the individual challenges of a specific construction project. Developing this mix design is exactly where the expertise of our specialists from Master Builders Solutions lies.



Master Builders Solutions employees test self-compacting concrete at Master Builders Solutions' Construction Chemicals Competence Center in Trostberg, Germany.



A Broad Selection of Concrete Admixtures

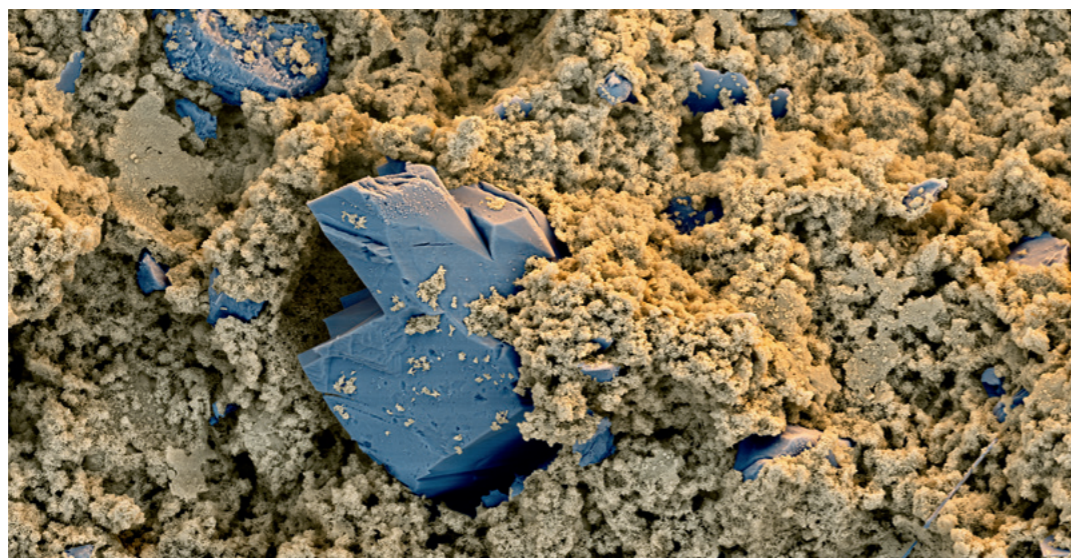
Concrete admixtures increase the energy efficiency of concrete production, improve durability, and reduce the environmental impacts.

For every requirement, you will find the right product in our portfolio: from plasticizers and hardening accelerators to retarders and air-entraining agents. With their extensive experience, our experts will assist you in selecting the right admixture. Let's take a closer look at two examples.

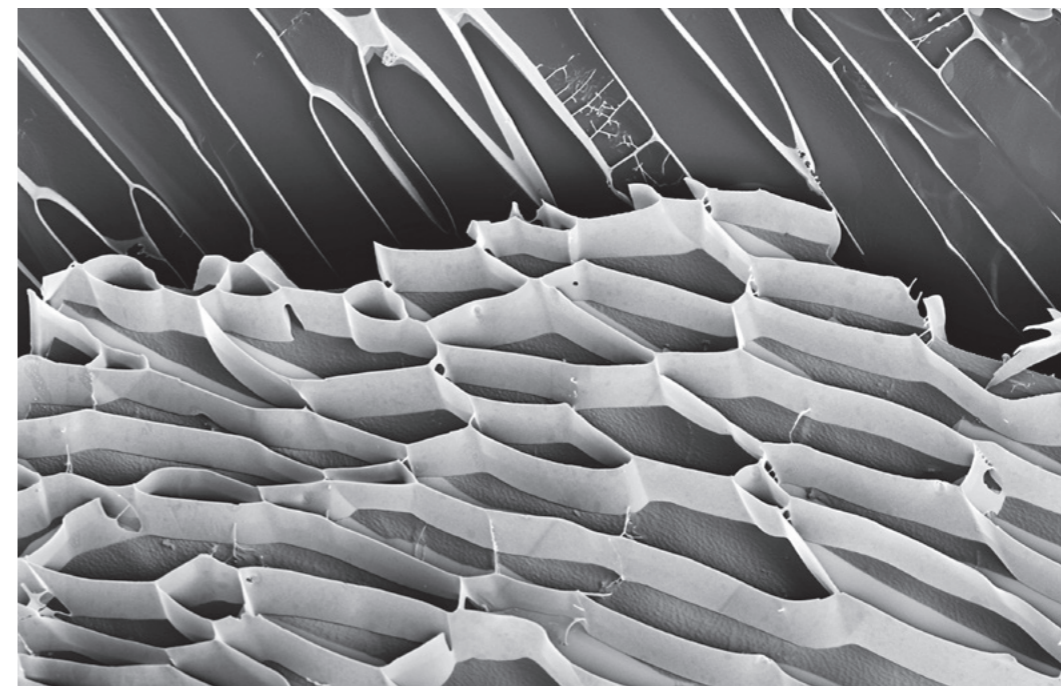
Master X-Seed

Master X-Seed is a hardening accelerator that significantly speeds up the strength development of fresh concrete. At 20 °C, concrete incorporating Master X-Seed hardens as quickly as concrete at 60 °C without an hardening accelerator. Therefore, no additional heat is required to accelerate concrete hardening, resulting in reduced CO₂ emissions. For the first time, Master X-Seed allows the addition of crystal seeds – finely dispersed, synthetically

produced Crystal Speed Hardening crystals in a ready-to-use suspension – to the mix during concrete production. This procedure, known as “seeding”, significantly accelerates the hardening process in the early stages of cement hydration. In this way, Master X-Seed optimizes the production process, improves concrete quality as well as energy efficiency, and reduces CO₂ emissions.



Master X-Seed crystal seeds at a scale of 960:1.



The water-soluble polymers of the MasterMatrix viscosity modifier arrange themselves into a matrix automatically. The image shows the matrix at a magnification of 1250:1.

MasterMatrix

MasterMatrix gives concrete stability as well as self-compacting properties. There is no need for manual compaction of the concrete, thus eliminating loud noise and vibrations harmful to workers. Thanks to its unique method of action in concrete, the fines content (e.g. cement) can be reduced. This in turn improves the ecological efficiency of the concrete. In addition, MasterMatrix makes concrete placing easier, saving up to 40% of man hours. In this way, an up to five fold increase in work productivity can be achieved. MasterMatrix is based on Master Builders Solutions proprietary intelligent ionic polymers that interact both with each other and with the surrounding water molecules to form a molecular network. This results in the creation of a water envelope and a highly structured cement paste: The smart molecules arrange themselves into a matrix-like structure.

MasterEase

A new groundbreaking admixture range for low-viscosity concrete

- New MasterEase® product range for superior rheology of high performance concrete
- Low viscosity and concrete mix stability facilitate pumping and placing of concrete
- Optimizes the concrete mix design and allows reduction of CO₂ footprint



Master Builders Solutions



The Master Builders Solutions brand brings all of expertise together to create chemical solutions for new construction, maintenance, repair and renovation of structures. Master Builders Solutions is built on the experience gained from more than a century in the construction industry.

The know-how and experience of a global community of construction experts form the core of Master Builders Solutions. We combine the right elements from our portfolio to solve specific construction challenges. We collaborate across areas of expertise and regions and draw on the experience gained from countless construction projects worldwide. We at Master Builders Solutions leverage global technologies, as well as our in-depth knowledge of local building needs, to develop innovations that help make more successful and drive sustainable construction.

Market leading products are developed from technically advanced formulations, optimized for the harsh environmental conditions found in the Middle East.

Our comprehensive portfolio

- Concrete admixturesCement additives
- Chemical solutions for underground construction
- Waterproofing solutions
- Sealants
- Tile fixing systems
- Concrete repair and protection solutions
- Performance grouts
- Performance flooring solutions
- Wall systems
- Fire protection systems



Master Builders Solutions products for the Construction Industry:

MasterAir®

Complete Solutions for air entrained concrete

MasterBrace®

Solutions for strengthening and structural adhesives

MasterCast®

Solutions for the manufactured concrete product industry

MasterCell®

Density reducing admixtures

MasterCem®

Solutions for cement manufacture

MasterEase®

Solutions for low viscosity concrete

MasterEmaco®

Solutions for concrete repair

MasterFiber®

Comprehensive solutions for fiber reinforced concrete

MasterFinish®

Solutions for formwork treatment

MasterFlame®

Passive fire protection system

MasterFlow®

Solutions for precision grouting

MasterGlenium®

Hyperplasticizer formulated from state-of-the-art polymers for the ultimate performance

MasterInject®

Solutions for concrete injection

MasterKure®

Solutions for concrete curing

MasterLife®

Solutions for enhanced durability

MasterMatrix®

Advanced rheology control solutions

MasterPolyheed®

High-performance superplasticizer

MasterPozzolith®

Solutions for water-reduced concrete

MasterProtect®

Solutions for concrete protection

MasterRheobuild®

Superplasticizer for concrete

MasterRoc®

Solutions for underground construction

MasterSeal®

Solutions for waterproofing and sealing

MasterSet®

Solutions for set control

MasterTile®

Solutions for tiling systems

MasterTop®

Solutions for industrial and commercial floors

MasterWeld™

Adhesive Solutions for construction

MasterX-Seed®

Advanced accelerator solutions for concrete

Ucrete®

Flooring solutions for harsh environments

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