

MASTER[®]
» BUILDERS
SOLUTIONS

Injection Technologies

Solutions for Underground Construction



Master Builders Solutions®

As Master Builders Solutions®, we are a leading global producer of responsible solutions for the construction industry, focussed on delivering our vision: *Inspiring people to build better.*

We provide value-added technology and market-leading R&D capabilities to improve the performance of construction materials and to enable the reduction of CO₂ emissions in the production of concrete. The comprehensive portfolio under the Master Builders Solutions® brand encompasses concrete admixtures, cement additives, and solutions for underground construction.

We collaborate across areas of expertise and regions and draw on the experience gained from countless construction projects worldwide, leveraging global technologies, as well as our in-depth knowledge of local building needs, to develop innovations that help make you more successful and drive sustainable construction.

Founded in 1909, Master Builders Solutions® operates 35 production sites globally, supporting you in mastering your building challenges of today and tomorrow – for a decarbonised future.

Global underground construction team

Master Builders Solutions®, with its global underground construction team, provides reliable, customer-oriented solutions focused on your needs in the tunneling and mining industries all over the world. We recognize that your success is underpinned by our ability to deliver solutions that meet or exceed your critical needs. By accompanying you from the start of your project and understanding the issues that are important to you, we can contribute to your success. We support you with product training and quality control, and our professional technical services team is on hand around the clock, helping you with specialist technical advice and trouble shooting.

Our comprehensive portfolio:

- Concrete admixtures
- Cement additives
- Chemical solutions for underground construction



Avoid the Unexpected with Pre-Injection

Unexpected water ingress and poor ground conditions during underground construction usually escalate costs, can have a negative influence on the environment, and inevitably cause significant delays. To counteract these risks, an economical approach is to pre-inject the ground ahead of the advancing face to avoid water ingress occurring, and to stabilize the ground.

Microcements and colloidal silica, the latter also known as mineral grout, allow a cost-effective approach and improve working safety with minimal environmental consequences.

Water Stopping

Foaming, water-sensitive polyurethanes are ideally suited to combat water ingress quickly and effectively. For particularly difficult cases the solution is a combination of drainage and the injection of a fast-reacting foaming resin.

Ground Consolidation

Fast-reacting and non-water-sensitive polyurea silicate systems quickly stabilize poor ground. The high-foaming version is excellent for void filling. The less water-sensitive polyurethanes are also suitable to strengthen the ground.

Crack Sealing and Concrete Rehabilitation

The range of acrylic resins are particularly suitable for rehabilitation injection for cast concrete, segment linings and brick & masonry lined tunnels.



Microcement



Fast Setting, Fast Cycle

MasterRoc® MP microcements are a range of superfine portland cements for pre-injection application. Due to their fineness they provide extremely effective penetration into fine cracks in rock and fine grained soils to give efficient water tightness, stability and durability.

They represent a significant technological advantage in cementitious injection. Their unique and innovative feature is rapid and controlled setting, allowing uninterrupted blasting rounds or continued injection sequences, thereby enhancing productivity considerably.

Where it would take 6 hours between blasting rounds with normal cement, the waiting time is only 2 hours with Master Builders Solutions®+ microcements.



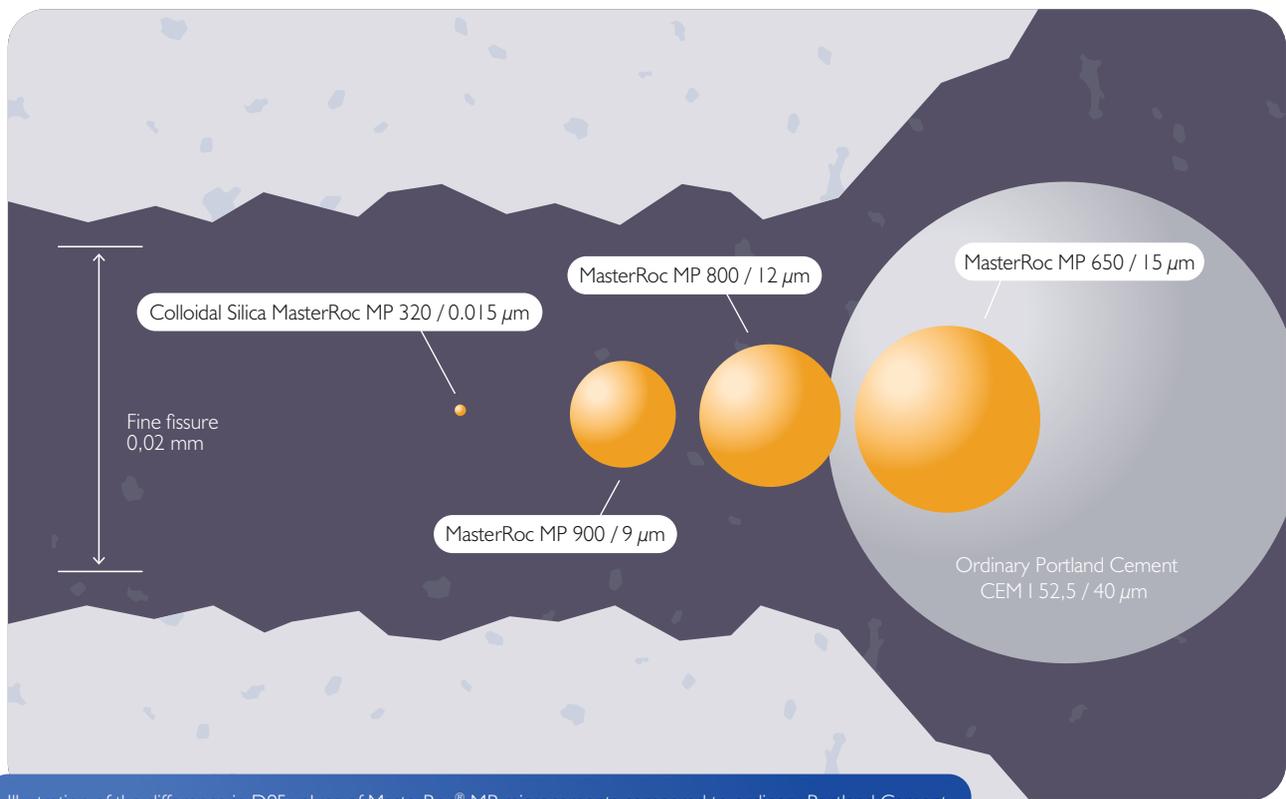


Illustration of the difference in D95 values of MasterRoc® MP microcements compared to ordinary Portland Cement

Microcement - Stable Penetrating Grout

A stable grout is crucial for efficient penetration into the rock, and cannot be achieved with ordinary cement. A stable grout can travel far without losing its effectiveness, reducing time required for a given result as less drilling and less pumping are necessary. Microcements penetrate small cracks and inter-granular spaces very well, and allow high pumping pressure where needed as the grout remains stable. A further benefit is that standard cement injection equipment can be used.

Limit Grout Travel Distance with Accelerated Setting of Microcement

The setting of microcement grout suspensions can be accelerated with a controlled dosage of a specially designed alkali-free accelerator. Using this unique method, the open time of the grout suspension can be controlled from 1-2 minutes up to approximately 20 minutes, remaining pumpable before it sets and becomes solid.

This is particularly suitable for situations where controlled injection is needed to limit grout spread in very permeable rock masses and soils, as well as for cold groundwater conditions where very fast setting is necessary.

MasterRoc® MP microcements are available on special request as slower setting sulphate resisting versions and in different grades relating to the maximum particle size as given by the D95 values illustrated in the image above.

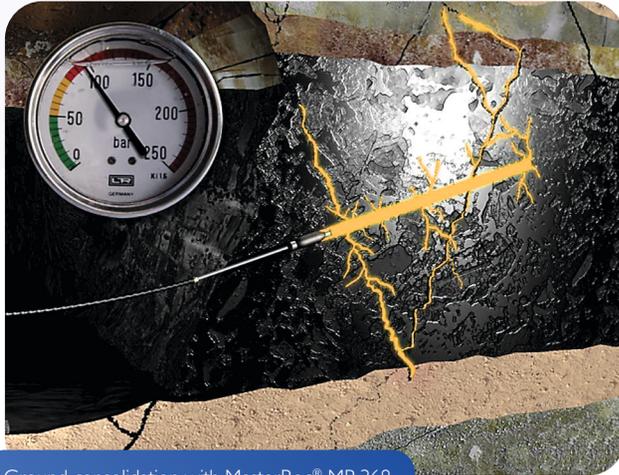
Polyurethane and Polyurea Silicates

Water Stopping, Water Sealing, Consolidation and Cavity Filling

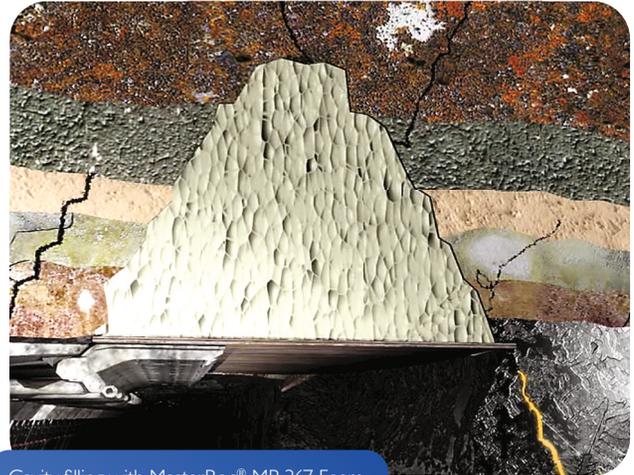
The MasterRoc® MP 350 series of polyurethanes and the fire-resistant (according to DIN4102-B2) MasterRoc® MP 360 series of polyurea silicates are designed for water stopping and sealing, strata consolidation and cavity filling applications, meeting the modern-day demands of the tunneling and mining industry. The range varies from a convenient 1-component PU for small water sealing jobs to specialist robust 2-component systems to effectively stop massive water ingress problems.

Many of the products for preventing water ingress can be adjusted on site to give varying performance properties to suit the conditions using different accelerators. All MasterRoc® MP polyurethane and polyurea silicate products are solvent free, and all foaming products build closed-cell foams, acting as a water barrier. They have been tested and certified by external institutes in terms of technical properties and health and safety aspects.





Ground consolidation with MasterRoc® MP 368



Cavity filling with MasterRoc® MP 367 Foam

Water Stopping

MasterRoc® MP 355 IK

- To stop low- to mid-volume water ingress
- Foaming time: 10 to 50 seconds
- Foam factor: 20 to 30
- MasterRoc® MP 355 IK DW is an almost identical product with a potable water approval and more flexible behavior
- 1-component pump

MasterRoc® MP 355

- To stop mid- to high-volume water ingress
- Reaction time: 10 to 70 seconds depending on accelerator type and amount
- Foam factor: 8 to 20 depending on accelerator type and amount of water
- MasterRoc® MP 355 Thix is a similar product for very high-volume water ingress
- 2-component pump

Water Sealing

MasterRoc® MP 350

- For permanent structural crack sealing of concrete and masonry structures
- Reaction time: 30 to 100 seconds (accelerator provided to adjust reaction time)
- Foam factor: up to 8
- 1-component pump

Ground Consolidation

MasterRoc® MP 358 GS / MP 358 SC

- To consolidate fractured ground, low sensitivity to water
- Reaction time: 30 to 70 seconds
- Foam factor: GS – up to 1.5, SC – up to 3
- 2-component pump

MasterRoc® MP 368

- Dense glue-like resin for fractured rock, gravel and coal, not sensitive to water
- Gel time / solidification time: 90 seconds / 160 seconds
- Foam factor: 1
- 2-component pump

MasterRoc® MP 367 Foam

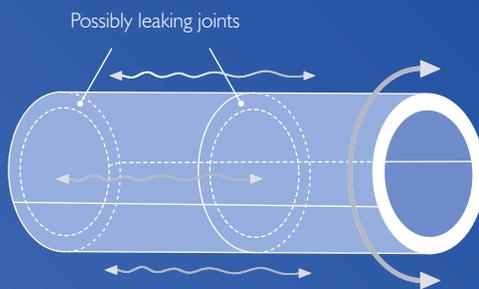
- Brittle foam for cavity filling in rock, gravel and coal, not sensitive to water
- Foaming time: 20 to 60 seconds
- Foam factor: up to 30
- 2-component pump

MasterRoc® MP 368 TIX

- Thixotropic dense glue-like resin for very fractured rock and strata, not sensitive to water
- Gel time / solidification time: 140 seconds / 210 seconds
- 2-component pump

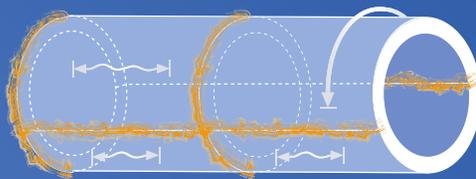
Acrylic Resins

Crack injection in tunnel linings



Water can flow in every direction, before and during injection

Goal of injection into sections and barriers: subsequently removing water



Strong Durable Gels for Crack Sealing and Concrete Rehabilitation

The MasterRoc® MP acrylic series is a range of high-performance acrylic resins that permanently seal the finest cracks in concrete instantly and even accommodate limited movement due to their flexibility and swelling capability. They are also ideal products for curtain injection behind leaking tunnel linings and diaphragm walls.

Furthermore, they can stabilize weak soil and sand immediately and seal off water. They are widely used in major infrastructure projects such as power stations' generator housings for the permanent waterproofing of concrete defects.

Certification

The European CE certificate specifies requirements and conformity criteria for the identification, performance (including durability aspects) and safety of injection products for the repair and protection of concrete structures.

Two of our latest acrylics, MasterRoc® MP 303 CE and MP 307 CE have CE certification for the "swelling fitted filling of cracks, voids and interstices in concrete" according to EN 1504-5.

Mastering underground construction challenges requires the right partner. Continuous innovation and customized solutions ensure that customers using Master Builders Solutions® operate successfully, and to the highest safety standards.

Crack Sealing and Rehabilitation

MasterRoc® MP 303 CE

- Flexible with good adhesion to wet rock and concrete and can swell up to 200%
- Reaction time: 10 seconds to 3 minutes
- Viscosity: 5 mPa·s
- 2-component pump

MasterRoc® MP 304

- Highly flexible, with good adhesion on damp, wet surfaces, and can swell up to 100%
- Reaction time: 15 seconds and 4 minutes
- Viscosity: 5mPa·s
- 2-component pump

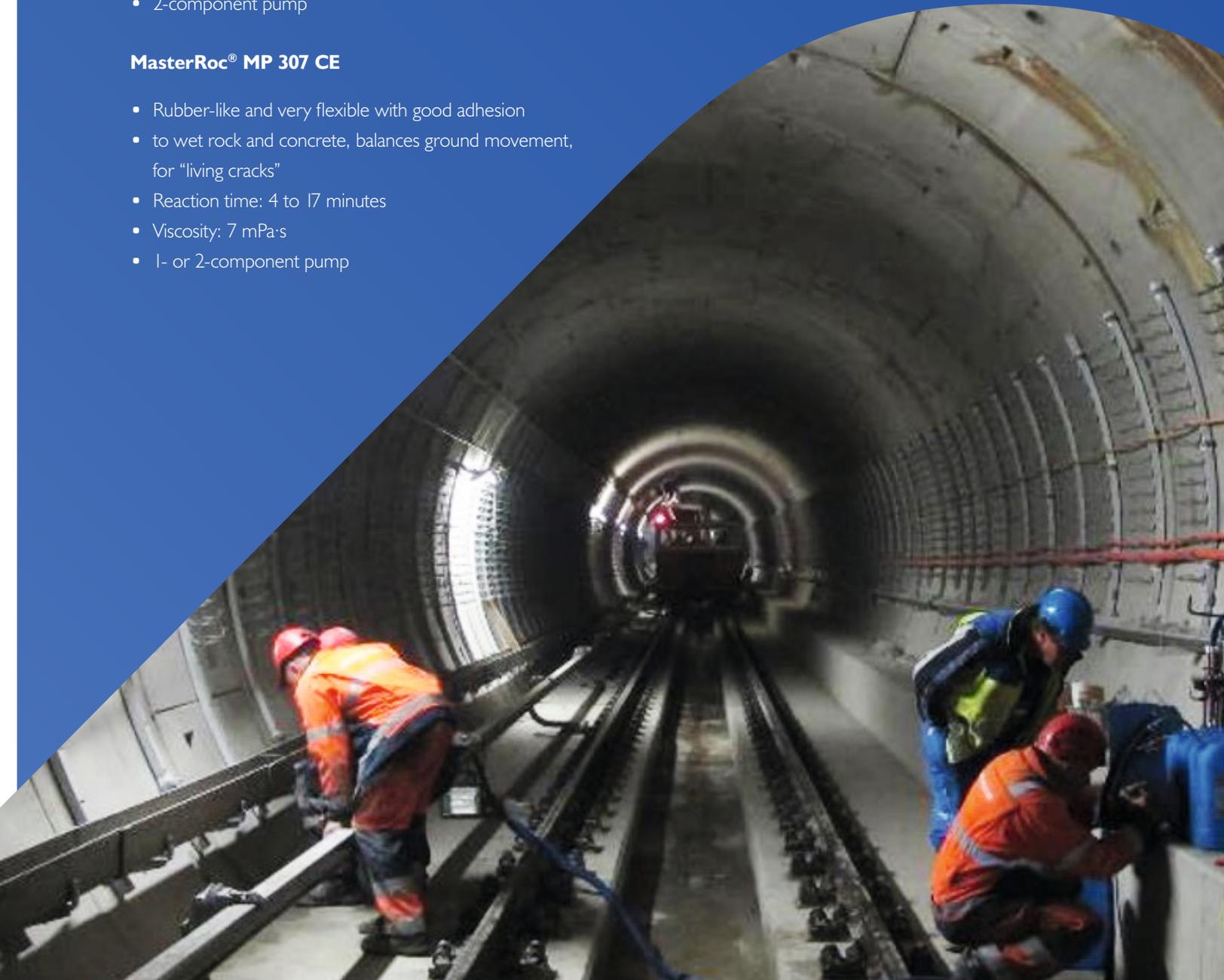
MasterRoc® MP 307 CE

- Rubber-like and very flexible with good adhesion
- to wet rock and concrete, balances ground movement, for "living cracks"
- Reaction time: 4 to 17 minutes
- Viscosity: 7 mPa·s
- 1- or 2-component pump

Ground Consolidation

MasterRoc® MP 309

- Extremely strong with good adhesion to wet
- rock and concrete, for consolidation in silty
- and sandy strata
- Reaction time: 45 seconds to 8.5 minutes
- Viscosity: 13 mPa·s
- 2-component pump



Colloidal Silica



The Mineral Grout

MasterRoc® MP 320 and MP 325 are colloidal silica gels, referred to as "mineral grouts". These are not chemical grouts and consist only of natural ingredients (quartz sand, water and salt). They are made of a stable liquid dispersion of discrete, nanometric spherical particles composed of 100% amorphous silicon dioxide. The colloidal silica products are used in jointed rock and fine grained soils mostly as a supplement to microcement injections to achieve the final required result and where durable long-term solutions for water sealing and ground stabilization are required. Eventual rehabilitation or repairs of leaks simpler and less

time consuming than most other waterproofing systems. Having a viscosity similar to water, colloidal silica penetrates soils and fine rock fissures very easily, ensuring unrivalled penetration and permanent stabilization of fine, silty sands. Unlike sodium-silicate-based products (waterglass), colloidal silica is durable and does not affect the pH value of the ground water, and continually gains strength over time. The gel time can be adjusted to between 10 minutes and 2 hours, allowing for adaptation to the needs of each project. A further benefit is that standard cement injection equipment can be used.



Training and Education

We provide technical injection training courses on a frequent basis centrally located in the Hagerbach underground facility in Switzerland. The courses are organized both as demonstration workshops in realistic underground settings and as practical injection operators' training. The demonstration workshops are practical "show-and-tell" sessions and aim to visualize and explain the possible types of application and the technical performance of our injection systems.

The practical injection operators' training is offered exclusively to injection customers who are working with Master Builders Solutions® injection systems. During this training the participants are given the chance to work in small groups,

taking part in hands-on exercises under the supervision of experienced instructors. The main objective is to gain practical skills for the correct application and execution of injection works. In addition, tailored training is organized for individual projects worldwide when required by customers.

Technical Services

We provide more than simply a range of products. Assisting customers in selecting the right injection system and setting out the injection method, as well as providing initial supervision and site training of the customer's personnel, is an essential part of our concept. We work together with suppliers of equipment and injection accessories to provide the best, most cost-effective and complete technology solution.

More brochures on our underground construction solutions are available at:

ugc.master-builders-solutions.com

Documentation available on request:

- Reference list
- Project reports
- Technical data sheets
- Design guidelines
- Method statements



Master Builders Solutions® for the Construction Industry

MasterAir®

Complete solutions for air entrained concrete

MasterCast®

Solutions for the manufactured concrete product industry

MasterCem®

Solutions for cement manufacture

MasterCO₂re™

Solutions for low-clinker concrete

MasterEase®

Low viscosity for high performance concrete

MasterFinish®

Solutions for formwork treatment and surface improvement

MasterFiber®

Comprehensive solutions for fiber reinforced concrete

MasterGlenium®

Solutions for high performance concrete

MasterKure®

Solutions for concrete curing

MasterLife®

Solutions for enhanced durability

MasterMatrix®

Advanced rheology control for concrete

MasterPel®

Solutions for hydrophobization, anti-efflorescence and surface protection

MasterPolyheed®

Solutions for mid-range concrete

MasterPozzolith®

Solutions for water-reduced concrete

MasterRheobuild®

Solutions for high strength concrete

MasterRoc®

Solutions for underground construction and surface improvement

MasterSet®

Solutions for set control

MasterSphere®

Solutions for guaranteed freeze-thaw resistance

MasterSuna®

Solutions for sand and gravel in concrete

MasterSure®

Solutions for extraordinary workability retention

Master X-Seed®

Advanced accelerator solutions for concrete

Quantified sustainable benefits. Advanced chemistry by Master Builders Solutions®.

Let the numbers do the talking: We have portrayed some of our most eco-efficient product solutions for concrete and precast production, construction, civil engineering, and flooring.

sustainability.master-builders-solutions.com



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