



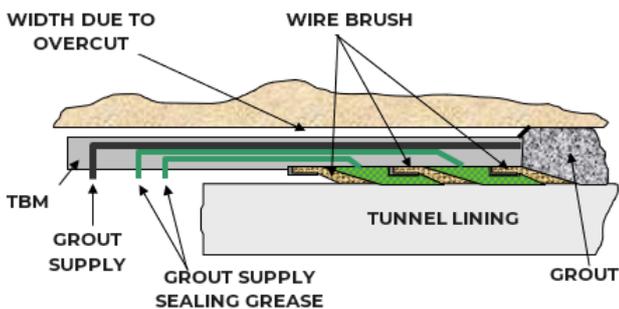
# Building a **SUSTAINABLE** future together

## GREEN SOLUTIONS FOR BACKFILL GROUT: MAPEQUICK CBS ACTIVE CF

MAPEQUICK CBS ACTIVE CF is a hydraulic **cement-free binder** developed by the MAPEI Underground Technology Team (UTT) to replace cement, either partially or totally, for higher strength and lower environmental impact two-component backfill grout used during tunnelling with Tunnel Boring Machines (TBM).

### WHAT IS BACKFILL GROUT?

When a tunnel is excavated using a tunnel boring machine (TBM), the machine cuts a larger diameter than the tunnel lining, which leaves a space between the outside of the lining and the excavation diameter, referred to as "over-cut". This space is most commonly filled with a two-component grout, comprising Part A and Part B, which is continually injected through the tail skin as the TBM progresses. The grout then helps to support the weight of the TBM, minimises ground movement and consequently the risk of subsidence (1).



*Tunnel Excavation with TBM Injecting Backfill Grout*

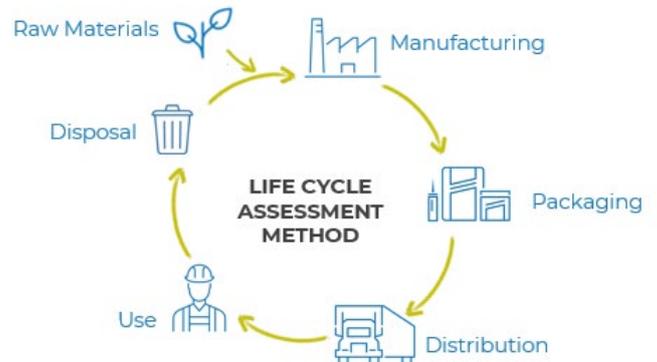
### HOW DOES BACKFILL GROUT IMPACT THE ENVIRONMENT?

Cement is the primary material component in backfill grout, and the production of cement is a highly energy-intensive process (2). Portland cement manufacturing is reported to contribute eight percent of global greenhouse gas emissions (3). With growing awareness of the damaging effects Carbon Dioxide and other Greenhouse Gas

emissions have on the earth's climate, achieving a reduced consumption of Portland Cement and the associated Greenhouse Gas emissions have become a vital indicator of a construction project's environmental impact (4).

### HOW IS THE ENVIRONMENTAL IMPACT MEASURED?

According to the international standards ISO 14040:2006 and ISO 14044:2018, the environmental impact of construction products can be evaluated using the Life Cycle Assessment methodology (LCA). An LCA follows either a cradle to gate or cradle to grave approach. The first considers the impact up to the packaging, and the latter makes an assessment right through to disposal.



*Life Cycle Assessment Method*

Among other environmental impact categories, the LCA measures Greenhouse Gas emissions with the index  $GWP_{100}$ , which expresses the total amount of gas emitted in kilograms of  $CO_2$  equivalent ( $kg CO_2$ ) during the product's life cycle.

### GLOBAL WARMING POTENTIAL



$GWP_{100}$  – Global Warming Potential refers to the emission/presence of GHGs (Greenhouse gasses) in the atmosphere (mainly  $CO_2$   $N_2O$   $CH_4$ ), which contribute to the increase in the temperature of the planet



A comparison using the LCA between Portland cement (5) and MAPEQUICK CBS ACTIVE CF showed that MAPEQUICK CBS ACTIVE CF offered up to a 56% saving in CO<sub>2</sub> emissions - a significant saving for a major project.

| UNIT                   | 1 kg MAPEQUICK CBS ACTIVE CF | 1 kg GP CEMENT (BAGGED) | IMPROVEMENT WITH MAPEQUICK CBS ACTIVE CF |
|------------------------|------------------------------|-------------------------|--|
| kg CO <sub>2</sub> eq. | 0.40                         | 0.90                    | 56%                                      |

### HOW MUCH GREENHOUSE GAS EMISSIONS COULD BE REDUCED OVER AN ENTIRE TUNNEL?

If we consider the construction of a 10 km tunnel with a diameter of 10 meters, using 300 kg of cement/m<sup>3</sup> and injecting an average of 5.5 m<sup>3</sup> of grout per lineal meter.

#### PORTLAND CEMENT

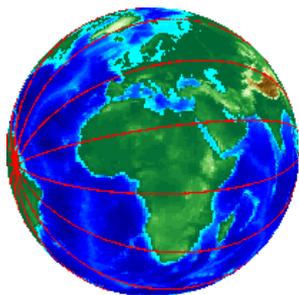
|                              |                 |
|------------------------------|-----------------|
| BACKFILL MATERIAL            | Portland Cement |
| QTY (kg)                     | 16,500,000      |
| kg CO <sub>2</sub>           | 14,850,000      |
| SAVING (kg CO <sub>2</sub> ) | <b>0</b>        |

#### MAPEQUICK CBS ACTIVE CF

|                              |                         |
|------------------------------|-------------------------|
| BACKFILL MATERIAL            | Mapequick CBS Active CF |
| QTY (kg)                     | 16,500,000              |
| kg CO <sub>2</sub>           | 6,600,000               |
| SAVING (kg CO <sub>2</sub> ) | <b>8,250,000</b>        |

The example above shows that **more than half** the Greenhouse Gas emissions that can be attributed to the process of backfill grouting on a tunnelling project could be saved by substituting the

traditional cement binder with MAPEQUICK CBS ACTIVE CF.



To put these numbers into perspective, a reduction of 8,250,000 kg CO<sub>2</sub> eq. emissions equate to **a car driving more than 68 million kilometres**, or

more than 1700 times around the earth's circumference at the equator (6).

### MAPEQUICK CBS ACTIVE CF KEY BENEFITS:

- Improved grout performance with the final strength and stiffness characteristics significantly higher than what is achieved with a conventional cement-based binder system.
- Less overall environmental impact for the project thanks to reduced Greenhouse Gas emissions associated with MAPEQUICK CBS ACTIVE CF compared with conventional cement.

Mapei have the technology and knowledge on how to support your business in green solutions for Backfill Grout.



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#### References:

- 1) <https://library.ita-aites.org/wtc/645-two-component-backfill-grout-system-in-double-shield-hard-rock-tbm-the-legacy-way-tunnel-in-brisbane-australia.html>
- 2) <https://www.mapei.com/au/en/news-and-events/event-detail/2021/03/24/sustainable-solutions-in-cement-manufacturing>
- 3) <http://media.bze.org.au/ZCIndustry/bze-report-rethinking-cement-web.pdf>
- 4) <https://www.isca.org.au/News-and-Media/Industry-News/Rethinking-Cement>
- 5) [https://www.holcim.co.nz/sites/newzealand/files/atoms/files/holcim\\_epd19082019.pdf](https://www.holcim.co.nz/sites/newzealand/files/atoms/files/holcim_epd19082019.pdf)
- 6) <http://co2cars.apps.eea.europa.eu>