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Object Initiative – Share our expertise – whitepaper 'Low Carbon Concrete'

Tractebel's whitepaper on Low Carbon Concrete represents a significant advancement in the pursuit of sustainable construction practices. This document is the first in a series dedicated to low carbon materials and passive emission buildings, underscoring Tractebel's commitment to reducing its carbon footprint both within the organization and in its projects. The whitepaper serves as a comprehensive guide for integrating Low Carbon Concrete into engineering practices to create greener, more livable urban environments.

Concrete and the Low Carbon Economy

Concrete is the third most widely used substance globally, following air and water. Its extensive use in construction is accompanied by a substantial environmental impact, as it accounts for 6-10% of global CO_2 emissions from human activities. The primary source of these emissions is the production of cement, a key ingredient in concrete. Cement production involves heating materials like limestone at high temperatures, which releases significant amounts of CO_2.

Benefits of Concrete

Despite its environmental challenges, concrete remains indispensable due to its numerous benefits:

- Durability and Longevity: Concrete structures are long-lasting and require minimal maintenance, making them resistant to weathering, erosion, and natural disasters.
- Versatility: Concrete can be molded into any shape, making it suitable for a wide range of structural applications.
- Strength: Concrete provides high compressive strength and, when reinforced, good tensile strength.
- Abundant Raw Materials: The raw materials for concrete are widely available, making it a cost-effective building solution.
- Thermal Mass: Concrete's ability to store and release energy over time can enhance building energy efficiency.
- Carbon Sequestration: At the end of its lifecycle, concrete can absorb CO_2 from the air through a process known as carbonation, reducing its overall carbon footprint.

Low Carbon Concrete (LCC)

Low Carbon Concrete is defined by its reduced CO_2 emissions compared to traditional Portland cement concrete. It is categorized into three types:

- Green Concrete: Achieves a 5% or greater reduction in CO_2 emissions.
- Low Carbon Concrete (LCC): Achieves a 20% reduction.
- Very Low Carbon Concrete (VLCC): Achieves a 35% reduction.

Sources of CO_2 in Concrete

The CO_2 emissions associated with concrete come from two main sources:

- Decomposition of Limestone: Heating limestone ($CaCO_3$) produces calcium oxide (CaO) and CO_2.
- Combustion of Fuels: The energy required to heat the materials in cement production comes from burning fossil fuels.

During the lifecycle of concrete, CO_2 is also absorbed through carbonation, which occurs when CO_2 in the air reacts with the hydrated cement phases in the concrete. This process can reduce the net CO_2 emissions of concrete.

Tractebel's Recommendations

To minimize the carbon footprint of concrete, Tractebel recommends:

- Avoiding Portland Cement: Instead, use alternatives like metakaolin and Hoffmann green cement, which have lower CO_2 emissions.
- Reducing Cement Content: Optimize the use of materials and reduce the amount of cement in concrete mixes. This can be achieved by using admixtures like superplasticizers, which reduce water content and, consequently, the required cement.
- Using Less Material in the Structure: Employ design strategies that minimize material use, such as using waffle slabs for the same load-bearing capacity with less concrete. Structural concrete can also serve as a finishing material, reducing the need for additional cladding or coatings.
- Recommendations Allowed by Eurocodes: Specify strength at 56 days instead of the conventional 28 days where appropriate. Use a wider range of cement types and combinations, and permit the use of admixtures to enhance sustainability and reduce CO_2 emissions. Encourage the use of recycled and secondary aggregates when locally available to minimize transportation impacts.

Future Alternatives

Several innovative materials and methods are being developed to further reduce the carbon footprint of concrete:

- Magnesium Silicate-Based Materials: These require less heating and can absorb CO_2 as they harden.
- CO_2-Absorbing Concrete Substitutes: Materials like CO_2NCRETE, which produce significantly less CO_2 during production and absorb CO_2 during their lifecycle.

Tractebel's Commitment

Tractebel is dedicated to sustainability through:

- Integrated Services: Providing comprehensive services at every project stage, from design, project management, construction to exploitation.
- Use of Sustainable Materials: Employing Low Carbon Concrete and other innovative materials to achieve local and global net-zero goals.
- Life Cycle Analysis: Utilizing tools to monitor and reduce the carbon footprint of projects, ensuring sustainable practices are implemented throughout the project lifecycle.

Conclusion

Tractebel's whitepaper - whitepaper: low-carbon-concrete - highlights the importance of eco-design and the use of innovative materials in reducing CO_2 emissions. By focusing on sustainable practices and materials, Tractebel aims to lead the way in creating greener, more livable urban environments. This publication serves as a tool to promote and implement low carbon solutions, reinforcing Tractebel's role in the transition to a low carbon economy.