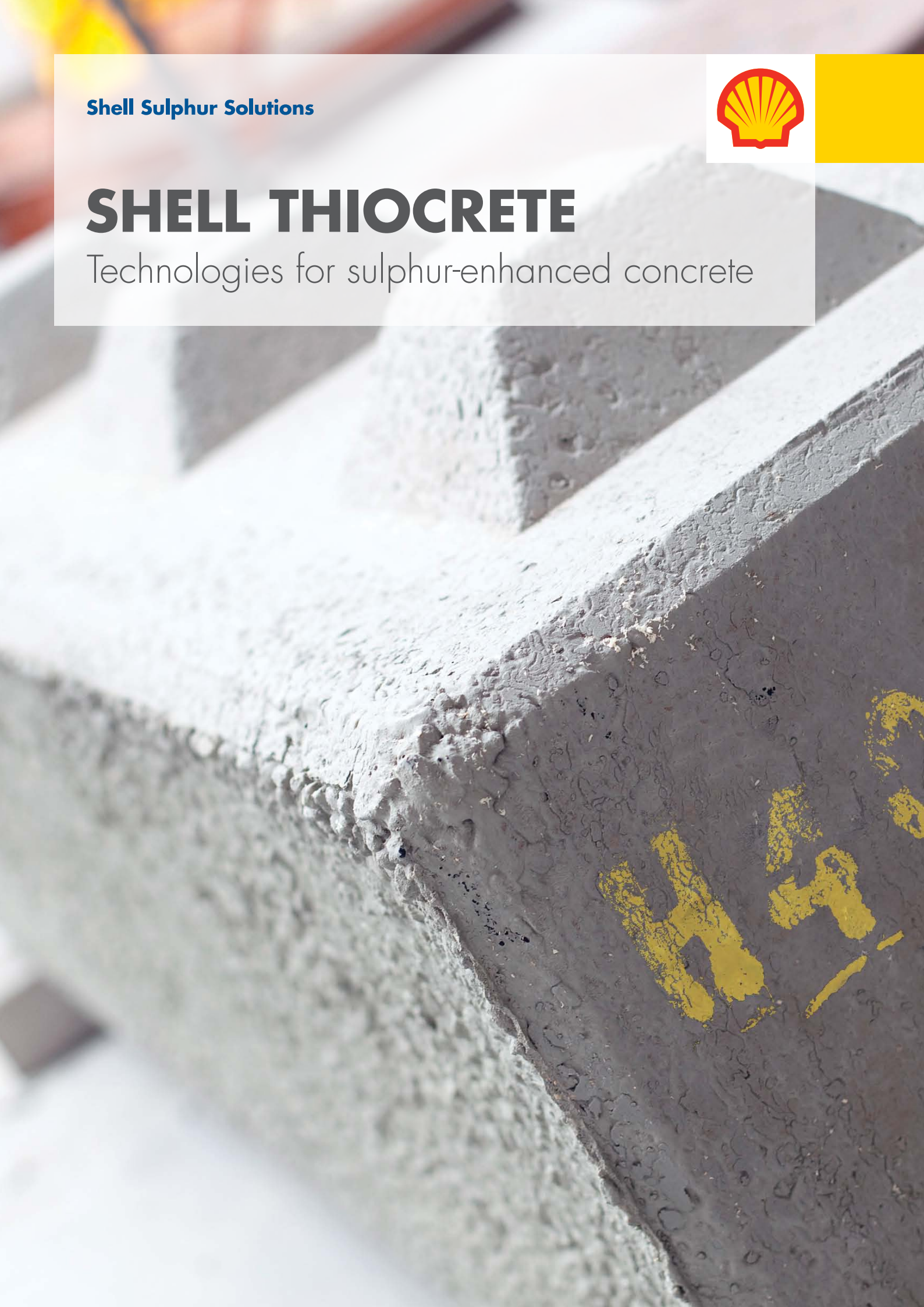


Shell Sulphur Solutions



SHELL THIOCRETE

Technologies for sulphur-enhanced concrete



SHELL THIOCRETE

TECHNOLOGIES FOR SULPHUR-ENHANCED CONCRETE

Shell Thiocrete technologies have been developed to help concrete manufacturers exploit the proven properties of sulphur concrete in a growing number of applications

Unlocking the potential of sulphur concrete

Sulphur has been used as a binder in specialist concrete applications such as chemical factory floors, for more than 30 years. Its properties gave it an advantage over Portland cement. However, because of the high cost of modifying sulphur with traditional technology for use as a concrete binder, it has been limited to specialist applications where its performance properties could justify a higher price than Portland cement.

Shell has developed a new technology* that can bring the cost of sulphur modification down. This means that instead of being limited to niche applications, concrete manufacturers can now offer the advantages of sulphur concrete in a much wider range of products than before.



The science of sulphur concrete

Unlike traditional cementitious binders that rely on chemical bonds being formed when they react with water, Shell Thiocrete uses modified heated liquid sulphur to 'glue' the aggregate together and form a stable, hard concrete product.

The resulting concrete offers a range of performance benefits without the need for special admixtures:

- Significantly improved resistance to acid, salt and water
- Greater compressive (up to 70MPa) and flexural strength (up to 14MPa)
- Easily pigmented to produce a variety of colours, from subtle neutrals to vibrant tones
- Readily moulded to create a wide range of surface textures and finishes.



Making concrete with sulphur

The process for making concrete with Shell Thiocrete is similar to hot asphalt production. A hot mixture of aggregate and modified sulphur is produced and then cast into moulds to create concrete products. Depending on the products being made, customers can choose to install a dedicated production line for sulphur concrete or arrange to use an existing asphalt mixing plant.



*Patent applications for the Shell Thiocrete technologies have been filed.



As well as improving the performance of concrete products, Shell Thiocrete also offers potential process efficiencies at the plant:

- There is no 'curing period' when making Shell Thiocrete concrete – the product gains its final strength on cooling – offering the potential for improved mould utilisation
- Shell Thiocrete broadens the range of materials that can be used in concrete production compared to Portland cement thanks to its better resistance to leaching and the fact that it does not involve hydration processes that are sensitive to chemical conditions.*

Recommended concrete applications

To maintain its high performance, Shell Thiocrete concrete needs to be kept below 100°C. Above this point the bond between Shell Thiocrete and the aggregates in the concrete begins to weaken. From a recycling perspective, this is a positive benefit, as Shell Thiocrete concrete products can be recycled by crushing, reheating and recasting. It does, however, restrict the use of Shell Thiocrete to applications where heat resistance is not required.

We recommend Shell Thiocrete for use in the following applications, based on the performance of prototypes that Shell has tested or commercial products developed by our partners:

- Paving slabs and kerbs
- Revetment blocks
- Drainage channels
- Traffic barriers
- Retaining walls
- Garden products.

Environmental benefits

Shell Thiocrete concrete offers a range of environmental benefits compared to Portland cement concrete:

- There are clear indications from Lifecycle Analysis conducted by Shell that concrete products manufactured with Shell Thiocrete have a significantly lower carbon footprint than those manufactured with Portland cement
- Shell Thiocrete does not require water, removing the energy and infrastructure costs associated with water supply. This is of particular benefit in locations where fresh water is scarce and desalination is necessary
- Shell Thiocrete's products can be recycled by crushing, reheating and remoulding with no significant loss of performance.

*The use of waste materials or problematic aggregates with Shell Thiocrete needs to be assessed on a case by case basis.

THE WAY FORWARD

The first semi commercial Shell Thiocrete production plant opened in July 2010.

To help prospective manufacturers and specifiers from around the world to see close up how the technology works and the quality of products that can be produced using it, Shell opened a prototyping facility near Amsterdam in July 2010.

Shell Thiocrete is entering the commercial phase of its development and Shell is now actively seeking partnerships with progressive manufacturers to deliver high quality sulphur concrete products with a compelling set of benefits:

- **Resistance to water and acid**
- **High strength**
- **Wide range of colours and finishes**
- **Lower carbon footprint than Portland cement**
- **Easy to recycle**
- **Broader range of suitable aggregates**
- **Requires no water.**

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