PowerCem Technologies

Innovations for better solutions!

Content

I. Introducing PowerCem Technologies.
II. What is RoadCem and what does it do in a stabilization.
III. Ability to stabilize all soil types.
IV. Design and Physical properties.
V. Advantages and implementation of RoadCem.
VI. Examples word-wide implementation.
VII. Main construction differences Traditional vs RoadCem in a nutshell.

I. Introducing PowerCem Technologies

Who we are:

PowerCem Technologies BV specializes in the research and development of a range of products contributing to sustainable environmental applications, in particular cement-bound construction works.

- Founded in 1996.
- Principal office in Moerdijk, The Netherlands.
- Applied in 40 countries worldwide.
- Distribution network supported by over 100 persons.

Our Mission:

'Protecting natural resources for the future'.

Testing the technology

PowerCem Technologies develops building materials, that enhance the use of alternative secondary and polluted commodities to yield a high-end quality building material which is cost effective, sustainable and above all environmental friendly.

The PowerCem strategy:

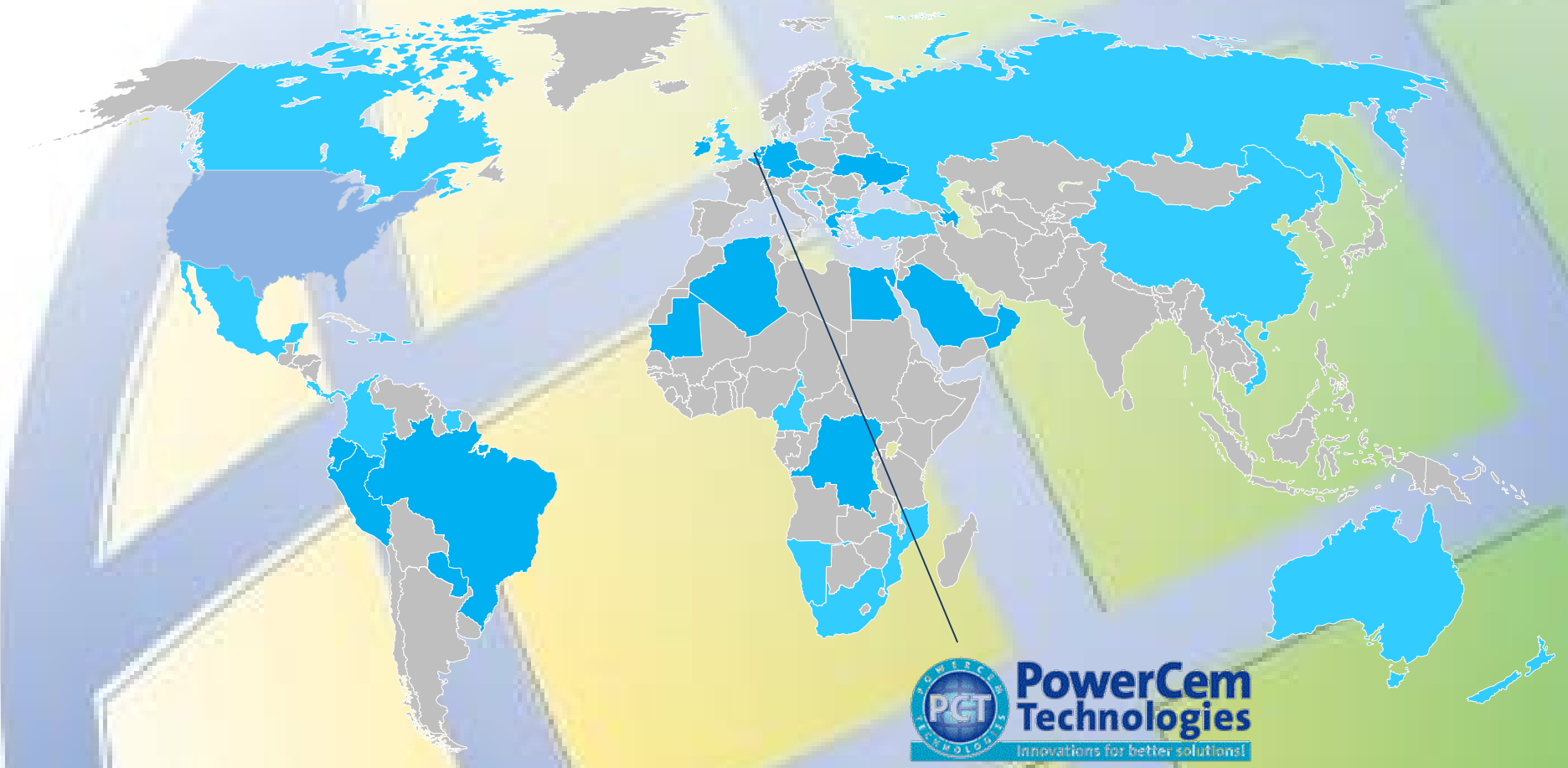
Participation in complex projects worldwide, as an invisible, but technical key component in cement-based materials and constructions.

- Share global knowledge with local partners.
- Teach engineering courses for design and application – to create successful local projects.
- Provide state of the art products.

Our vision:

'Sharing knowledge and providing products, worldwide to create a higher performance of the infrastructure'.

We are a global company



PowerCem all over the world

Armenia
Australia
Belgium
Brazil
Bulgaria
Cameroon
Canada
Colombia
Congo
Croatia
Curacao
Czech Republic
Dominican Republic
Ecuador
Egypt
Germany
Greece
Guatemala
Iraq
Ireland
Mauritania
Mexico
Mozambique
Netherlands
New Zealand
Pakistan
Panama
Paraguay
Peru
Qatar
Russia
Saudi Arabia
Singapore
South Africa
South Sudan
Suriname
Turkey
United Kindom
USA
Vietnam

PowerCem products

- Proprietary chemical composition
- Unique and patented
- Quality control according ISO 9001/14001
- Completely safe!

Literature: Material Safety Data Sheets
Patent of PowerCem Technologies
ISO Certificate

Partners in scientific research and construction engineering

TU Delft
Technische Universiteit Delft

UNESCO

University of the Witwatersrand, Johannesburg

KTH Vetenskap och Konst
Royal Institute of Technology

TNO

Radboud Universiteit Nijmegen

ARCADIS
Infrastructure, environment, buildings

University of Ulster

II. What is RoadCem® and what does it do in a stabilization.

Major benefit categories

- Ability to stabilize all types organic and inorganic soils } **Chemical**

- Improvement strength parameters
- Higher fatigue resistance
- Supports high dynamic forces
- Higher resistance against thermal cracking
- High durability

} **Physical**

Reduction of :

- Overall costs
- Primary materials usage
- Construction traffic
- Construction time
- Low Maintenance
- C2C

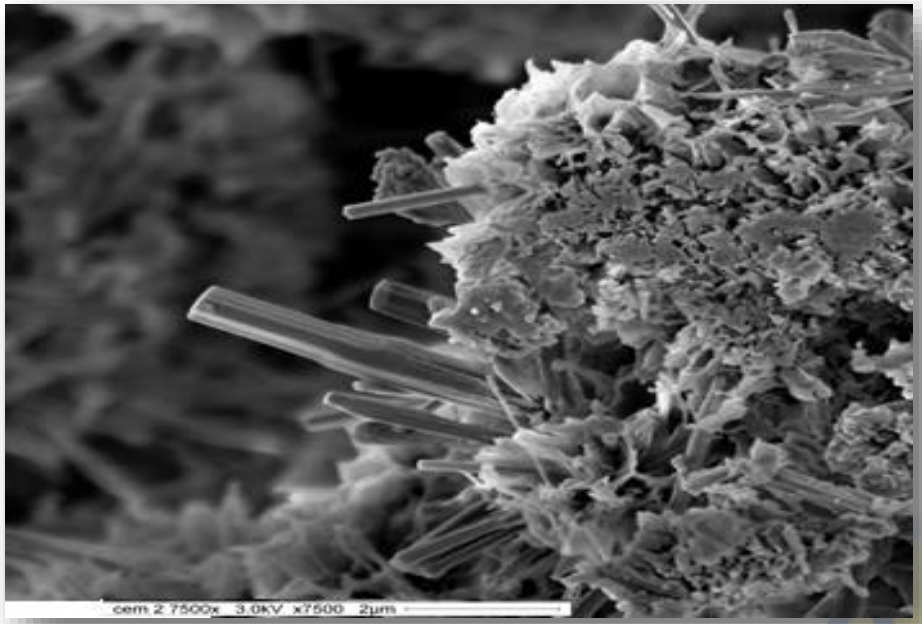
} **Implementation**

The PowerCem Products

- Special composition of synthetic zeolites and alkali earth metals.
- Developed as additive to chemically modify cement bound materials.

Nano Scale Using the RoadCem additive:

Chemical process creates a crystalline needle matrix that form interlocking filaments (thread-like structures) between the material particles (soil & cement) resulting in a flexible structure.

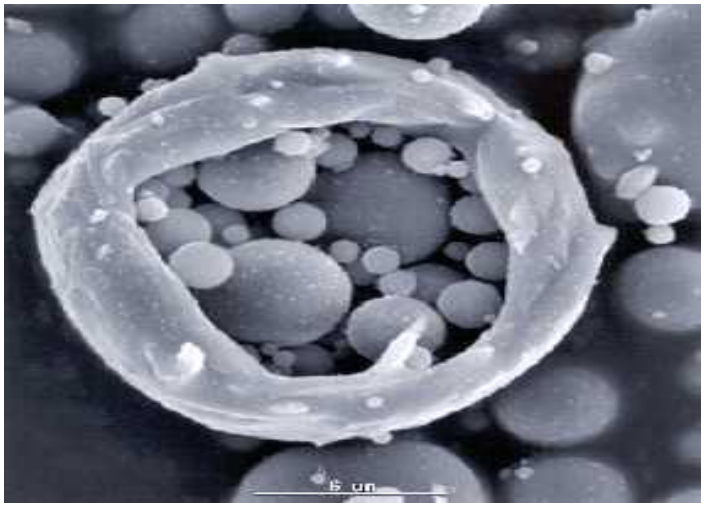


Literature: Nano indentation research on cement structures RADBOUD UNIVERSTY, Netherlands
Effects of using RoadCem, ULSTER UNIVERSITY (Ireland)

Traditional vs RoadCem®

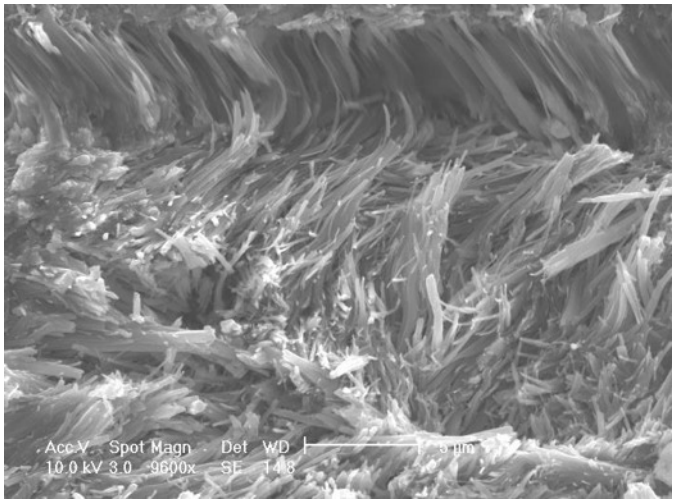
Nano technology!

Traditional Stabilization:



Cement glues the particles together “Brittle”!

RoadCem stabilization:



Formation of strings, interlocking the particles “Flexible”!

Literature: Nano indentation research on cement structures RADBOUD UNIVERSTY, Netherlands
Effects of using RoadCem, ULSTER UNIVERSITY (Ireland)

University of ULSTER

Radboud Universiteit Nijmegen

III. Ability to stabilize all soil types

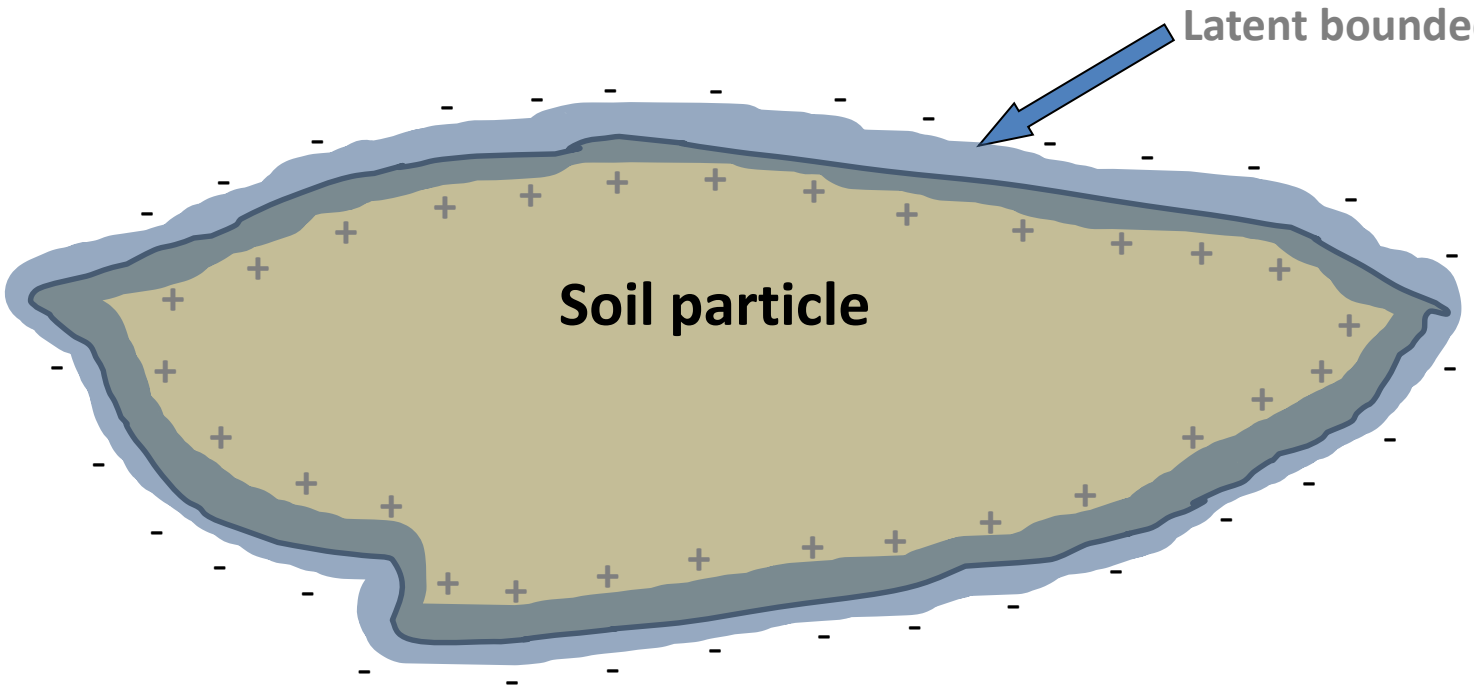
The Effect of RoadCem Technology on the Soil

- Reduction of the surface pressure
- Increase of the pH-value
- Better penetration of the cement into the particles

The Effect of RoadCem Technology on the Soil

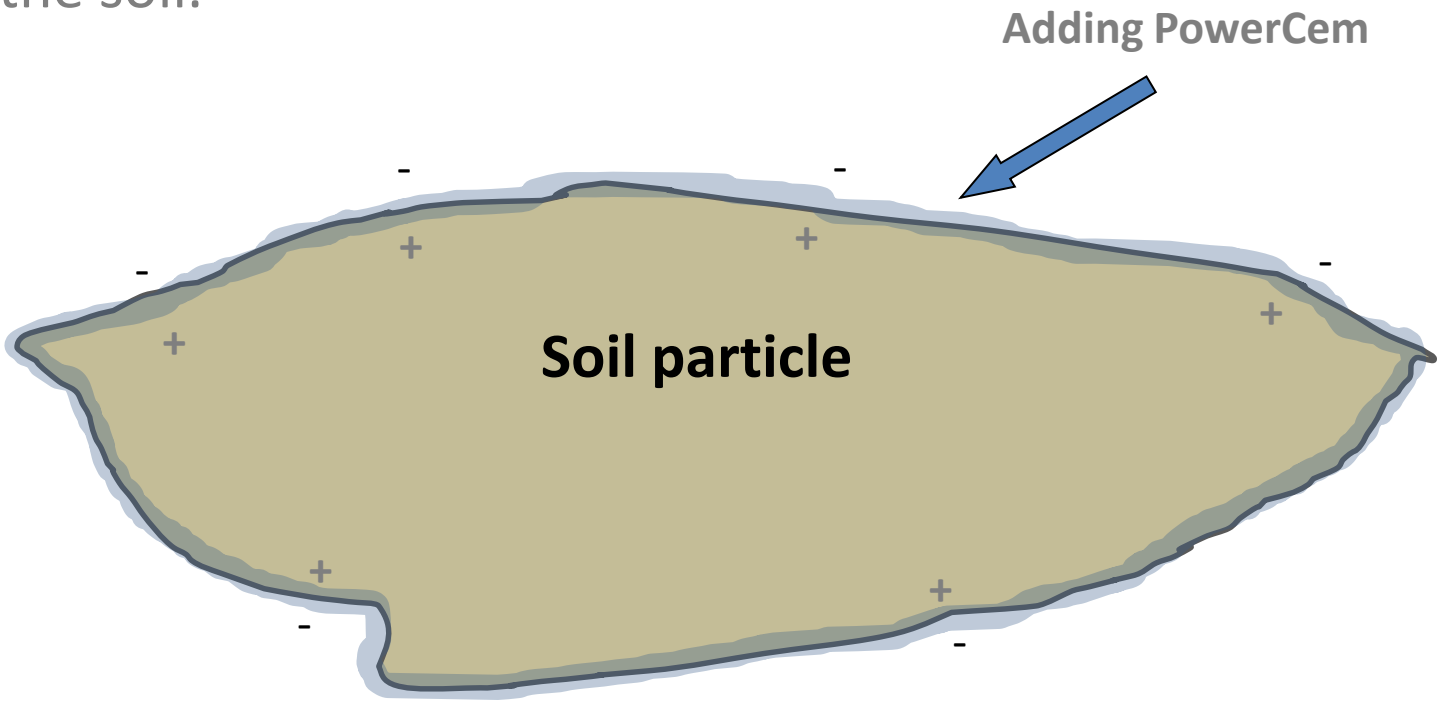
Water barrier prevents cement interfere structure

The latent bound water forms a film around the soil particle



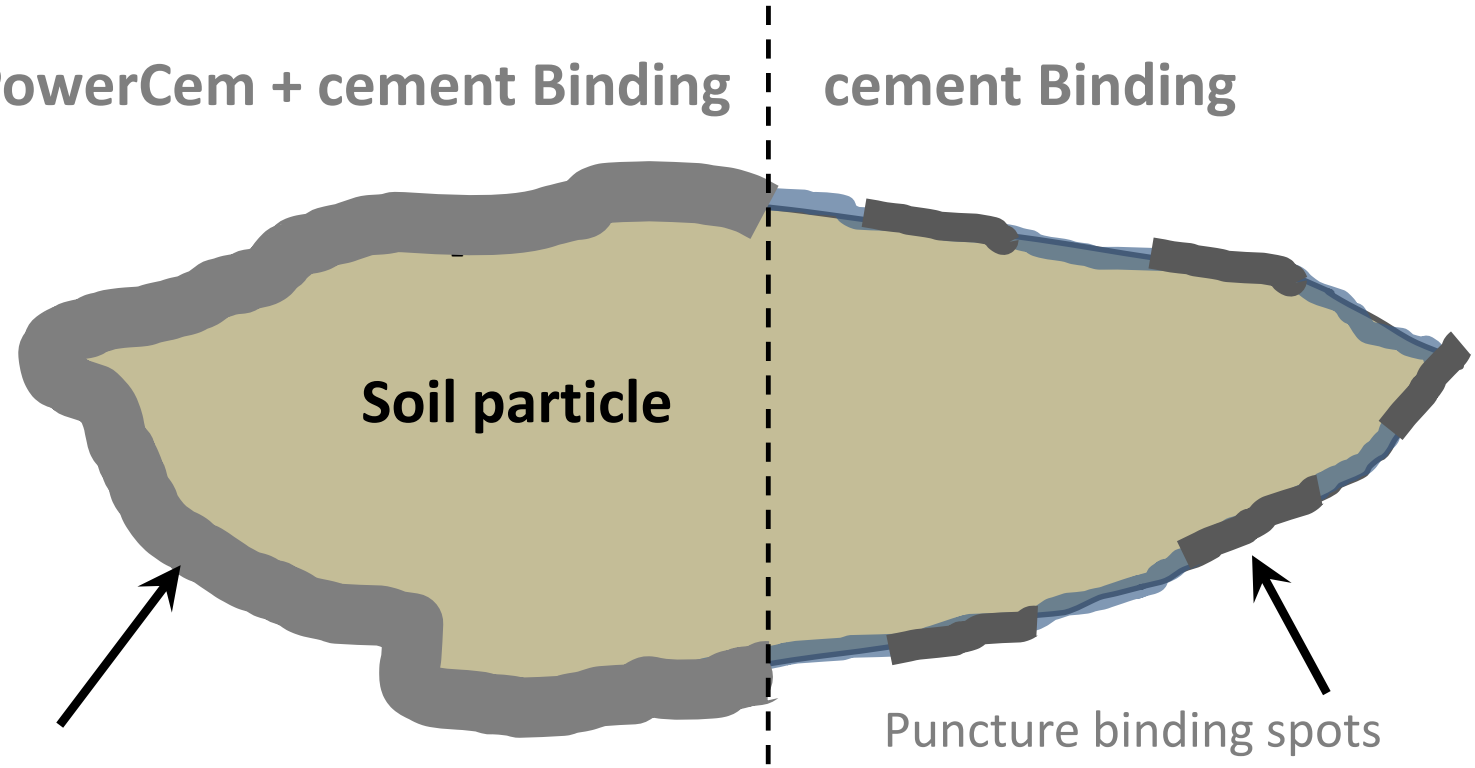
The Effect of RoadCem Technology on the Soil

RoadCem reduces the surface pressure of the water which releases the latent bound water and increases the pH value of the soil.



The Effect of RoadCem Technology on the Soil

Cement plus RoadCem causes a strong binding with the soil particles which results in a strong and durable material.

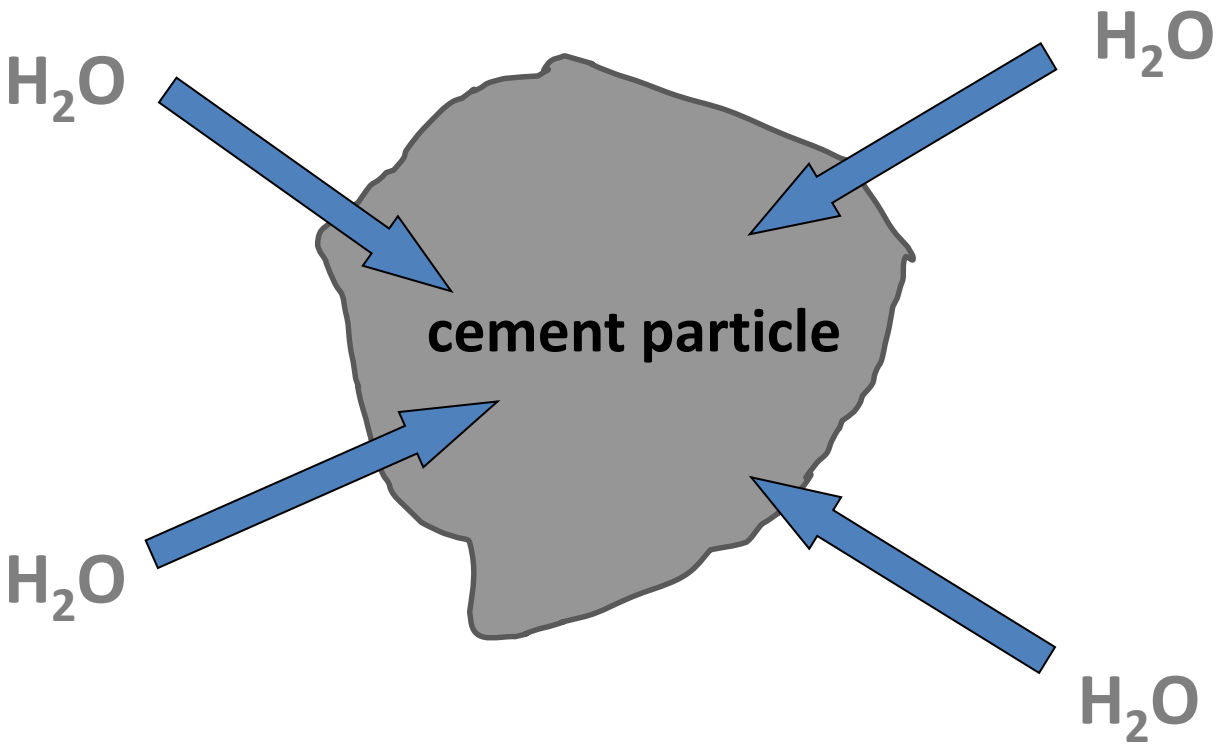


The effect of RoadCem on pozzolanic materials

- Traditional cement hydration with inorganic and organic soils
- Cement hydration using the RoadCem Technology with inorganic and organic soils

Traditional cement hydration

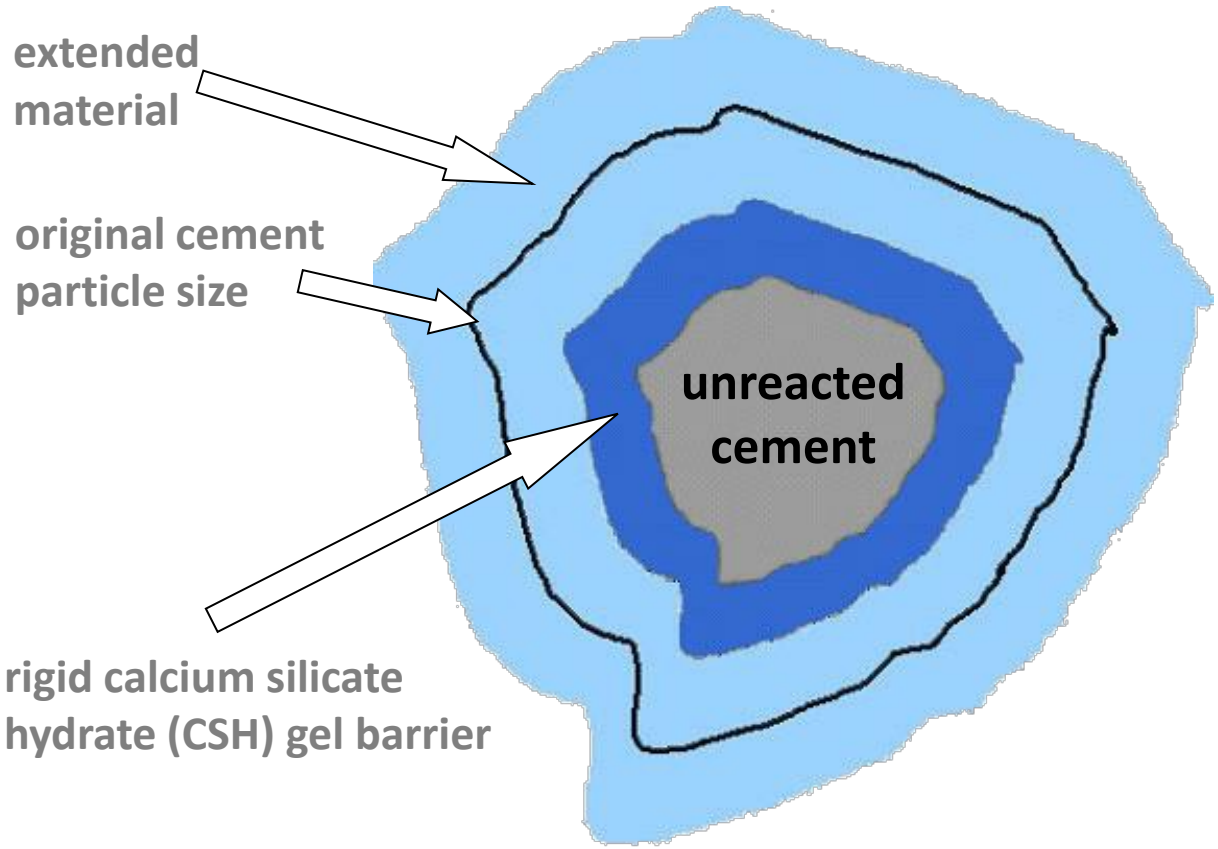
Water enters the cement particle and reacts to form calcium silicate hydrate



$$2(CaO)_3 \cdot SiO_2 + 7H_2O \Longrightarrow (CaO)_3 \cdot 2(SiO_2) \cdot 4H_2O + 3Ca(OH)_2$$

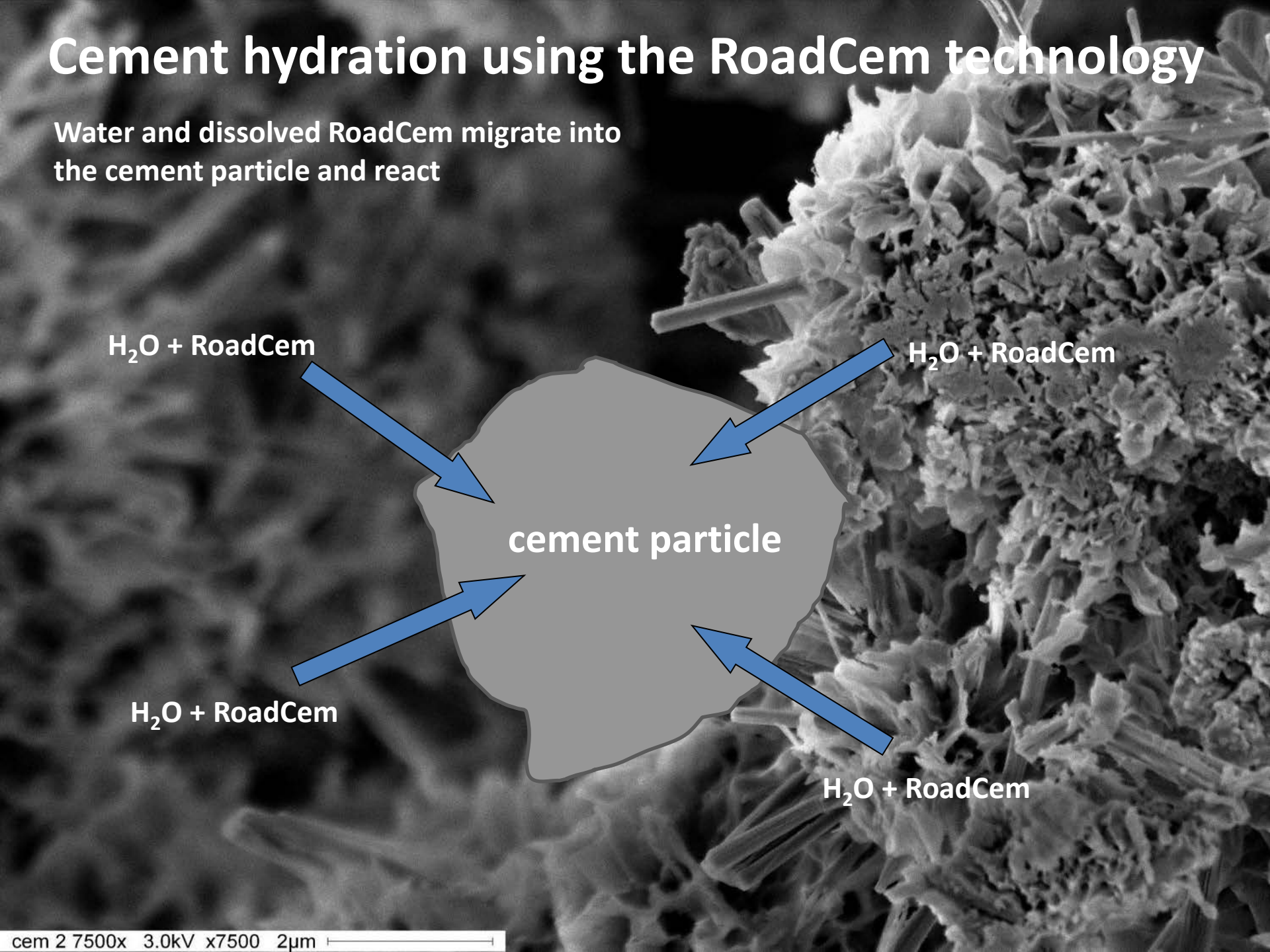
Traditional cement hydration

CSH gel is a barrier to in-depth hydration

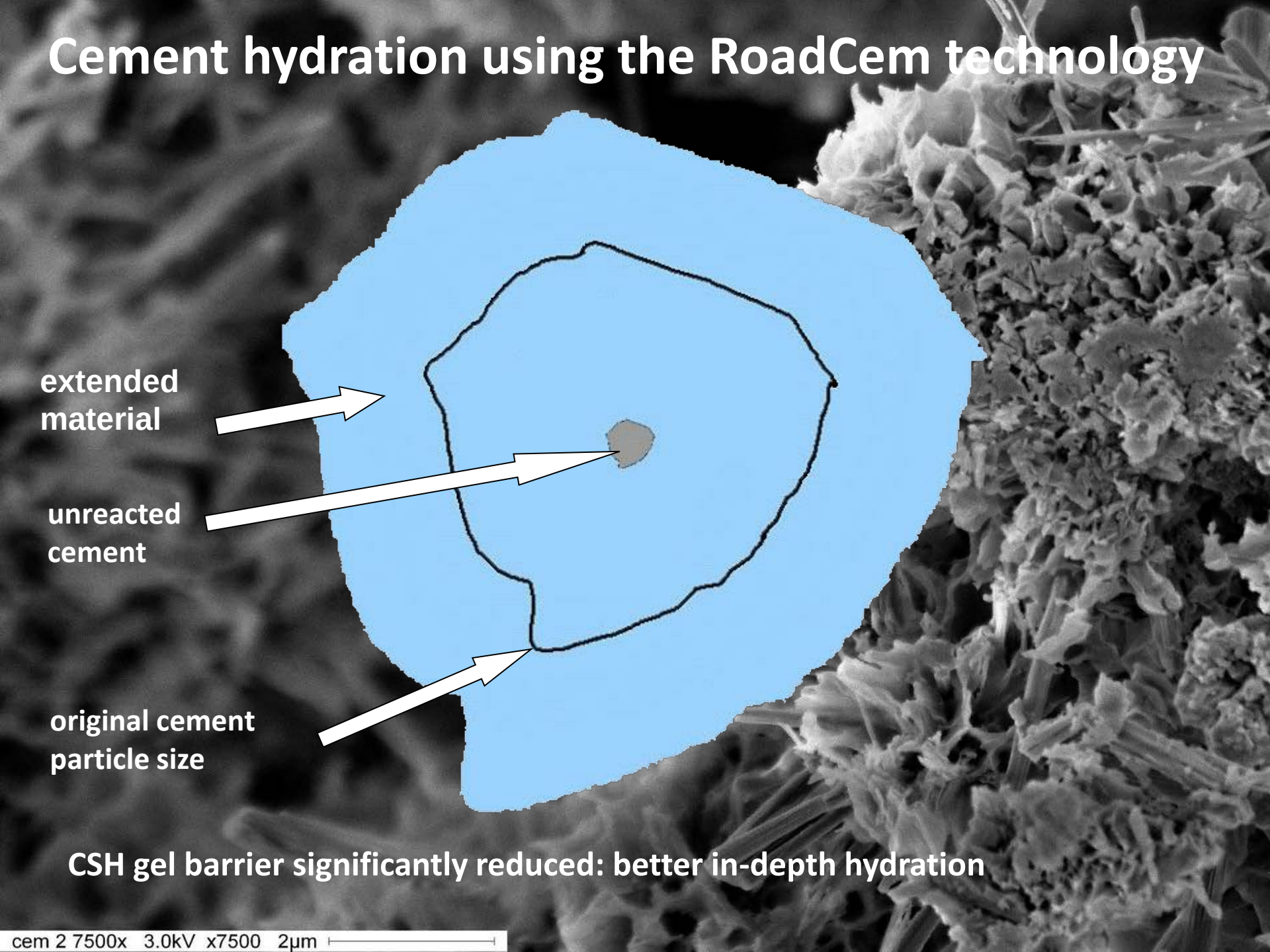


Cement hydration using the RoadCem technology

Water and dissolved RoadCem migrate into the cement particle and react

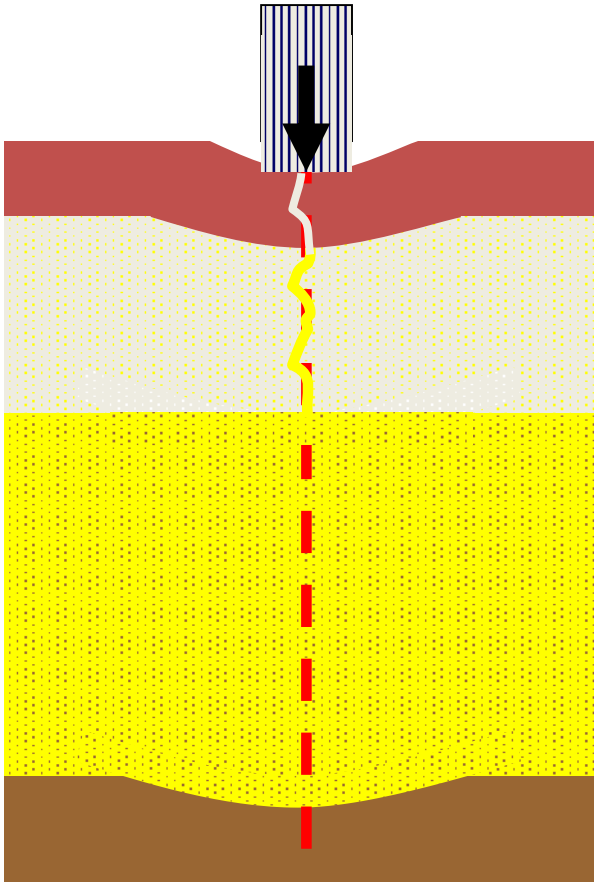


Cement hydration using the RoadCem technology



IV. Design and Physical properties

Design: Road fail mechanisms



Deformation construction

Deformation base course (unbound)

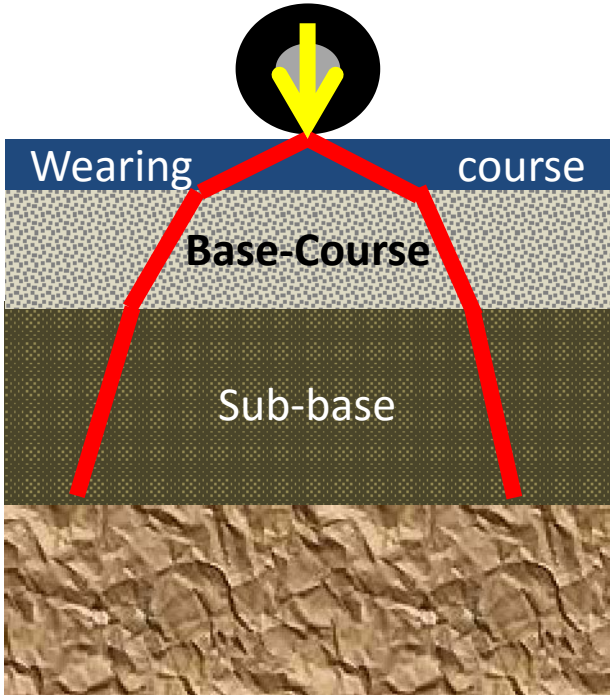
Crack-formation base course (bound)

Deformation sub base

Deformation subgrade

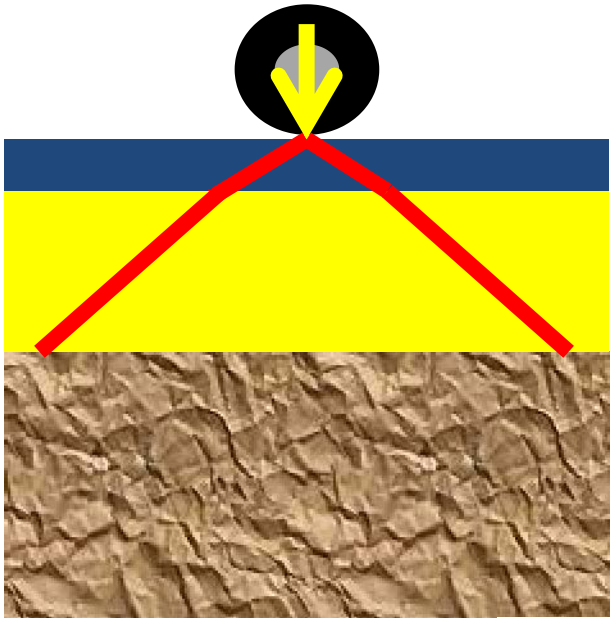
Traditional construction

- Excavation
- Soil disposal
- Requires large amounts of primary materials
- High transportation intensity
- Longer construction time
- Hindrance (traffic jams, noise and air pollution in residential areas) due to building traffic
- Higher cost (primary and secondary)



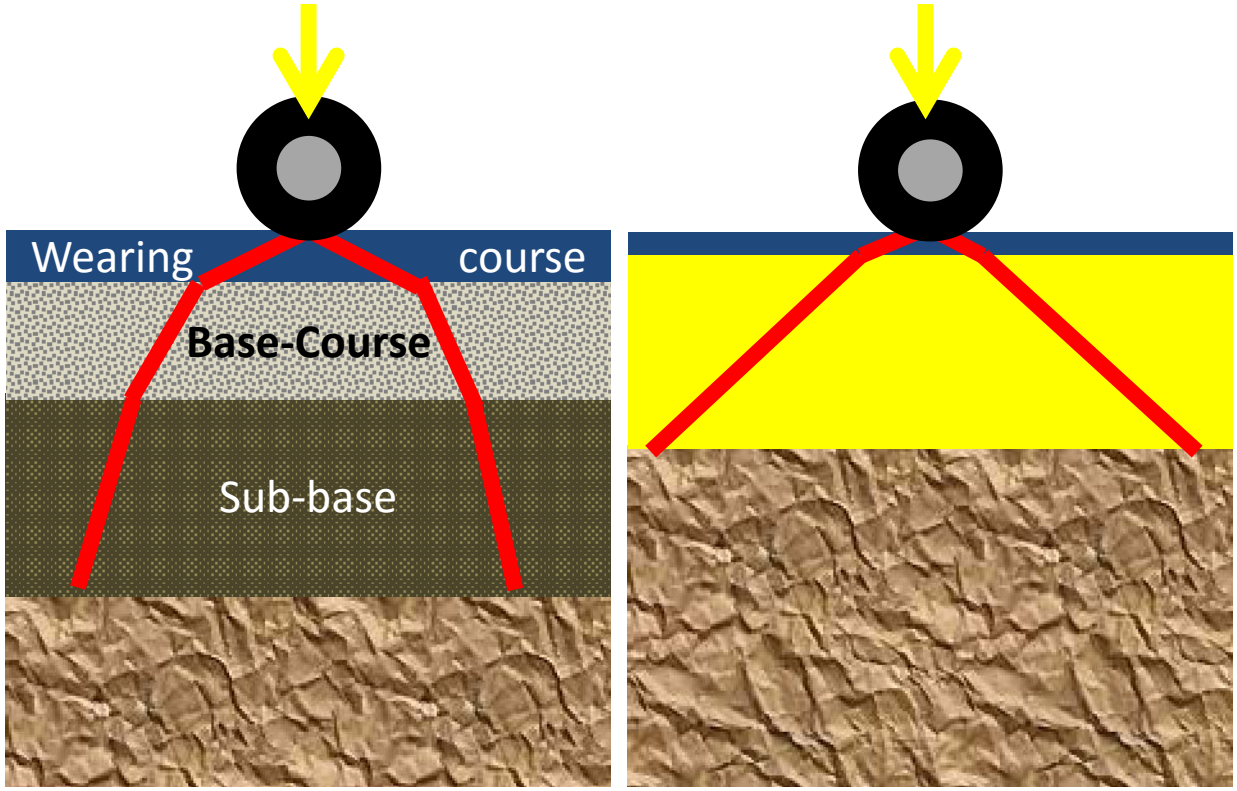
RoadCem construction

- In-situ technique.
- Able to stabilize all types of soil.
- High load spreading.
- Chances of reflective cracking are reduced, due to flexural properties.

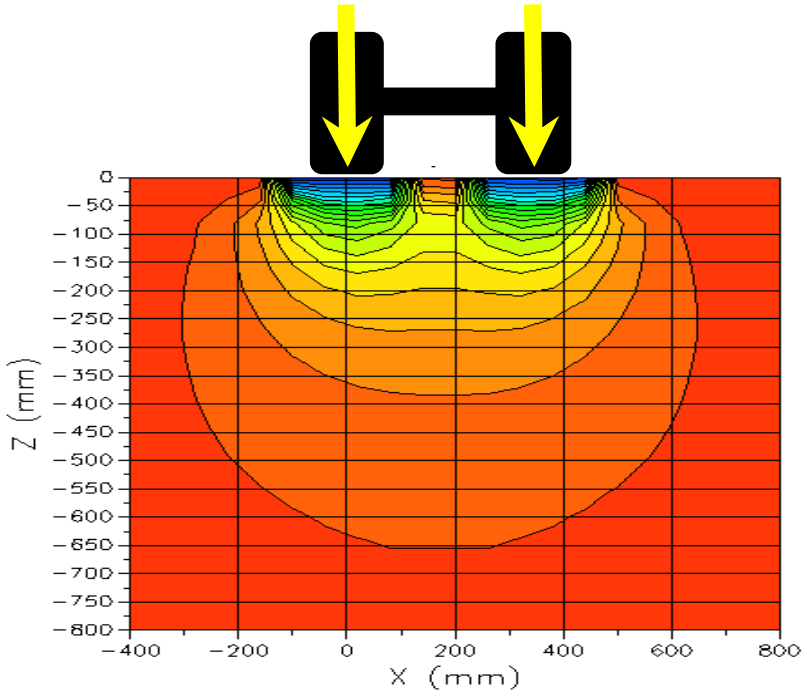


Stresses

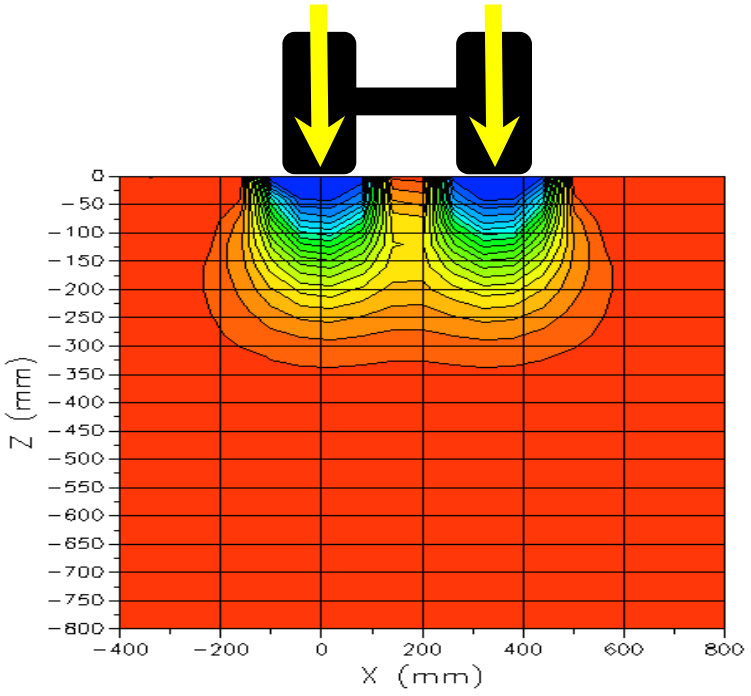
Traditional vs RoadCem construction



Effect of higher dynamic elastic modulus with RoadCem

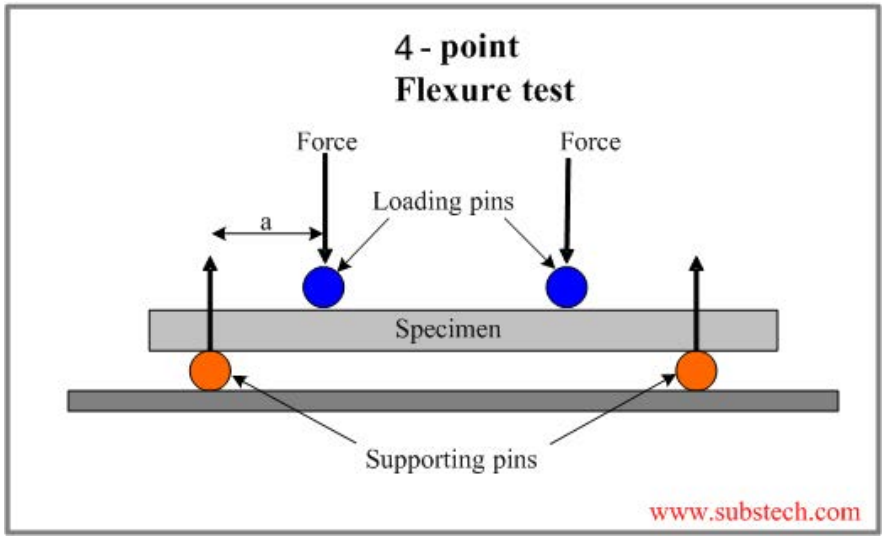


Traditional



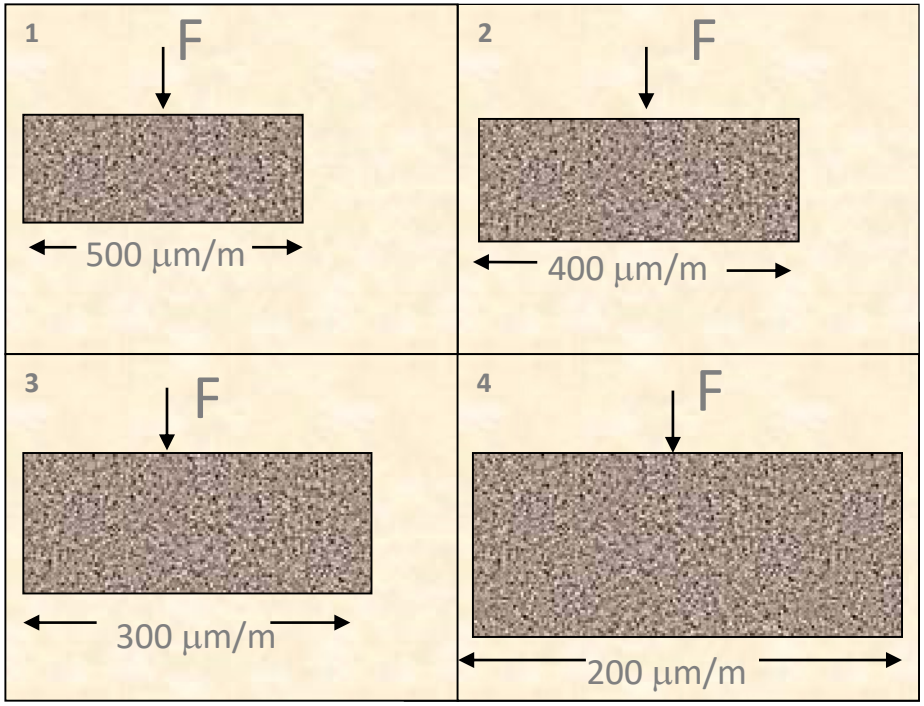
RoadCem

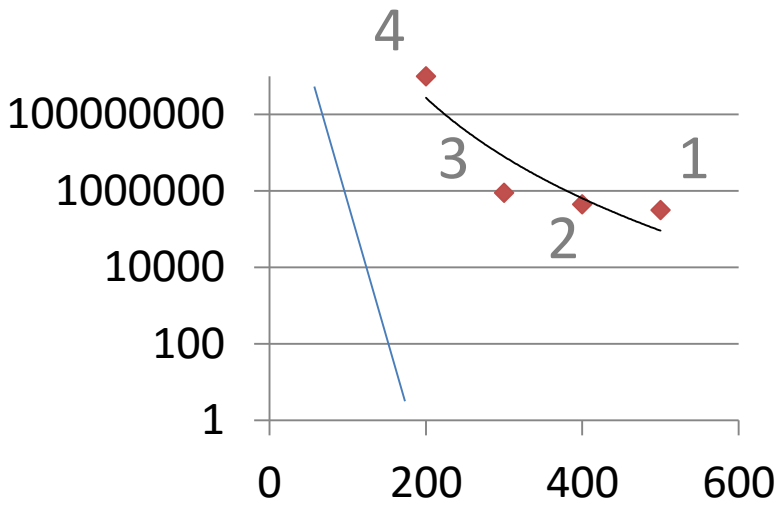
Increased fatigue resistance of in-situ stabilization



Measuring flexural strength; 4 Point bending test

Increased fatigue resistance of in-situ stabilization





Fatigue line: Traditional sand cement stabilization

Fatigue line: RoadCem stabilization

Literature: Cement-bound materials literature study TU Delft

Increased fatigue resistance of in-situ stabilization

- Higher stiffness > better spread of a load.
- Higher dynamic modulus > thinner pavement.
- Increased fatigue resistance > thinner pavement

Limited thickness with RoadCem achieves a longer lifetime.

Literature: Cement-bound materials literature study TU Delft

V. Advantages and implementation of Roadcem.

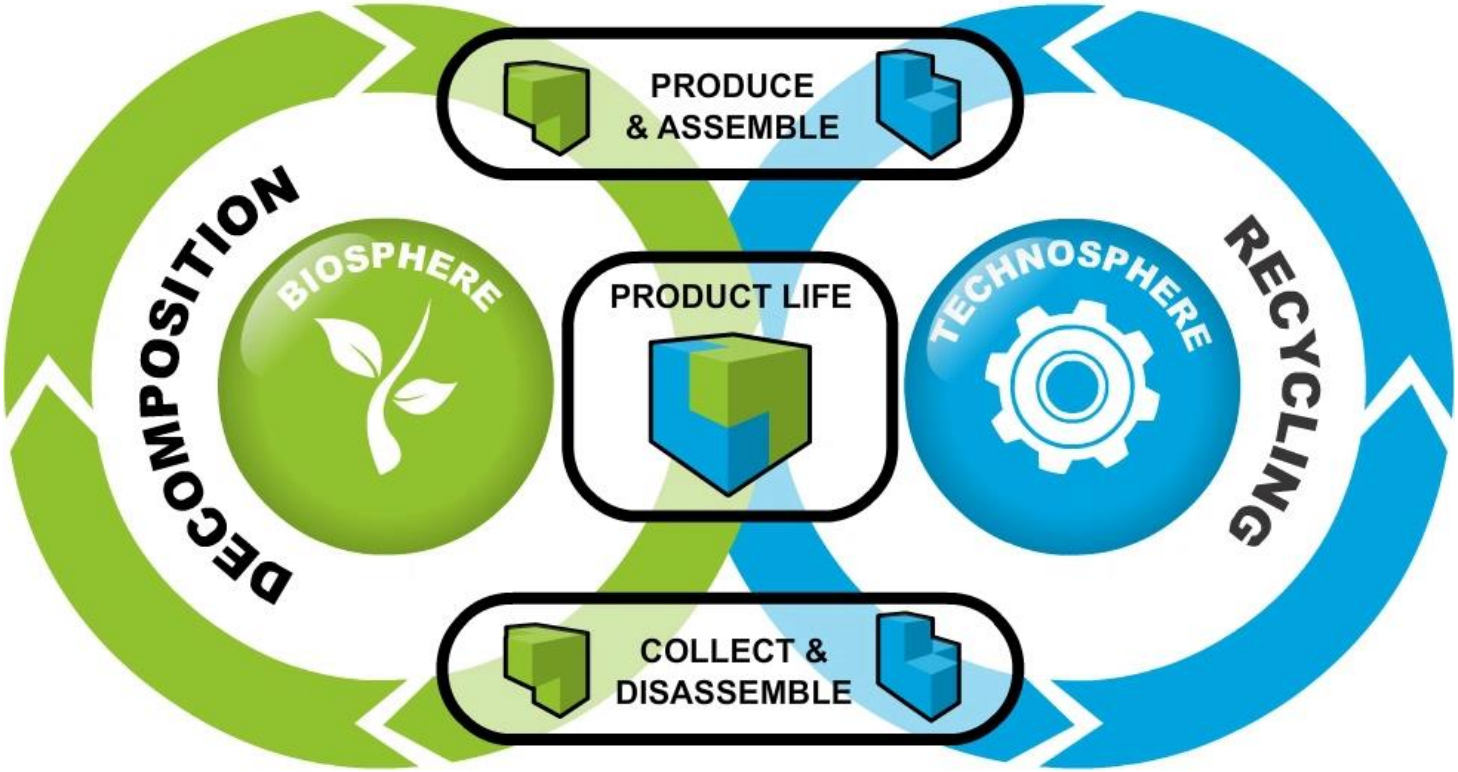
Advantages of using RoadCem

- No Aggregates, 95% Less use of Bitumen
- No Damage from Water (UNESCO Recommended)
- All weather Roads with lifetimes designable from 10 to 100 years
- Can Use Old Pavement Material, reclaimed asphalt, fly ash, iron ore slag
- Adaptive method for any geography, location, soil type and weather

Traditional construction

RoadCem construction

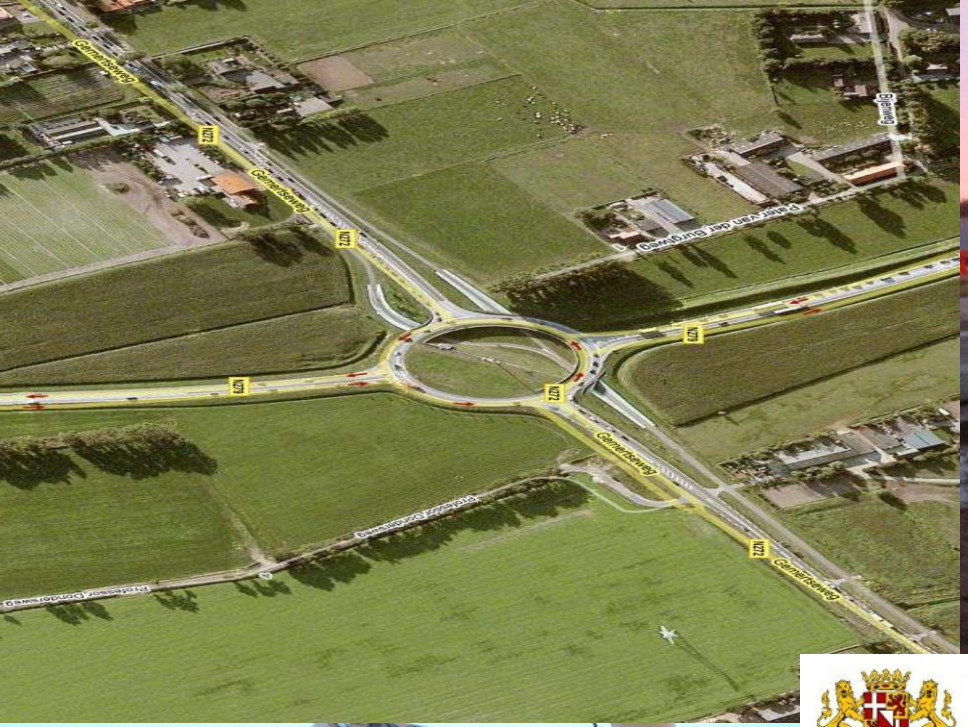
Cradle to Cradle



Cradle to Cradle (C2C) design or regenerative design is a biomimetic approach to the design of products and systems.

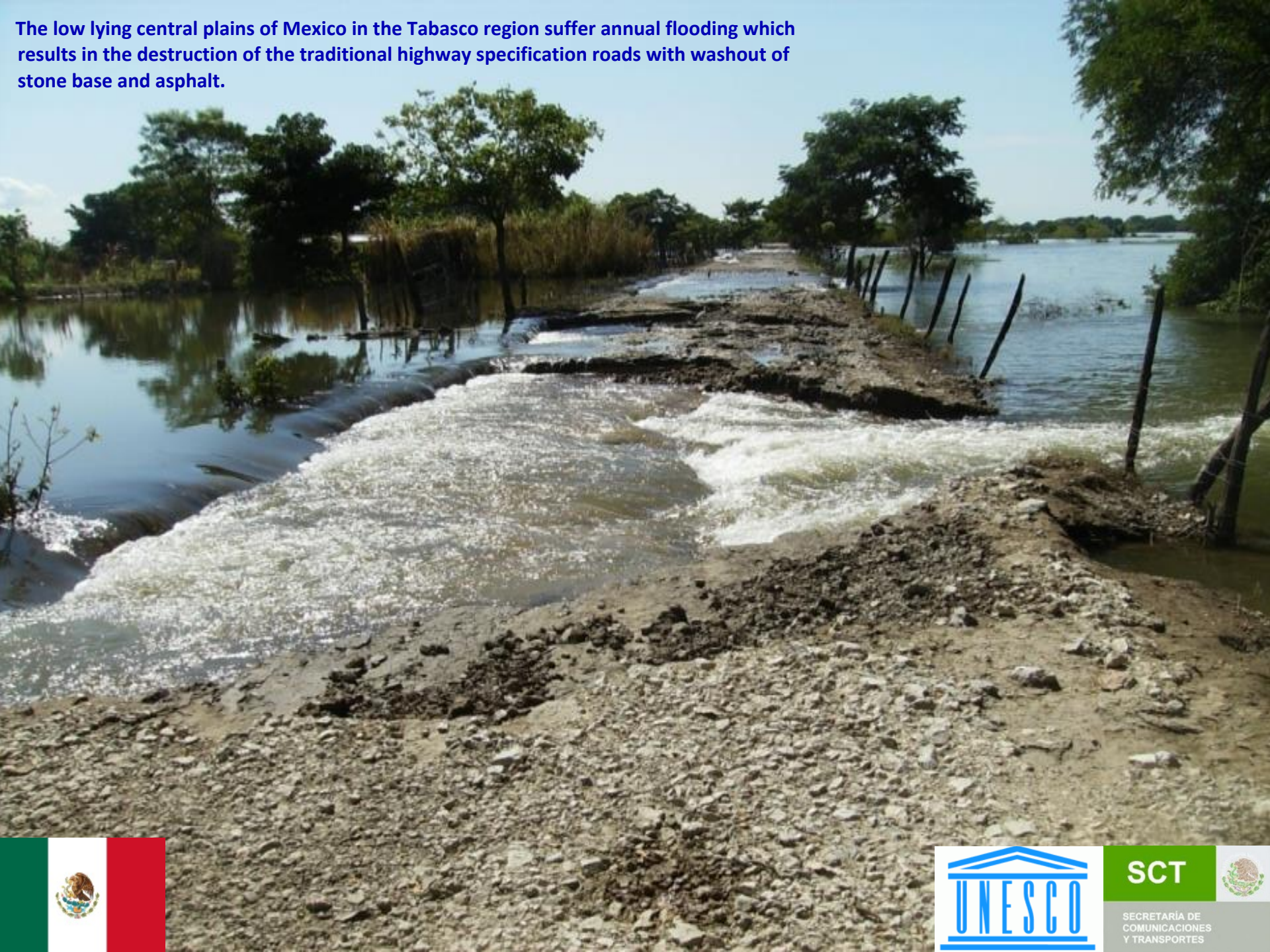
Due to the fact that the pH is neutral, after the lifetime of the bounded material, which can be more than 100 years, it can be crushed and left in the environment. This is particularly interesting when one needs to make temporary access roads.

V. Examples word-wide implementation showing the versatility of the use of RoadCem



In Holland a busy junction needed to be enlarged to cope with increasing volumes of traffic. This was achieved without disrupting traffic by the fast solution of stabilising the existing soils around the traffic island with RoadCem & cement and simply asphalting the stabilised soil base to form additional highway lanes.

ARCADIS


The low lying central plains of Mexico in the Tabasco region suffer annual flooding which results in the destruction of the traditional highway specification roads with washout of stone base and asphalt.
UNESCO
SCT
SECRETARÍA DE COMUNICACIONES Y TRANSPORTES


Since adopting RoadCem stabilised soils roads as standard specification in this region, the only concern when the floods subside is what to do with the dead fish? By the way please note for many roads they do not even bother with asphalt anymore.
UNESCO
SCT
SECRETARÍA DE COMUNICACIONES Y TRANSPORTES

Oil Extraction in the Amazon region requires heavy duty access roads the natural sulphate bearing clays in this area are difficult to maintain in the wet season. This RoadCem road was originally to have an asphalt wearing course. As you can see on the next page it was so strong, they waited for two years of really plant movements before they applied the asphalt.

BR PETROBRAS

Shell Oil are drilling across large swathes of NE Canada in the environmentally sensitive Caribu lands with deep organic clays and bone chilling winters. The access roads they need and heavy duty drilling platforms they need are being built with recyclable RoadCem soil stabilisation. A technology that can treat these deep soils, can survive the winters, is stiff enough to support heavy point loadings and is not damaged or permeated by oil and chemical spills.

When drilling is completed the 1,000,000 lb crawling rig is dismantled and shipped out by the temporary RoadCem haul roads and the 400mm deep RoadCem Platform has the top 10mm removed for disposal before being milled back to natural soil again.

Walton on Thames Road bridge for Costain and Atkins - RoadCem turns organic mud to heavy duty cranes platforms.

Building AWARDS 2014

2 APRIL GROSVENOR HOUSE HOTEL LONDON

Large piling mat constructed for Severn Trent Water with RoadCem - Using existing organic silty soils without import of stone.

No cracking, no breakaway, no deflection, high visco dynamic properties preventing bounce.

"The best mat we ever piled" Bullivant's H&S spokesman.

Building AWARDS 2014

2 APRIL GROSVENOR HOUSE HOTEL LONDON

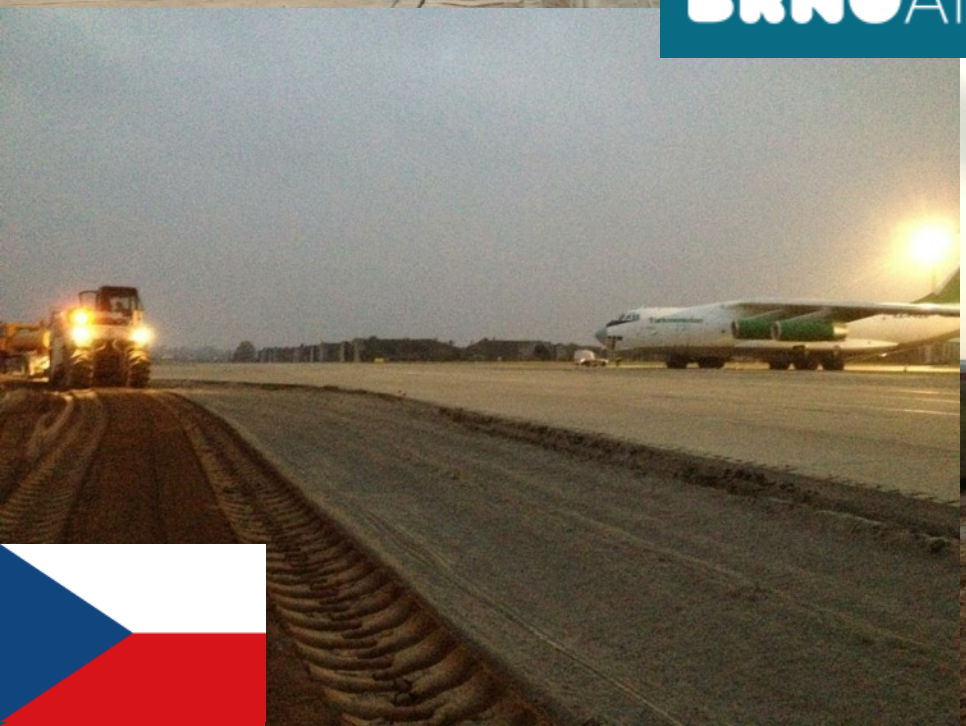
The Walton on Thames road bridge built by Costain plc, major construction award winning project in 2013,14 and 15.

We are proud to say that the crane shown positioning the two part bridge in place is operating on a RoadCem stabilised soil platform, built exclusively from the pre existing site soils.

That is true sustainable innovation.

RoadCem stabilised soil bases for runways and taxiways - strong. stiff and extremely durable with amazing lifespan.

BRNO AIRPORT

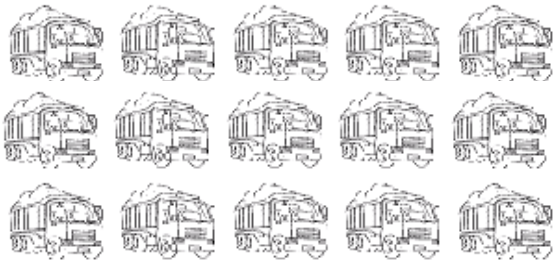
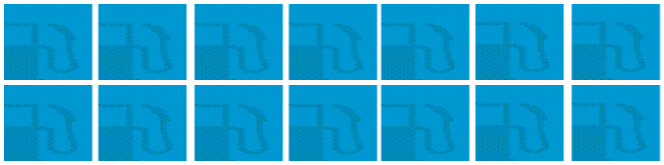


RoadCem pavements for Intensive Static/Slow Moving Load

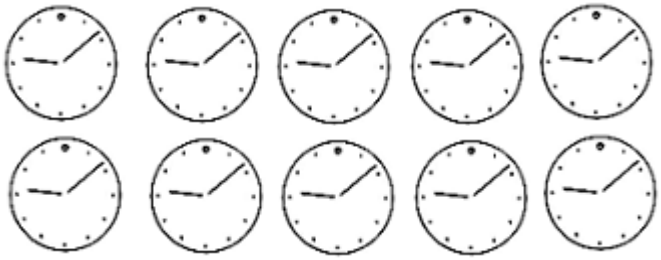
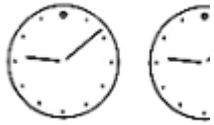
Mexico; Puerta Toluca Rail Terminal

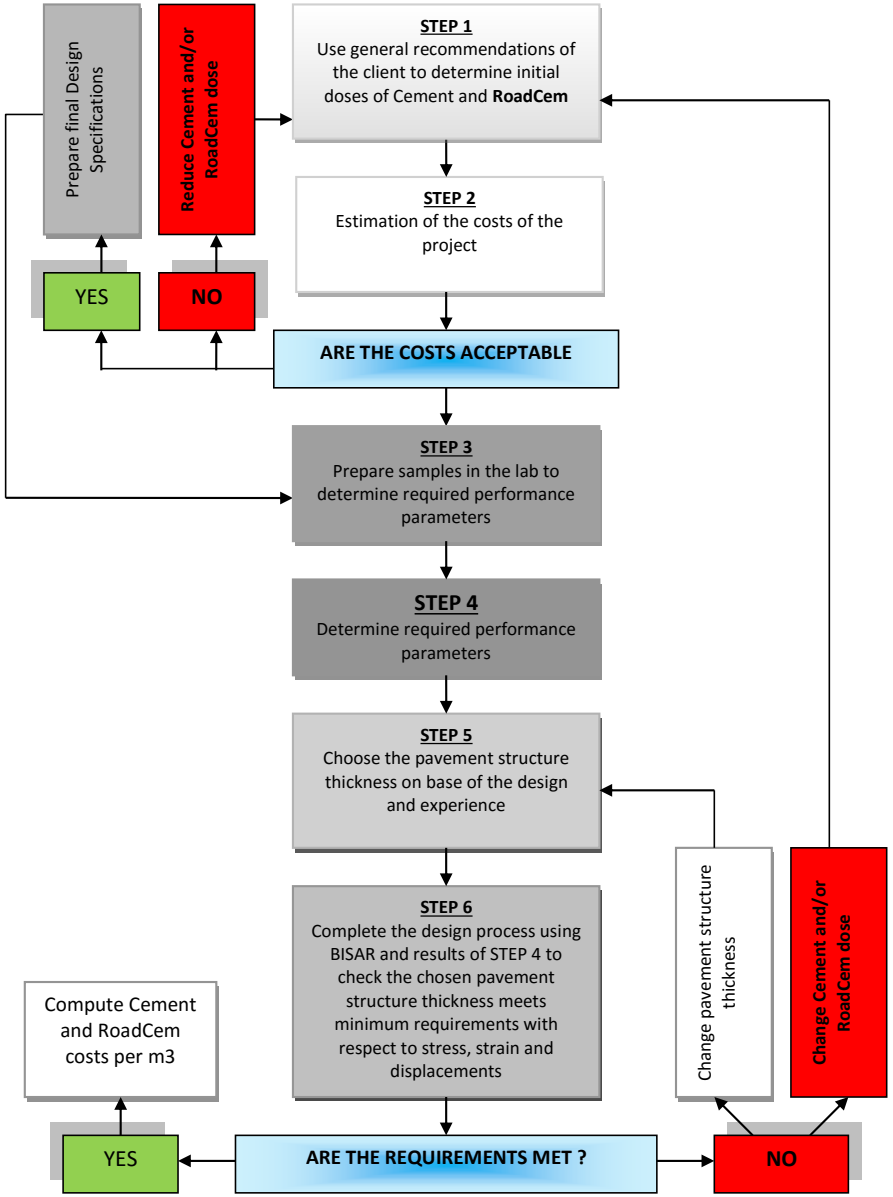
VI. The main construction differences
Traditional vs Roadcem in a nutshell

Example: road length 1000 m, width 7.5 m

Traditional construction	RoadCem construction
	
113 trucks	7,5 trucks
	
2 560 tons of new material	168 tons of new material
	
1 312 tons material to dispose of	0 tons material to dispose of
	
7 125 liters of diesel fuel consumed	1 180 liters of diesel fuel consumed

Example: road length 1000 m, width 7.5 m

Traditional construction	RoadCem construction
	
20 days	3 days
	
	up to 40% cost reduction


Prepare final Design Specifications
Reduce Cement and/or RoadCem dose
STEP 1
Use general recommendations of the client to determine initial doses of Cement and RoadCem
STEP 2
Estimation of the costs of the project
YES
NO
ARE THE COSTS ACCEPTABLE
STEP 3
Prepare samples in the lab to determine required performance parameters
STEP 4
Determine required performance parameters
STEP 5
Choose the pavement structure thickness on base of the design and experience
STEP 6
Complete the design process using BISAR and results of STEP 4 to check the chosen pavement structure thickness meets minimum requirements with respect to stress, strain and displacements
Change pavement structure thickness
Change Cement and/or RoadCem dose
Compute Cement and RoadCem costs per m3
YES
ARE THE REQUIREMENTS MET ?
NO