Exploring Self-Repairing Materials and Their Application Towards Sustainable Design

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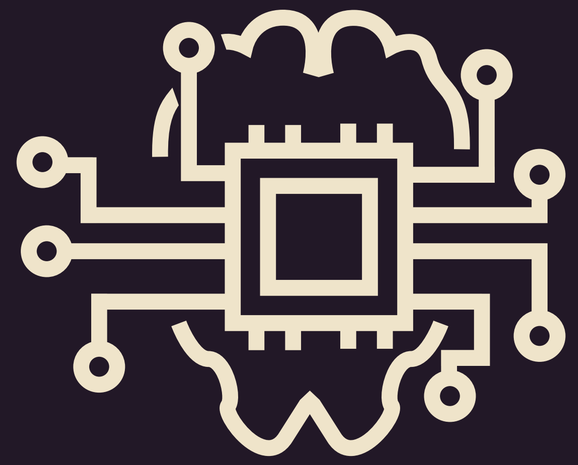
Intrinsic

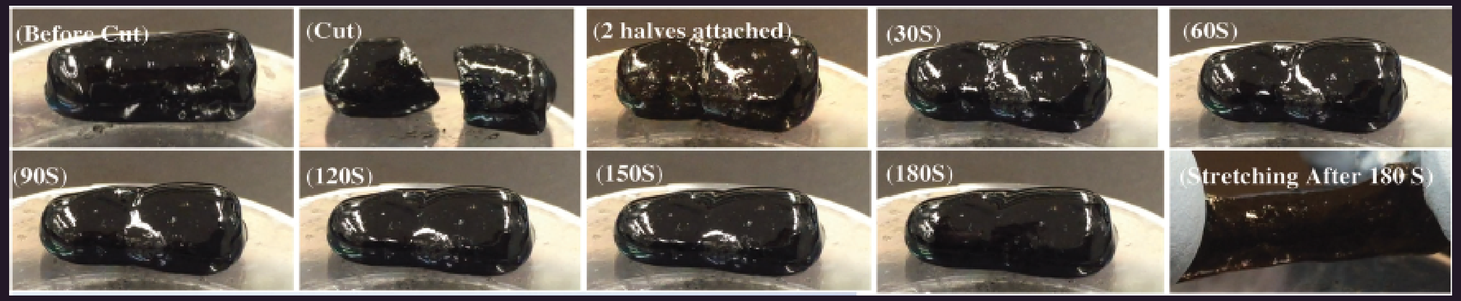
Intrinsic

Extrinsic



Hydrogel - A

100% mechanical recovery in 2 min
90% electrical recovery in 30 sec
Autonomous Healing
Ultrastretchability - 1500%
Pressure sensitivity
3D printability
Repeated tests show results with same self-healing efficiency



Hydrogel - B

Repaired instantaneously

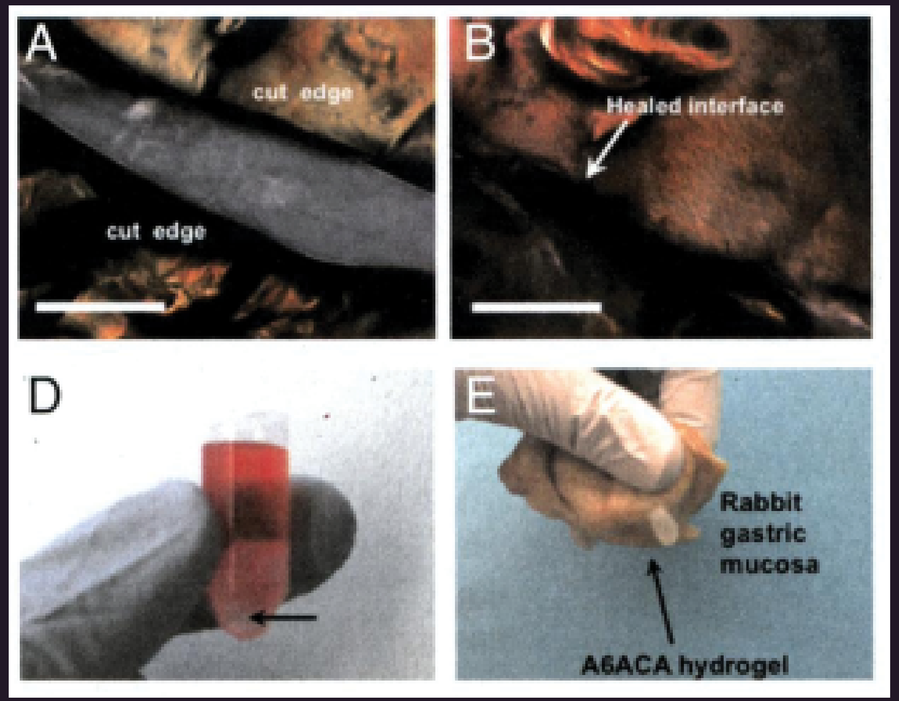
Healing is reversible,

controlled by PH

- Lower PH = healed
- Higher PH = separate

Hydrophobic

Requires initial contact to heal



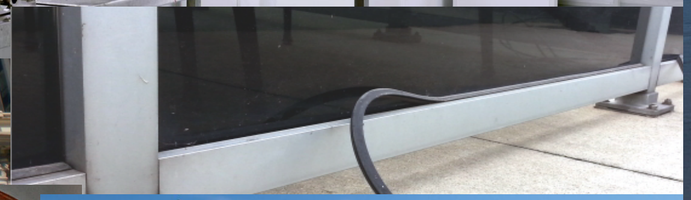
BioConcrete

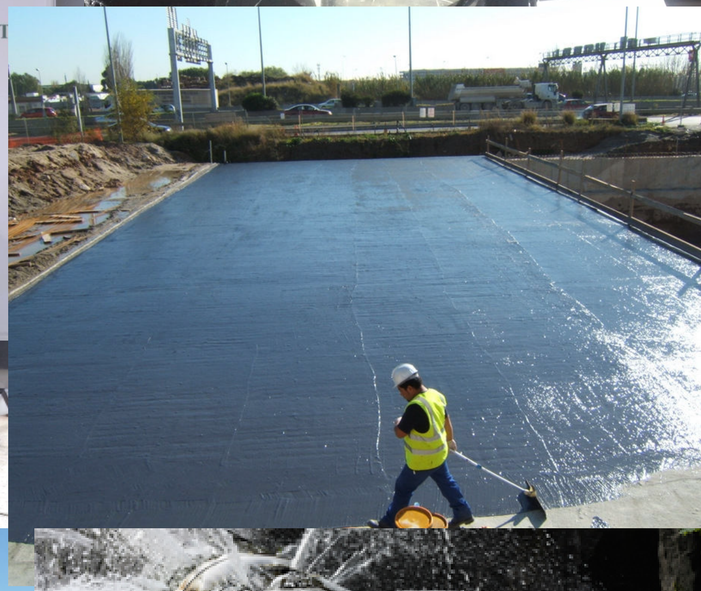
Bacteria mixed into concrete, feeding off water and calcium carbonate to produce limestone
Can withstand high PH/ alkalinity
Able to remain dormant and replicate without food or oxygen for decades
Consumes oxygen, preventing corrosion

“Sustainable design seeks to redefine how buildings are designed, built and operated to be more responsible to the environment and responsive to people”

What are the potential applications?


MONSANT






MONSAN

90% of all failures in waterproofing are accountable to poor workmanship


MONSANT

Curtain wall replacements may cost upwards of $175-250 per square foot


MONSANT

42% of people say the expense of fixing their cracked screen is the reason they choose not to


MONSANT

Chemical injuries to the eye represent between 11.5%-22.1% of ocular traumas

Sustainable Design

Constructability

Reliability

Safety

Sustainability

Engineered Living Materials

What are ELMs?

DARPA's goal is to COMBINE the structural properties of TRADITIONAL building materials with the attributes of LIVING SYSTEMS

However, they are unable to easily control the size and shape of living materials in ways that would make them useful for construction

ELM Types

HYBRID ELM

Hybrid materials composed of inert structural scaffolds that support the growth of living cells

PROGRAMMABLE ELM

Aims to discover fundamental engineering principles that enable the genetic programming of structural features into biological systems

“Biomimicry is an approach to innovation that seeks sustainable solutions to human challenges by emulating nature’s time-tested patterns and strategies”

Hygroscopic Actuated Wood

Silk Pavilion

BioMason

What is BioMason?

BioMason is a brick inspired by the growth of coral

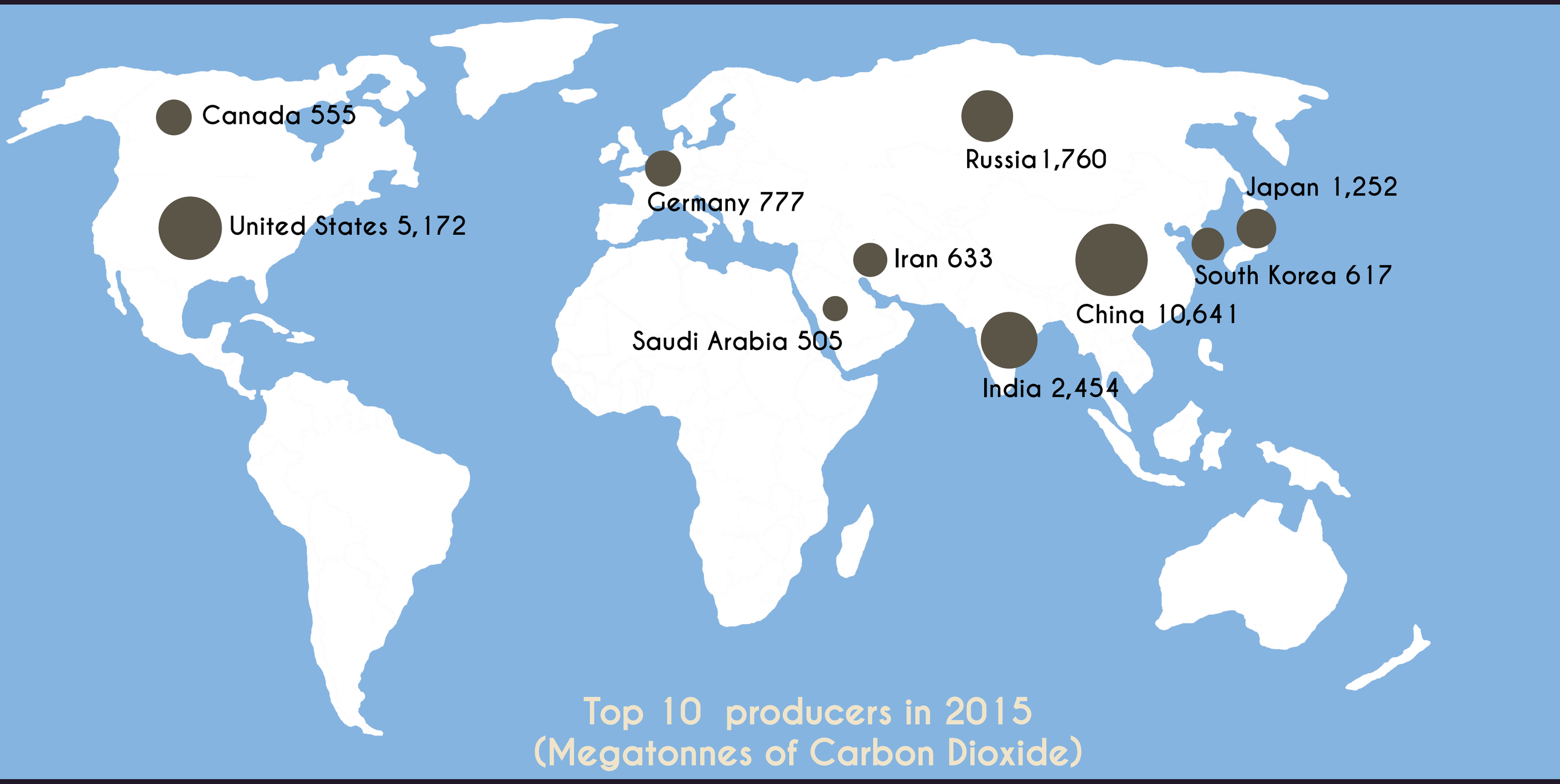
It is created by mixing bacteria and sand to ‘grow’ cement and make bricks

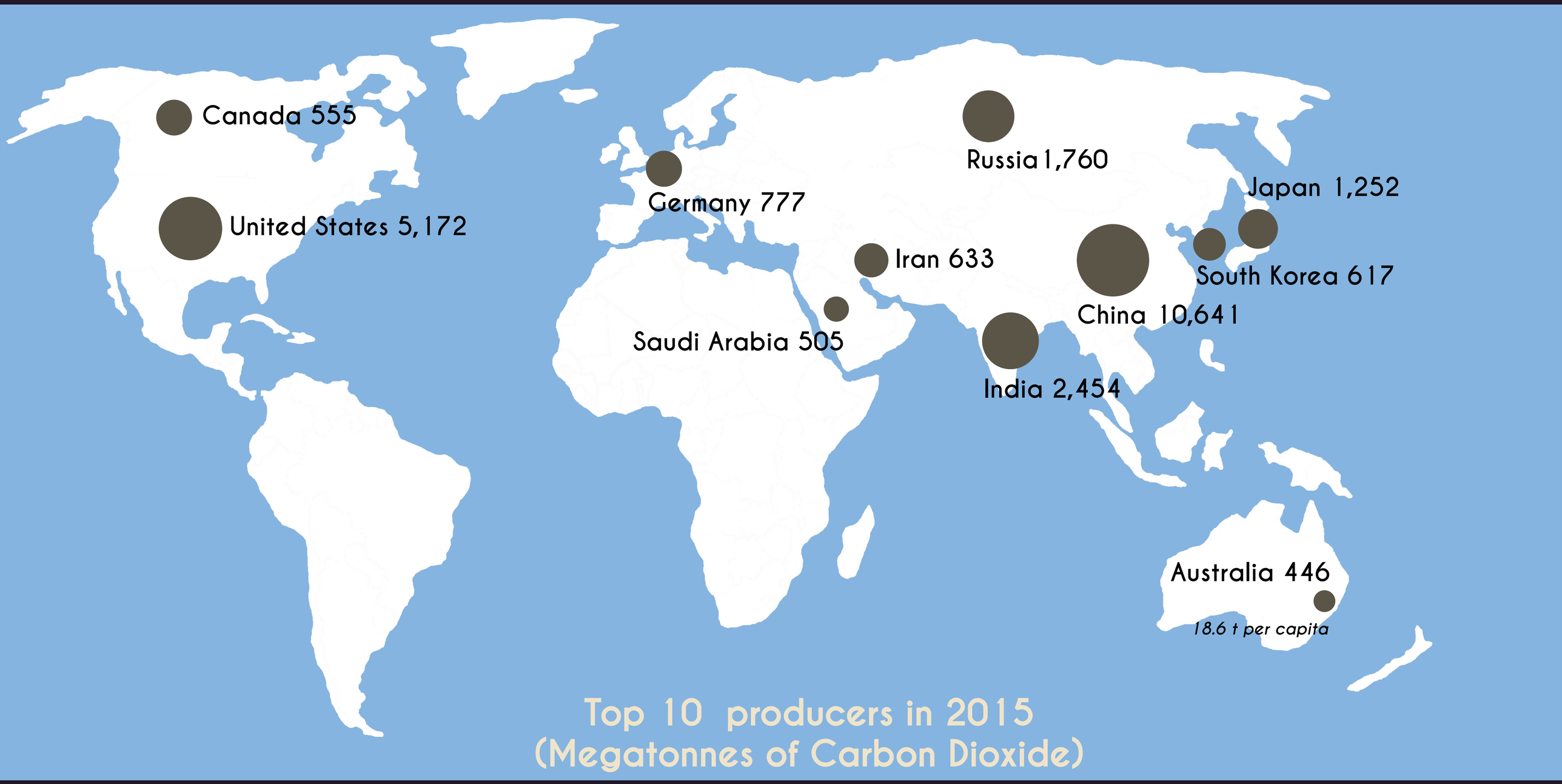
Absorbs CO2 from the air to make calcium carbonate

Cures in 2-3 days at ambient temperature

No waste in manufacturing, nutrients and minerals required are obtained from natural sources

“40% of global carbon dioxide emissions are linked to the construction industry”


Canada 555
United States 5,172
Germany 777
Russia 1,760
Japan 1,252
Iran 633
South Korea 617
China 10,641
Saudi Arabia 505
India 2,454
Top 10 producers in 2015
(Megatonnes of Carbon Dioxide)



Top 10 producers in 2015
(Megatonnes of Carbon Dioxide)

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Self-repairing sustainable concrete?

Lifeguard Station - Netherlands

How viable are these potential applications?