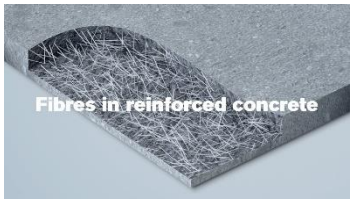
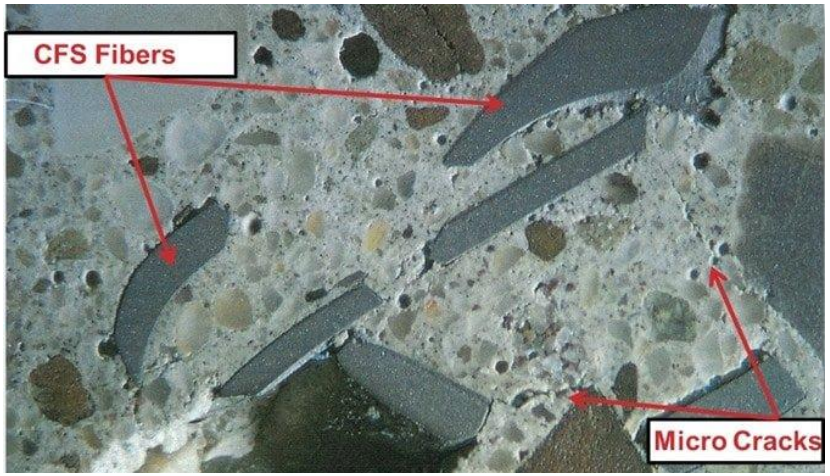
Special concretes



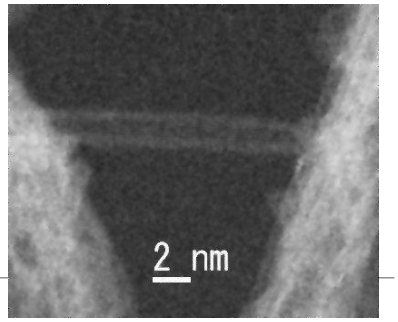
Fibre reinforced concretes



For a strong, ductile and durable construction the reinforcement needs to have the following properties at least: high relative **strength,** high toleration of **tensile strain,** good **bond** to the concrete, irrespective of pH, moisture, and similar factors**, thermal compatibility**, not causing unacceptable stresses in response to changing temperatures. **Durability** in the concrete environment, irrespective of corrosion or sustained stress for example.

Cellulose fibers, metallic fibers, glass fibers, etc.

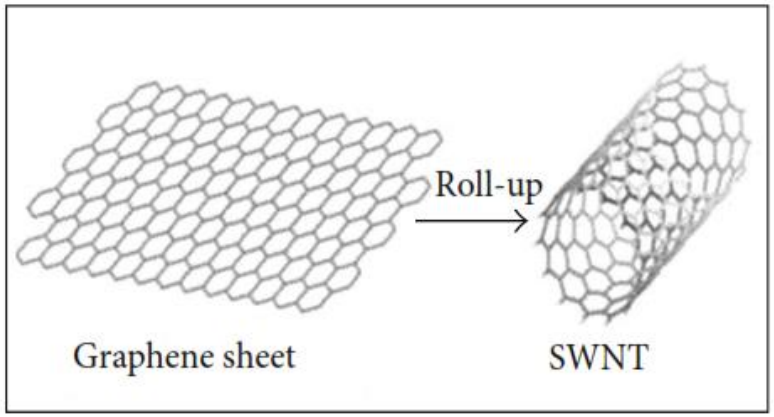
Carbon nanotube

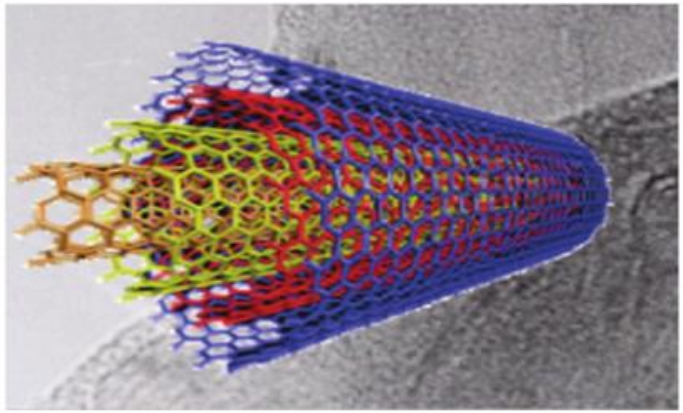


https://en.wikipedia.og/wiki/Carbon_nanotube

- size: 0.3 nm – 100 nm diameter, several 100 µm length
- good electric and heat conductivity
- most rigid and strong
- tensile strength: 60-100 GPa (concrete: 2-5 MPa, stainless steel: 550 MPa)
- produced as one of the components of the Arowex composite materials. Increased its strength with 20-50%, decreased its weight, increased its life-time
- Boenig company: electrical sensing composite material, that can measure the aging (abrasion) of the structural constituents of an aircraft – patented by Boeing

CNT reinforced concrete



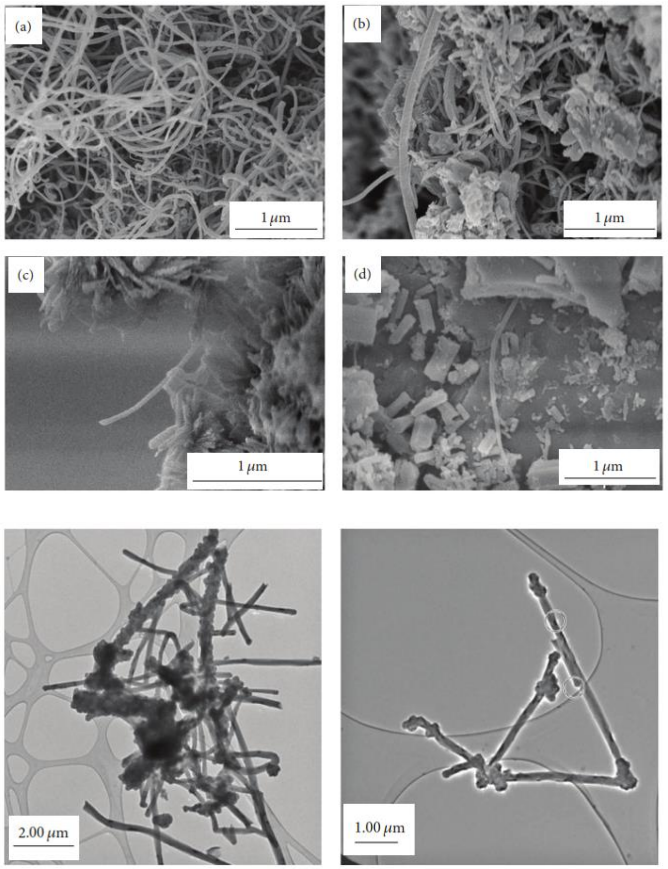


CNT – carbon naotube

They have to be dispersed!

Increase in flexural strength from 8 to 40% and an increase in elasticity modulus of 15 to 55 %.

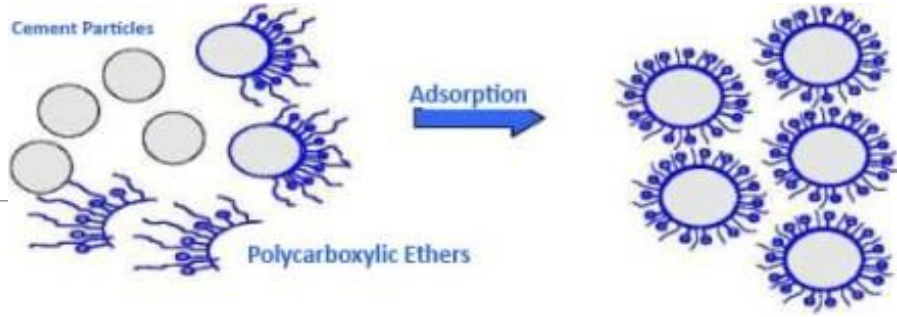
CNT reinforced concrete



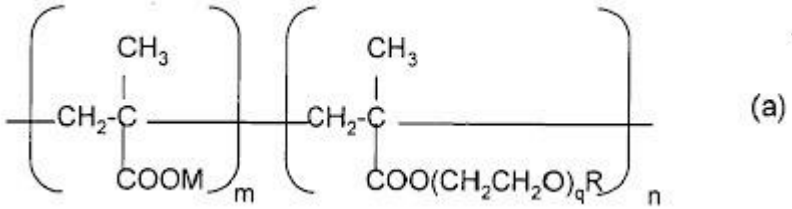
Dispersion by coating it with different surfactants

Dispersion by coating it with polymers

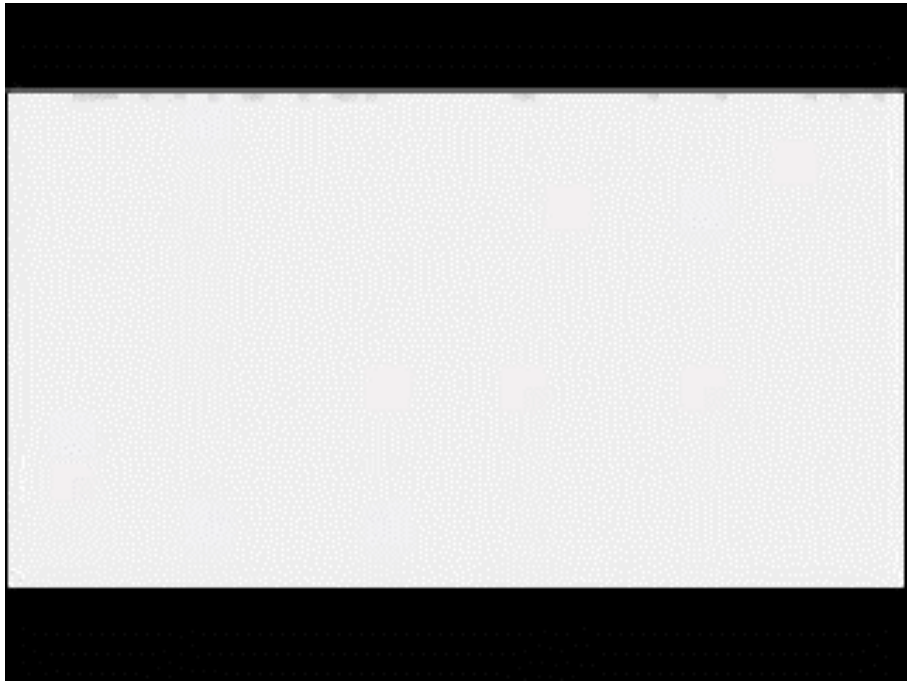
Superplasticizer



- reduce the water necesity
- strength increases, the water to cement ratio decreases
- most used: polycarboxilate ether



- added quantity: 0.15-0.3 wt%
- the superplasticizer molecules are adsorbed on the surface of the concrete particles and limit the aggregation of them. By changing the design of the molecule the time while the liquid phase is maintained can be controlled (around 2 hours)

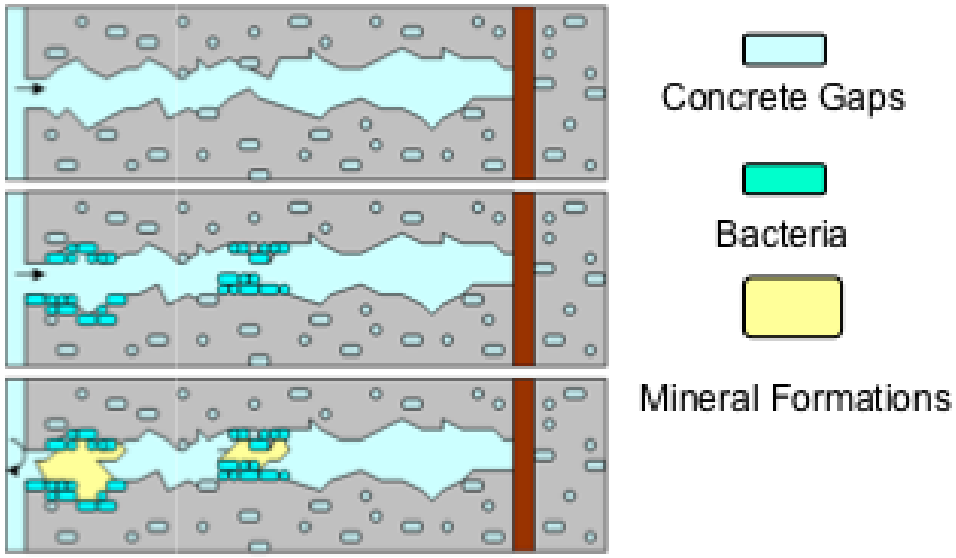


Self-curing concrete

Bacillus pseudofirmus
- can resist without oxigen for 200 years
- the water activates it, limestone is produces

Alkalifil bacteria
- Resist at high pH values

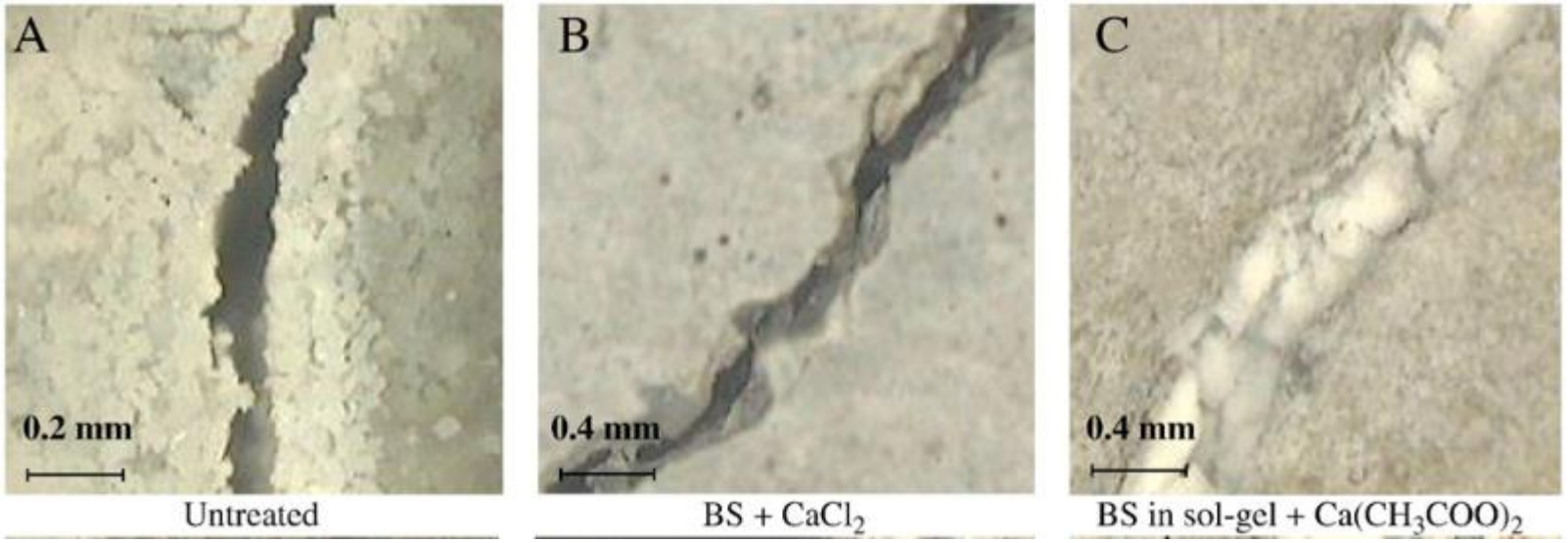
Bacillus alkalinitrilicus
- produces calcium-lactate

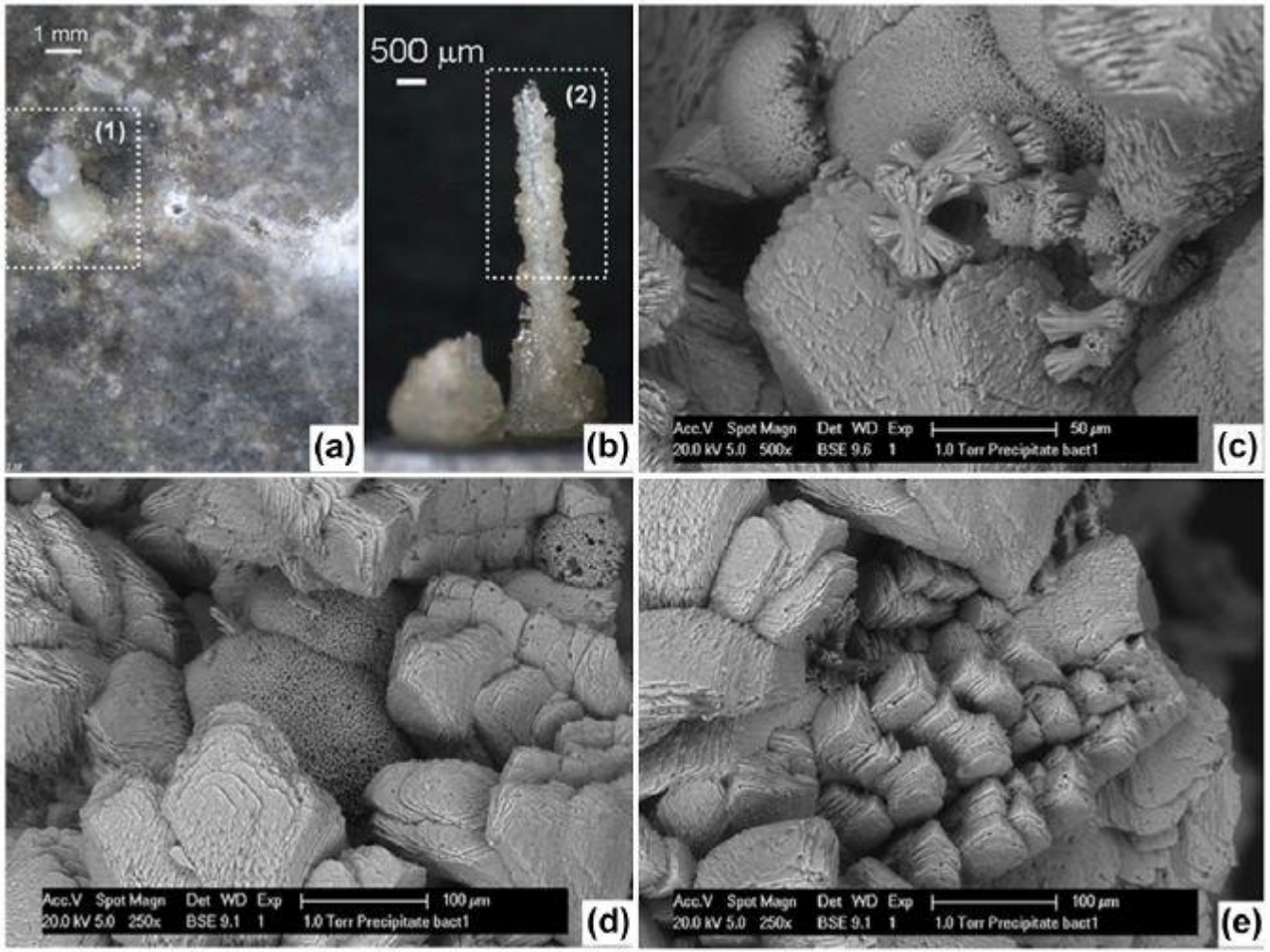


Self-curing concrete

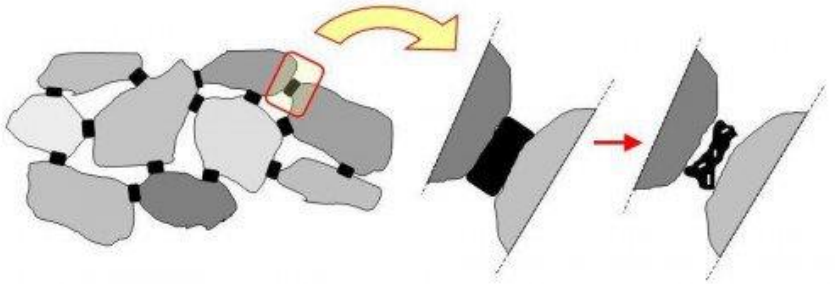
Bacillus sphaericus

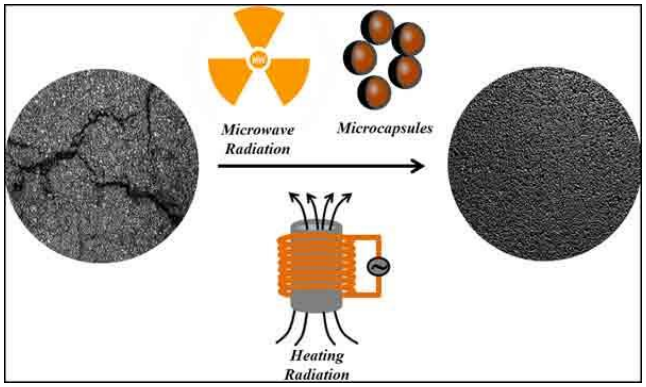
- Sol-gel
- $CaCl_2$, $Ca(NO)_3$, $Ca(CH_3COO)_2$

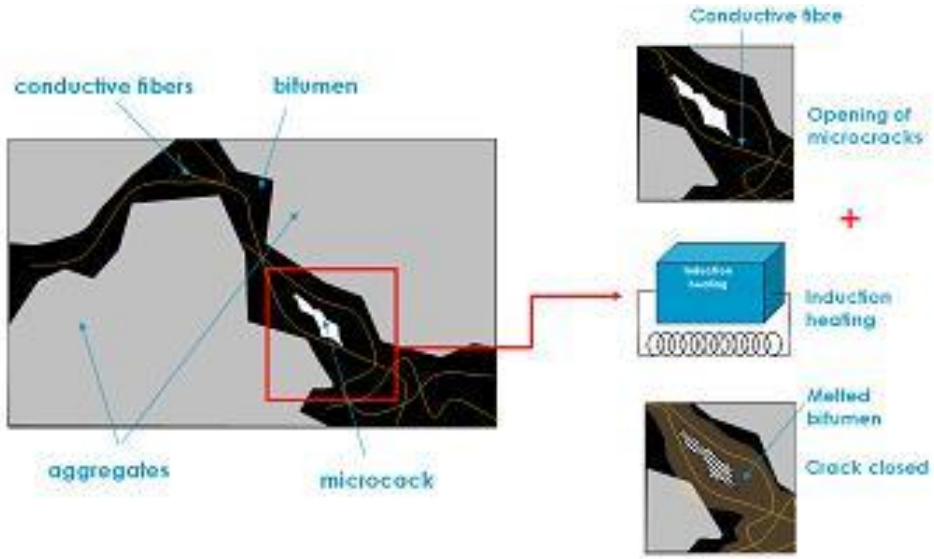


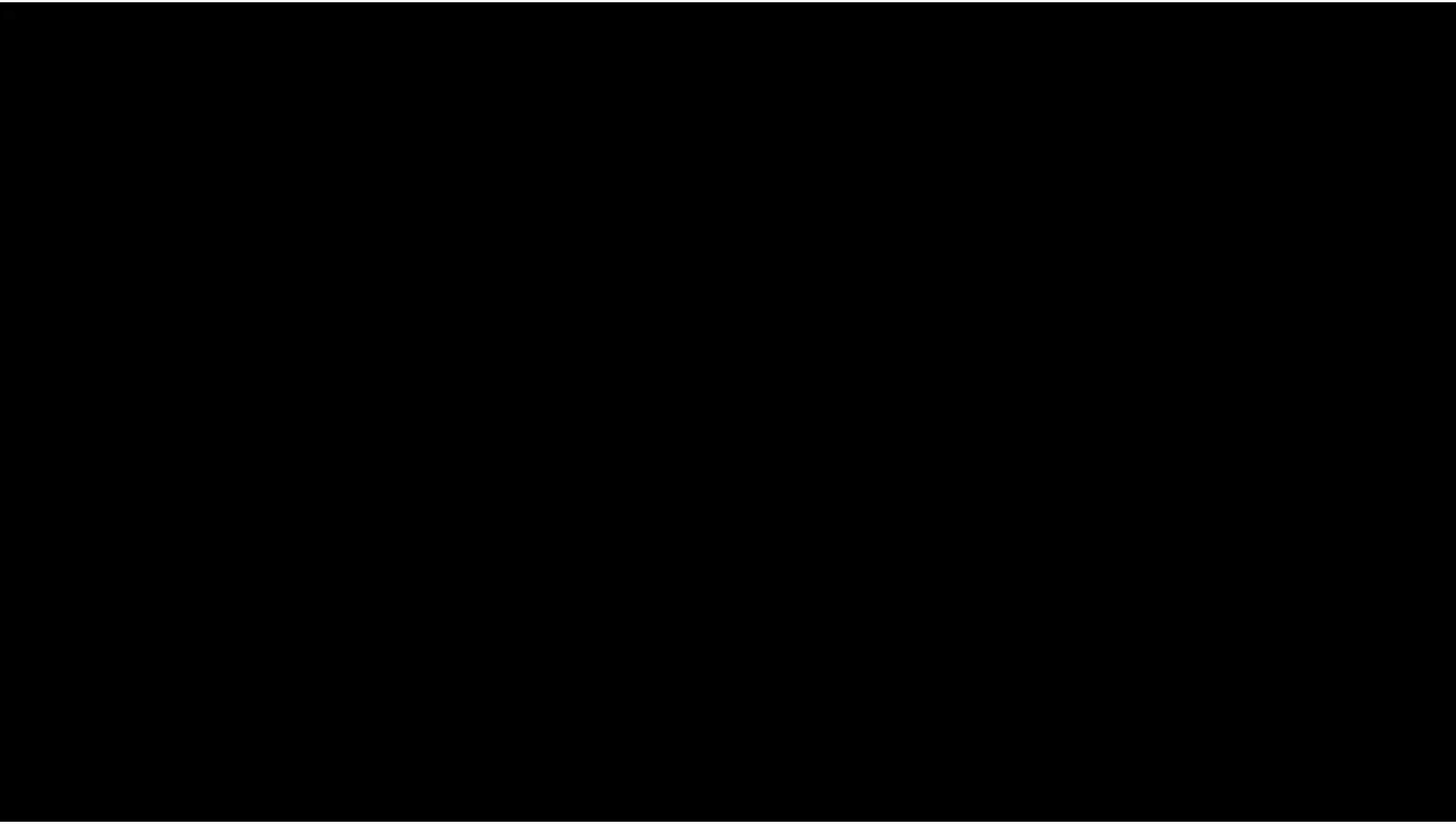

1 mm
(1)
(a)
500 µm
(2)
(b)
Acc.V Spot Magn Det WD Exp 50 µm
20.0 kV 5.0 500x BSE 9.6 1 1.0 Torr Precipitate bact1
(c)
Acc.V Spot Magn Det WD Exp 100 µm
20.0 kV 5.0 250x BSE 9.1 1 1.0 Torr Precipitate bact1
(d)
Acc.V Spot Magn Det WD Exp 100 µm
20.0 kV 5.0 250x BSE 9.1 1 1.0 Torr Precipitate bact1
(e)

Self-healing asphalt

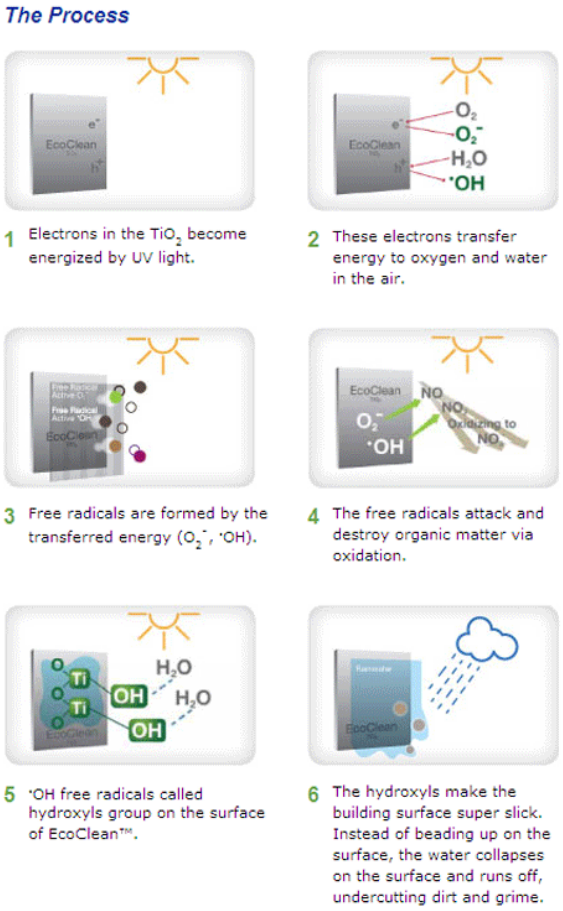








Self-cleaning concrete



1 Electrons in the TiO_2 become energized by UV light.

2 These electrons transfer energy to oxygen and water in the air.

3 Free radicals are formed by the transferred energy (O_2^-, ·OH).

4 The free radicals attack and destroy organic matter via oxidation.

5 ·OH free radicals called hydroxyls group on the surface of EcoClean™.

6 The hydroxyls make the building surface super slick. Instead of beading up on the surface, the water collapses on the surface and runs off, undercutting dirt and grime.

3D printing of concrete

Characteristics:

- quick
- cost effective
- time saving
- printers are portable
- forms are infinite, complex geometries
- no need of mold

Limitations:

- only mid-sized homes/buildings
- size of additives is limited
- special concrete mixes have to be used
- today is not a fully developed technology

3D printing of concrete

How it works

- instead of plastic, concrete is used
- a base needs to be created independently from the 3D
- rails and pillars need to be constructed for the printer
- window frames and ceiling are premanufactured

Requirements

- flowability has to be perfectly designed, without reducing other mechanical properties
- superplasticizers need to be added (reduce the water necesity)
- nanofiber reinforcing

3D concrete printing