Technology Breakthrough for Treatment to Concrete Problem

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ECO Binder – Technology
Silicate Binder – Technology

new innovative binder system
with unique properties
ECO-Binder-System

We are using secondary raw industrial waste materials like:

- GGBS
- fly ash
- pumice
- kaolin
- volcanic ash
Standard binder systems are based on Portland cement, which contains after hydration $\text{Ca(OH)}_2$ and CSH (calcium silicate hydrate).

**Ca(OH)$_2$**
- no hardening effect of surface
- high reactive with acid and water

**CSH**
- high abrasion resistant
- stable
- high chemical resistance for acids and alkalies

**ECO-Binder-System**

- no hardening effect of surface
- high reactive with acid and water
Ca(OH)$_2$ reacts with silicates and forms high resistant crystals (**Calciumsilicathydrate-CSH**).
ECO-Binder-System

Our Binder System:

- replaces Portland cement and parts of epoxy resin
- is produced by using alternative and environmentally friendly raw materials
- no hazardous labeling
- reducing CO$_2$ emission

Products:

- higher acid resistance
- higher density
- no efflorescence
- abrasion resistance
- very high durability
Eco - Binder Products using alternative and environmentally friendly raw materials

- Self Levelling Mortar
- Industrial Floor System / IFS
- Waterproofing
Industrial Floor System – self leveling floor system

- Unique and high-performance industrial floor
- High mechanical load with high abrasion resistance
- Crack and shrinkage free and fast curing
- Water vapor permeable
- Applicable from 3 to 45°C
- Walkable after 6h
- Fully loadable after 2 days
- Made with alternative materials that have low CO₂ footprint (No solvent, no resin)

No binder system in the world does have such outstanding properties and unique features.
Industrial Floor System

Application

Application by hand
Industrial Floor System

Application by pump machine
Industrial Floor System

Finished Floor after 3 h
Waterproofing

- Made from environmentally friendly raw materials
- Resistant to chemicals (acids, alkalis and solvents)
- Resistant to sulfates (up to 3000 mg sulfate per 1 liter of water)
- No efflorescence and not damaging to concrete & masonry
- Fast loading capacity & frost resistant Not hazardous
- Heat resistant up to +300 °C
- For use on horizontal & vertical surfaces
- Completely inorganic
- Enhanced durability
Flexible waterproofing

- High flexibility up to 1.3 mm
- High mechanical load with high abrasion resistance
- Applicable from 5 to 45°C
- Reworkable after 6h
- UV – resistance
- Waterproof even by a 1 mm thick layer
Silicate binder system
Silicate-Technology

Solution for areas with high chemical load and corrosion
Why cement based products are not suitable for high chemical load?
Disadvantage of cement

during hydration different phases occur:

- **calcium silicate hydrat (CSH)** (chemically stable and unreactive)
- **calcium hydroxide (Ca(OH)\(_2\))** (highly reactive – weak point of concrete!)
Silicates of the 1st generation

Silicate based products were used to replace organic based products.

However, practical tests showed that these products contain following problems:

- Two or three component
- Difficult to apply
- Not suitable for wet substrate
We have developed new silicate binder systems with unique innovative properties.

- Extremely high chemical resistance
- Extremely high temperature resistance
- Exceptionally high abrasion resistance
- Easy application even on wet surfaces
- Environmentally friendly, sustainable, non-hazardous to human health
- Enable the up cycling of secondary raw materials for effective reduction of CO₂ Emissions
- Our waterproofing system are impermeable to high pressure water both positive and negative
Silicate - Properties

- Temperature resistant
- Tensile adhesive strength
- Chemical resistant
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Cement</th>
<th>Epoxy</th>
<th>Silicate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health risk</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Durability (pressure)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Tensile strength</td>
<td></td>
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<tr>
<td>Acid resistance</td>
<td></td>
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<tr>
<td>Bases resistance</td>
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<tr>
<td>Solvent resistance</td>
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<tr>
<td>Early water resistance</td>
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</tr>
<tr>
<td>Abrasion resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature resistance [°C]</td>
<td>200°</td>
<td>100°</td>
<td>1350°</td>
</tr>
<tr>
<td>Price (large scale production)</td>
<td></td>
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</table>
Surface protection system

Liquid silicates

- penetrates deep into the surface
- reacts with the high reactive components of the concrete (Ca-ions)

- Stable structure
  - Increase of scratch hardness
    (prevent abrasion)
  - Solidifies soft or less solid surfaces
  - Very long, stable shelf life

- Chemical resistance
  - Concrete is long term protect from corrosive attack
  - 100 times better protection
  - Improvement of the freeze-thaw resistance

- Waterproof - but water vapour permeable
  - Pore closure
  - No air-tight closure
  - No efflorescence can occur
Outstanding Properties of Liquid Silicate
Silicate based Impregnation

- Penetrate deep into the substrate reacts with components from cementitious underground
- Form a dense Silicate matrix to strengthen the substrate and an acid resistant silicate structure
- Eliminates efflorescence
- Against positive and negative water pressure
- Increase the surface hardness and abrasion resistance of concrete
- Increases the temperature resistance of the substrate
- Solvent free, 100% environmentally friendly
Test for acid resistance

storage of the specimen at constant acid concentration

treatment with 2 % sulfuric acid for 56 days

untreated

treated with silicate sealant
Test for acid resistance

storage of the XA 1 and XA 3 specimen at constant lactic acid concentration for 28 days
Test for water absorption
Water absorption after 40 min with the “Karsten'schen tube” and long time storage
Test for abrasion resistant
Application - Protection against algae

Concrete surfaces after 3 years outside

untreated

|treated|
Silicate Products Applications

1. **Concrete upgrade and soil protection** for facades, design concrete, floor coating, biogas plants, halls, bridges, tunnels, agriculture and industry.

2. **Waterproofing and construction chemicals** in ground-, drinking-, sea- and wastewater (sewage treatment plants, swimming pools, water engineering, tunnels, bridges).

3. **Anti-corrosion protection on steel** for drinking water and sewage pipes, pipelines, geothermal plants, plant engineering and construction, heavy industry, power plants.

4. **Construction materials**, e.g. screeding systems especially for underfloor heating, hygienic- or rapid assemblies, currently still under development.
Application examples - International references

Sydney Opera basement renovation
Application examples - International references

Project with silicate technology products

Sydney Opera House, renovation

Realization the 07.03.2011
Sydney Opera basement renovation

Application Situation
The roof is covered with tiles, which have to be cleaned with acid cleaner. The basement is not protected concrete.

Problem
Corrosion protection on steel reinforced concrete to protected the concrete surface from acid cleaner and salt water

Products
Silicate Mortar for waterproofing / re profiling
Liquid Silicate for concrete protection
Stoerebelt Bridge in Denmark
waterproofing from inside against salt water
Stoerebelt Bridge in Denmark
waterproofing from inside against salt water

Application Situation
Concrete bridge over the sea. The anchor block got cracks in the concrete matrix, where salt water was penetrating through and corrosion starts inside the anchor block.

Problem
Waterproofing on wet surface against salt water (6 m below sea level, 0.6 bar water pressure) salt contaminated concrete.

Products
- Primer
- Silicate Mortar for waterproofing and re-profiling
- Flexible waterproofing
Protection of road areas to contamination and freeze-thaw damage
Silicate impregnation with excellent resulting salt resistant and anti-pollution effect

APPLICATION SITUATION
A new concrete road area with colored concrete should be protected against corrosion.

PROBLEM
Salt, freeze-thaw attacks destroys very quickly during winter time.

PRODUCTS
- Liquid Silicate – deep waterproofing
- Liquid Silicate – to protect the surface

1. Construction site  2. Substrate before treatment
3. Application of 2 Liquid Silicate  4. Surface 6 month later
Facade protection with reactivation of corrosion protection for steel reinforcement and protection principle W, reinforcement of surface, reduction of water uptake and optimization of frost-dew-resistance and microbiological protection, biocide free, Arnstadt, 5.700m²
Concrete upgrade and soil protection
Floor protection

Eco binder advantages:
- Easy to apply, large surface efficiency
- Short drying time
- Long lasting in use
- High surface hardness, low abrasion
- Health-, safety and environment friendly, low CO2 emissions
- Acid and oil resistant
- Excellent soil protection
- Fast and easy cleaning
- Indoor and outdoor use
Concrete upgrade and soil protection

Application - Agriculture

Treated end of 2009

Untreated surface

After 2 years usage

After 2 years usage
Waterproofing and levelling of concrete and steel

Biogas plant
Application Situation
A concrete tank has to be protected and renovated against sulphuric acid and cracking

Problem
The silage and the sulphuric acid attack strongly the concrete or any waterproofing
Therefore, the old damaged epoxy waterproofing had to be replaced

Products
Flexible waterproofing
Protection of an biogas plant against chemical corrosion

Highly flexible waterproofing with excellent chemical resistance

1. Biogas plant
2. Old damaged coating
3. Application of by brush
4. Final coated tank
Renovation of waste water treatment plant
Corrosion protection of concrete waste water pipelines,
Innovative silicate mortar with excellent adhesion on humid surfaces, salt and acid resistant, with excellent corrosion protection for steel reinforcement

Application situation
Biogenic sulfuric acid attack has heavily corroded the concrete surface and the steel reinforcement. The ambient conditions are very wet and dirty. Only automatic cleaning by robot possible.

Problem
Corrosion protection of the concrete and steel surface against waste water and biogenic sulfuric acid attack.

Products
Silicate mortar – waterproofing
Liquid Silicate – sealant
Silicate Products

Silicate Waterproofing
Silicate Total Protection Coating
Silicate Mortar
Silicate Grout
## Silicate Waterproofing

### Properties and benefits:

- Hardening in areas with high humidity
- Applicable on wet surfaces
- pH 0-14 resistance against inorganic and organic acids
- Water pressure stable up to 1.5 bar
- Environmental friendly, solvent free
Silicate Waterproofing

strengthen the substrate, renovation of a manhole
Total Protective Coating
extreme high chemical resistant

Properties and benefits:

• resistant to all organic and anorganic solvents or acids
• extreme high temperature resistant up to 1350 °C
• outstanding tensile adhesive strength on mineral substrates
• excellent adhesive strength on steel and glazed surfaces
Total Protection coating
extreme high chemical resistant

Acid attack:
Only silicates are permanent resistant from pH 0-14!!!
Silicate mortar are resistant like ceramic tiles.
Total Protection coating
extreme high chemical resistant

A 0.5 mm thick coating protects your anorganic or mineral surface for highly aggressive chemicals.

The product penetrates deep into the surface and reacts with the calcium ion (Ca$^{2+}$) to CSH phases and solidify the surface.
Total Protection coating
extreme high chemical resistant

<table>
<thead>
<tr>
<th>No.</th>
<th>Concentration</th>
<th>Change in Diameter [%]</th>
<th>Change in Mass [%]</th>
<th>Colour of Inspection Liquid before Storage</th>
<th>Colour of Inspection Liquid after Storage</th>
<th>Colour of Sample after Storage</th>
<th>Consistency of Storage after Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.</td>
<td>Water</td>
<td>+0.37</td>
<td>-2.10</td>
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<td>colourless</td>
<td>grey</td>
<td>no alteration</td>
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</tbody>
</table>

**Inorganic Acids**

<table>
<thead>
<tr>
<th>No.</th>
<th>Concentration</th>
<th>Change in Diameter [%]</th>
<th>Change in Mass [%]</th>
<th>Colour of Inspection Liquid before Storage</th>
<th>Colour of Inspection Liquid after Storage</th>
<th>Colour of Sample after Storage</th>
<th>Consistency of Storage after Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hydrochloric Acid 5%</td>
<td>-0.36</td>
<td>-6.94</td>
<td>colourless</td>
<td>milky-cloudy, formation of sediments</td>
<td>light grey</td>
<td>no alteration</td>
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<tr>
<td>2.</td>
<td>Hydrochloric Acid 20%</td>
<td>-0.10</td>
<td>-6.16</td>
<td>colourless</td>
<td>citreous, slight formation of sediments</td>
<td>light grey</td>
<td>no alteration</td>
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<tr>
<td>3.</td>
<td>Sulphuric Acid conc.</td>
<td>+0.17</td>
<td>+5.60</td>
<td>colourless</td>
<td>brown</td>
<td>grey</td>
<td>slightly affected</td>
</tr>
<tr>
<td>4.</td>
<td>Phosphoric Acid 5%</td>
<td>-0.34</td>
<td>+0.60</td>
<td>colourless, slight formation of sediments</td>
<td>light grey</td>
<td>no alteration</td>
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</tr>
<tr>
<td>5.</td>
<td>Phosphoric Acid conc.</td>
<td>-0.19</td>
<td>-0.97</td>
<td>colourless</td>
<td>colourless</td>
<td>light grey</td>
<td>no alteration</td>
</tr>
<tr>
<td>6.</td>
<td>Nitric Acid 5%</td>
<td>+0.61</td>
<td>-5.98</td>
<td>colourless</td>
<td>milky-cloudy, slight formation of sediments</td>
<td>light grey</td>
<td>no alteration</td>
</tr>
<tr>
<td>7.</td>
<td>Nitric Acid 10%</td>
<td>+0.33</td>
<td>-6.62</td>
<td>colourless</td>
<td>milky-cloudy, slight formation of sediments</td>
<td>light grey</td>
<td>no alteration</td>
</tr>
<tr>
<td>8.</td>
<td>Nitric Acid conc.</td>
<td>+0.27</td>
<td>-1.88</td>
<td>colourless</td>
<td>yellow, cloudy, slight formation of sediments</td>
<td>light grey</td>
<td>no alteration</td>
</tr>
<tr>
<td>9.</td>
<td>Boric Acid saturated</td>
<td>-0.17</td>
<td>+4.61</td>
<td>colourless, formation of sediments</td>
<td>grey</td>
<td>no alteration</td>
<td></td>
</tr>
</tbody>
</table>

**Organic Acids**

<table>
<thead>
<tr>
<th>No.</th>
<th>Concentration</th>
<th>Change in Diameter [%]</th>
<th>Change in Mass [%]</th>
<th>Colour of Inspection Liquid before Storage</th>
<th>Colour of Inspection Liquid after Storage</th>
<th>Colour of Sample after Storage</th>
<th>Consistency of Storage after Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td>Lactic Acid 5%</td>
<td>+0.13</td>
<td>+1.07</td>
<td>colourless</td>
<td>colourless, slight formation of sediments</td>
<td>light grey</td>
<td>no alteration</td>
</tr>
<tr>
<td>11.</td>
<td>Lactic Acid conc.</td>
<td>-0.41</td>
<td>-1.10</td>
<td>colourless</td>
<td>colourless</td>
<td>light grey</td>
<td>no alteration</td>
</tr>
<tr>
<td>12.</td>
<td>Acetic Acid 10%</td>
<td>+0.46</td>
<td>+2.31</td>
<td>colourless</td>
<td>colourless</td>
<td>light grey</td>
<td>no alteration</td>
</tr>
<tr>
<td>13.</td>
<td>Acetic Acid 20%</td>
<td>+0.26</td>
<td>+3.61</td>
<td>colourless</td>
<td>colourless</td>
<td>light grey</td>
<td>no alteration</td>
</tr>
<tr>
<td>14.</td>
<td>Citric Acid 5%</td>
<td>-0.13</td>
<td>-1.21</td>
<td>colourless</td>
<td>yellowish, slight formation of sediments</td>
<td>light grey</td>
<td>no alteration</td>
</tr>
</tbody>
</table>
Total Protection coating
extreme temperature resistance

Up to 1350°C
Silicate re-profiling mortar

**Properties and benefits:**

- hardening in areas with high humidity
- applicable on wet surfaces
- pH 0-14 resistance to inorganic and organic acids
- 1,5 bar waterproof
- environmental friendly, solvent free
- one-component, 100% inorganic
Silicate re profiling mortar
## Silicate tile adhesive

### Properties and benefits:

- 100 % inorganic, one-component
- High slip resistance and adhesion according to DIN EN 1308 & 1348
- Long open time according to DIN EN 1346
- C2-FTE according to DIN EN 12004
- Non-flammable
- Water resistant, frost-proof and temperature resistant
Silicate grout

Properties and benefits:

- one-component
- high mechanical strength with high abrasion resistance
- no efflorescence
- water vapor permeable
- no allergy potential
- no hazard labeling required
Silicate Binder Technology

- Protects the concrete durable
- Increase the resistance against salt water and chemicals
- Easy to apply
- Environmental friendly
- 100 % mineral based protection system
- Water vapor permeable
- Hazardous labeling free
Thank you for your attention