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150 researchers from 10 countries
35M € investment from EU, Turnover in 2014 = 8M €
(Sustainability of Project – min 10% = 3,5M€/year)

• Final application oriented research
• Direct cooperation with industrial partners
• International approach (researchers, cooperations)
• Wide range of the research fields (nanomaterials, automotive, medical, filtration, advanced machinery)
Laboratory of geopolymers

- Geopolymer-based composites with fibers and nanoparticulate reinforcement
- Heat resistant geopolymer mortar
- Surface modifications
Hydrophobic treatment

• Basic component of impregnating liquid is the methyl-silicon resin. By using a suitable solvent (e.g. xylene) and water is formed an aqueous emulsion. Thus prepared emulsion should be further thickened to increase the viscosity of the resulting solution.

• The silicone component is via a carrier solvent of water and residual solvent highly efficiently transported deep into the structure of the material.

• To increase the utility properties (hydrophobic and antisoiling) of the emulsion are part of the emulsion also nanoparticles.

• The protective layer is developed on the basis of nanotechnology. Thanks to the nanometric dimensions (10 - 30nm) nanoparticles can penetrate into the porous structure of the substrate.
Hydrophobic treatment

Tested substrate: BAUCIS L 160 (České lupkové závody, a.s)
- geopolymeric binder based on fire clays
- light gray in color
- alkalination with sodium solution

Composition: Metakaolinite

<table>
<thead>
<tr>
<th>Compound</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{Al}_2\text{O}_3$</td>
<td>41 - 43 %</td>
</tr>
<tr>
<td>$\text{Fe}_2\text{O}_3$</td>
<td>3 %</td>
</tr>
<tr>
<td>$\text{TiO}_2$</td>
<td>1,6 %</td>
</tr>
<tr>
<td>$\text{K}_2\text{O}$</td>
<td>0,6 %</td>
</tr>
<tr>
<td>$\text{CaO (MgO)}$</td>
<td>0,2%</td>
</tr>
<tr>
<td>$\text{SiO}_2$</td>
<td>52 - 53%</td>
</tr>
<tr>
<td>+ 20 % CaO</td>
<td></td>
</tr>
</tbody>
</table>
Hydrophobic treatment

Contact Angle Measurements

Tab. 1: The average value of the contact angle (of 10 measurements )

<table>
<thead>
<tr>
<th>Sample</th>
<th>[θ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>47,64</td>
</tr>
<tr>
<td>Pure emulsion</td>
<td>103,18</td>
</tr>
<tr>
<td>Emulsion with nanoparticles</td>
<td>105,39</td>
</tr>
</tbody>
</table>
Hydrophobic treatment

Measurement of water absorption

Samples weighing 15 g were immersed in 500 ml of water for 48 hours.

Tab. 2: The average value of water absorption (of 3 measurements)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Absorption [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>76.05</td>
</tr>
<tr>
<td>Pure emulsion</td>
<td>17.71</td>
</tr>
<tr>
<td>Emulsion with nanoparticles</td>
<td>17.03</td>
</tr>
</tbody>
</table>
Hydrophobic treatment

The behavior of samples under the elevated temperatures (LOM) – magnification 40x

- Untreated 200°C
- Pure emulsion 200°C
- E. with NPs 200°C
- Untreated 500°C
- Pure emulsion 500°C
- E. with NPs 500°C
Hydrophobic treatment

The behavior of samples under the elevated temperatures (LOM) – magnification 40x

- Untreated 700°C
- Untreated 900°C
- Pure emulsion 700°C
- Pure emulsion 900°C
- E. with NPs 700°C
- E. with NPs 900°C
Hydrophobic treatment

Using this impregnation may also prevent efflorescence.
Thanks for Your Attention

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