Cellulose Ethers for hot climate performance improvement in EIFS mortars

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Quick Introduction

Torsten Busch

- Global New Product Leader, Construction Additives
- Started 1984 (Henkel, Aqualon, Hercules, Ashland)
  - R&D / Technical Sales Service
  - Sales / Marketing
  - Global Business Management
  - Sales Management
Problem areas during mortar application

- High temperature
- Dry climate
- Wind
- Substrate
  - water retention
  - water retention
  - and again ... water retention
Why use hot temperature performing cellulose ethers for EIFS mortars and Skim Coat?

**Hot climate conditions often result in:**
- too fast hardening in bucket (short „pot life“)
- too short open time (workability/smoothening time)
- crack formation
- sanding effect of the finished mortar

**While using new grades hot-temperature performance can clearly be improved resulting in:**
- less waste of material
- better workability / application properties
- higher efficiency / better quality of applied mortar
- less complaints for applied mortar
- possible reduction of cellulose ether use level
Viscosity of different cellulose ethers upon temperature increase

- MHEC 25000
- MHPC 20000
What is happening upon temperature increase?

- Hydrodynamic volume

Temperature + ions

"free water" disappearing into environment and substrate >>> not available for setting and strength development
Specialty Water Soluble Polymers for hot climate EIFS application
## Dry Mortar Formulation
### EIFS Europe

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Ingredient</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.0%</td>
<td>CEM I 52.5 N</td>
</tr>
<tr>
<td>53.0%</td>
<td>silica sand F34</td>
</tr>
<tr>
<td>20.0%</td>
<td>silica sand 0.5 – 1.0mm</td>
</tr>
<tr>
<td>0.20%</td>
<td>zinc stearate</td>
</tr>
<tr>
<td>3.0%</td>
<td>redispersible polymer powder – low Tg</td>
</tr>
<tr>
<td>0.15%</td>
<td>cellulose ether</td>
</tr>
</tbody>
</table>
Comparative concept testing
Water retention values @70°C

* All investigated samples have viscosities of ~ 40'000mPas
Comparative concept testing
Pot life of EIFS @ 40°C

- **Hot temp. CE**
  - Pot life at 40°C [min]: >250

- **Standard CE (MHPC)**
  - Pot life at 40°C [min]: >190

Ashland Specialty Ingredients
Comparative concept testing
Open time of EIFS @ 40°C

- **Hot temp. CE**
- **Standard CE (MHPC)**

Open time at 40°C [min]

0 5 10 15 20 25 30 35 40

Hot temp. CE

Standard CE (MHPC)
## EIFS Application Testing
### European Formulation

<table>
<thead>
<tr>
<th></th>
<th>Standard MHPC</th>
<th>Hot temperature CE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Factor</strong></td>
<td>0.17</td>
<td>0.21</td>
</tr>
<tr>
<td><strong>Workability</strong></td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td><strong>Pot Life 40° C [h]</strong></td>
<td>3h</td>
<td>4h</td>
</tr>
<tr>
<td><strong>Open Time 40° C [min]</strong></td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td><strong>Tensile Strength at 20° C [N/mm²]</strong></td>
<td>0.09</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Crack</strong></td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

**Rating:**
- Excellent (++++)
- Good (+++)
- Satisfactory (++)
- Acceptable (+)
Dry Mortar Formulation
EIFS Asia

28.0%  cement 42.5
61.8%  silica sand (50 - 100 mesh)
  8.0%  CaCO$_3$
  2.0%  redispersible polymer powder – low Tg
  0.20%  cellulose ether
# EIFS Application Testing
Asian Formulation

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard MHPC</th>
<th>Hot temperature CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water factor</td>
<td>0.18</td>
<td>0.21</td>
</tr>
<tr>
<td>Workability</td>
<td>+++</td>
<td>+++(+)</td>
</tr>
<tr>
<td>Paste stability</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Pot life @ 50°C, 90% r.h. [h]</td>
<td>3.0h</td>
<td>4.5h</td>
</tr>
<tr>
<td>Pot life @ 50°C, 20% r.h. [h]</td>
<td>3.0h</td>
<td>3.6h</td>
</tr>
<tr>
<td>Open time @ 50°C 20% r.h. [min]</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Tensile strength dry storage [N/mm²]</td>
<td>0.13</td>
<td>0.12</td>
</tr>
<tr>
<td>Crack formation</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

Rating: excellent: ++++  good:+++  satisfactory:++  acceptable:+
Characteristics for EIFS

- Water Factor
- Open Time 40°C
- Water retention 70°C
- Pot Life 40°C
- Workability
- Tensile Strength

**Graph Legend**
- Red: Hot temp. CE
- Black: Reference MHPC

**Software**
- Ashland Specialty Ingredients
Characteristics for Skim Coat

- Water Factor
- Open Time
- Water retention 20°C
- Water Retention 70°C
- Workability
- Pot Life

Legend:
- Hot temp. CE 1
- Hot temp. CE 2
- Ref. MHPC
Application Characteristics at high temperatures:

- Extended pot life
- Longer open / workability time
- Good paste stability
- Good workability
- High water retention capability
- No crack formation
- High abrasion resistance
- Improvement of tensile strength

Water factor of EIFS Coat mortar must be adjusted to achieve best product performance!
ASHLAND

With good chemistry great things happen.