Screed Additives – Mode of action and application

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Introduction – Who we are?

Competence Center for Flooring construction for more than 30 years:

• IBF = Institut für Baustoffprüfung und Fußbodenforschung
• Material testing (raw materials, binder);
• Performance testing;
• Trouble shooting
• Support of organizations with respect to technical questions;
• External inspection service according to RAL GZ 818;
• Large scale flooring projects for special purpose.
GÜTESCHUTZ ESTRICHGÜTZEUGNIS Nr. B 13/14 BAUSTELLENÜBERPRÜFUNG

Antragsteller: Mustermann

Betreff: 45390 Oer-Erkenschwick, Ewaldstraße, BV Raimann, Caluza Park


1. Zuschlag
   Zusammensetzung: 8/8 mm
   Art: Kiessand
   Lagerung: 1

2. Bindemittel
   Art: CEM I 52,5 R
   Lagerung: 1

3. Mörtel
   Art: Zementestrich
   Beschaffenheit: 1
   Verarbeitung: Pumpe
   Lagerung: 1

4. Baustellenbedingungen
   Art: Eps + Eps T
   Lagerung: 1
   Verarbeitung: 1

7. Abdeckung
   Art: PE-Folie
   Verlegung: 1
   Anschlüsse: 1
   Förderung: 1
   Ebenheit: 1
   Prüfungsgut: keine getrennte Prüfung
   Gesamtbewertung: 2

Bemerkungen: Prüfung auf die verlegten Estrich-Ersatzteile
entspricht etwa Siebmetalle B1Ca nach DIN 1045-2

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53842 Troisdorf, 26.03.2014

Sachbearbeiter

Institut für Baustoffprüfung und Fußbodenforschung-IBF
Large scale flooring projects
Seminars und Trainings

Dr. Roland Augustin-IBF
According to EN 13318 a screed is one or more layers of screed mortar placed at the construction site on a base. It can either be bonded to the base or not or laid on a separating layer or on an insulating layer. Its purpose is to fulfill one or more of the following functions:
- achieve a certain required height;
- used as a base for flooring material;
- used directly as a wearing surface.

In Germany the term screed includes screed mortar, screed materials and the finished product.

Only such binders, aggregates, **admixtures**, **additives** and water may be used in the production of screed mortars that guarantee the properties that the manufacturer has named.

**CT** cementitious screeds **CA** calcium sulfate screeds

**German Purity Law on Screed?**

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Anteil der Estrichmaterialien

Estrichmörtelmarkt 2016
Gesamt = 3,2 Mio. m³

- Zementestrich (konventionell) 1,257 Mio. m³ 40%
- Calciumsulfatestreich (konventionell) 0,29 Mio. m³ 9%
- Zementfließestreich 0,280 Mio. m³ 9%
- Calciumsulfat-Fließestreich 0,936 Mio. m³ 30%
- Sonstige Estriche 0,344 Mio. m³ 10%

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Usual properties of screed mortars

Table 1. Screed materials and tests which apply to each type

<table>
<thead>
<tr>
<th>Screed materials based on:</th>
<th>compressive strength</th>
<th>flexural strength</th>
<th>wear resistance &quot;Bohume&quot;</th>
<th>wear resistance &quot;HCA&quot;</th>
<th>wear resistance to rolling wheel</th>
<th>surface hardness</th>
<th>resistance to indentation</th>
<th>resistance to rolling wheel with floor covering</th>
<th>setting time</th>
<th>shrinkage and swelling</th>
<th>consistency</th>
<th>pH value</th>
<th>modulus of elasticity</th>
<th>Impact resistance</th>
<th>bond strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>N</td>
<td>N</td>
<td>N* (one of three)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O*</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Calcium sulfate</td>
<td>N</td>
<td>N</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O*</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Magnesite</td>
<td>N</td>
<td>N</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>N*</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Mastic asphalt</td>
<td>-</td>
<td>-</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>-</td>
<td>N</td>
<td>O</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Synthetic resin</td>
<td>O</td>
<td>O</td>
<td>-</td>
<td>N*</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>N*</td>
<td>N</td>
<td>-</td>
</tr>
</tbody>
</table>

N = Normative \quad O = Optional, where relevant \quad - = not relevant

* only for screed material intended for wearing surfaces
### Admixture:
Material added in small quantity during the mixing process to modify the properties of the screed material in the fresh and/or hardened state.

### Air entraining admixture:
Admixture that allows a controlled quantity of small, uniformly distributed air bubbles to be incorporated during mixing of screed material and which remain after hardening.

### Set retarding admixture:
Admixture which delays the beginning of setting of screed material.

### Plasticizing admixture:
Admixture which, without affecting the consistence, permits a reduction in water content of a screed material, or without affecting the water content increases the flow or which produces both effects simultaneously.

### Super plasticizing admixture:
Admixture which, without affecting the consistence, permits a high reduction in the water content of a cementitious screed material, or which, without affecting the water content increases the flow considerably, or which produces both effects simultaneously.

### Additives:
Material added to a screed material to modify the chemical and/or the physical property.
5.3 Estrich

5.3.1 Allgemeines

Der Estrich ist nach DIN 18560-1 herzustellen.

Bei Heizestrichen auf Basis von Calciumsulfat oder Zement dürfen nur solche Zusatzmittel verwendet werden, die den Volumenanteil der Luftporen des Mörtels um nicht mehr als 5 % erhöhen.
### Mode of Action

<table>
<thead>
<tr>
<th>Materials</th>
<th>Abbreviation-German</th>
<th>Mode of action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super plasticizing admixture</td>
<td>FM</td>
<td>physical</td>
</tr>
<tr>
<td>Air entraining admixture</td>
<td>LP</td>
<td>physical</td>
</tr>
<tr>
<td>Stabilizing admixture</td>
<td>ST</td>
<td>physical</td>
</tr>
<tr>
<td>Set retarding admixture</td>
<td>VZ</td>
<td>chemical</td>
</tr>
<tr>
<td>Set accelerating admixture</td>
<td>BE</td>
<td>chemical</td>
</tr>
</tbody>
</table>
Superplasticizing Admixtures

Mode of action

- Reduction of surface tension of water
- Lubricant
- Reverse electrical charge
Mode of action

Improved performance by using less water

Sand A/B₈; MV 1:6; w/c ≈ 0,70; without admixture
Before flow
Mode of action

Improved performance by using less water

Sand A/B₈; MV 1:6; w/c ≈ 0,7; without admixture
flow ≈ 12 cm
Mode of action

Improved performance by using less water
(identical recipe using $\approx 1\%$ admixture)

Sand $A/B_8$; MV 1:6; w/c $\approx 0.7$; with admixture flow $\approx 20$ cm
Mode of action

Sand A/B\textsubscript{8}; MV 1:6; w/c \approx 0.7; without admixture
Flow \approx 12 \text{ cm}

at 50 kg cement/pump:
\begin{align*}
\text{w/c } 0.7 & = 35 \text{ l water} \\
\text{w/c } 0.5 & = 25 \text{ l water}
\end{align*}

Sand A/B\textsubscript{8}; MV 1:6; w/c \approx 0.5; with admixture
flow \approx 12 \text{ cm}
Air entraining admixture

- Improvement of performance
- Improvement of density
- Better enclosure of heating tubes

Sand A/B₈; MV 1:6; w/c ≈ 0.5; with admixture
  flow ≈ 12 cm
  density ≈ 2.16 kg/dm³

Sand A/B₈; MV 1:6; w/c ≈ 0.7; without admixture
  flow ≈ 12 cm
  density ≈ 2.26 kg/dm³
Air entraining admixture

Sand A/B₈; MV 1:6; w/c ≈ 0,7; without admixture
flow ≈ 12 cm
Air entraining content ≈ 3 %

Sand A/B₈; MV 1:6; w/c ≈ 0,5; with admixture
flow ≈ 12 cm
Air entraining content ≈ 10 %
## Air entraining admixture - Strength

<table>
<thead>
<tr>
<th>Screed</th>
<th>fresh Air entrainer Vol-%</th>
<th>hardened Flexural strength N/mm²</th>
<th>hardened Compressive strength N/mm²</th>
<th>confirmation Flexural strength N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screed without Admixture</td>
<td>2,8</td>
<td>6,0</td>
<td>40</td>
<td>3,8 (CT-F5)</td>
</tr>
<tr>
<td>Admixture A</td>
<td>9,7</td>
<td>5,1</td>
<td>33</td>
<td>3,1 (CT-F4)</td>
</tr>
<tr>
<td>Admixture B</td>
<td>12,7</td>
<td>4,1</td>
<td>21</td>
<td>2,4 (≈CT-F4)</td>
</tr>
</tbody>
</table>
Drying behaviour-sorption isotherme

Bild 24: Charakteristischer zeitlicher Verlauf der Trocknungsgeschwindigkeit und der Feuchteverteilung bei einseitiger Austrocknung eines hygroskopischen, kapillaraktiven Baustoffs

Reference: PhD-Thesis Dr. Wiegrink TU-München 2002
Additives-products to enhance the drying process

- Additives for enhancing of the drying process **without** deviations in the relevant moisture content of screed according to DIN 18560-1

  These additives reduce the water need of screed, no chemical binding of water

- Additives for enhancing of the drying process **with** deviations in the relevant moisture content of screed according to DIN 18560-1

  Special products according to DIN 18560-1
  Special definitions of limit values for CM measurement.
Factors influencing the drying process

- **Screed:**
  - Water/cement ratio during production
  - Type and amount of cement
  - Type of aggregate (sand)
  - Thickness of screed

- **Climatic conditions:**
  - Air temperature
  - Relative humidity
  - Air exchange after installation of screed
Chemical composition of admixtures

- Products similar to additives used in concrete industry:
  - Naphthalinsulfonates
  - Lignosulfonates
  - Melaminesulfonates
  - Polycarboxylates (PCE)

- Additives for concrete are specified according to EN 934-2
- Performance tested according to annex ZA;
- CE labeled
- Products not specified are regulated on a national basis (Germany: Allgemeine bauaufsichtliche Zulassung-abZ)
- Admixtures and additives for screed are not covered by EN 934 or national regulations
- Certification system Switzerland (FSHBZ-Gütesiegel)
Performance Testing

- Technical information from the BEB (11/2016)
- Description of a possible procedure for performance testing
- Development of a certification program by IBF in early 2017
- Principle: Testing of a admixture or additive based on a comparison of
  - Screed **without** admixture/additive
  - Screed **with** admixture/additive

Result show the absolute performance of the admixture/additive!!!
IBF-Certification program

- **Initial Type Testing**
  - Testing of properties of fresh screed material (like air entrainers, flow and others)
  - Testing of properties of hardened material
    - Especially compressive and flexural strength after 7 and 28 days
    - Conformation test of flexural strength after 28 days
    - Bond strength
    - Drying performance and others
  - Compatibility testing
  - Identification by IR-Spectroscopy
  - Control of safety data sheet (GHS-Conformity)

- **Annual re-test** (short term)
Future Developments

Improvement by life cycle approach:
- Performance
- Usage stage
- Disposal/Recycling
- Testing of real conditions of additives for enhancing of drying conditions
Summary

- German Purity Law for Screed (?)
- New building technologies require faster and reliable screed
- Admixtures for different process types are available
- Water input by screed into new buildings needs to be reduced
- IBF Testing and certification program can be a first step to improve security of admixtures and additives for screed
- Lice Cycle certification will be a next step