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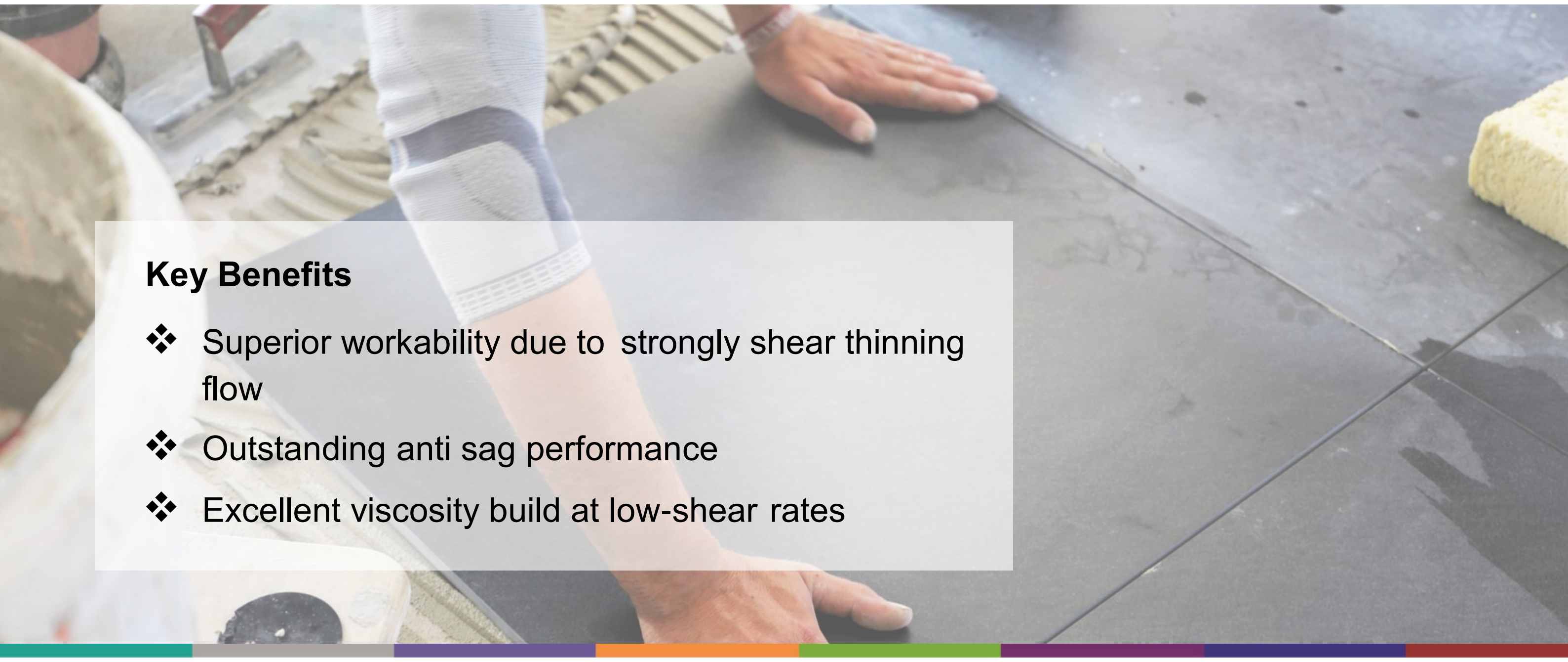
Application Leaflet

BENAQUA® 4000

Partial replacement for cellulose ethers in cementitious thinset tile mortars



Key Benefits

- Superior workability due to strongly shear thinning flow
- Outstanding anti sag performance
- Excellent viscosity build at low-shear rates

Introduction

Thinset tile adhesive mortars are used for earthenware tiles or facings, for example made from granite or marble of higher value. These adhesives are typically applied in a very thin layer thickness.

These mortars consist of Portland cement, finely graded quartz sand, redispersible latex powder and additives. Hydraulic curing Portland cement functions as the main binder and requires a carefully balanced water level to ensure proper curing and, as a consequence, the required strength. The addition of small amounts of redispersible latex powder (2 - 4%) provides additional bonding strength and keeps the cured material flexible to a certain extend. This is especially important in so called “flex adhesives” which are designed to be crack resistant, e.g. in case of temperature changes.

Traditionally, thinset mortars are formulated with cellulose ether to control the consistency, sag resistance and water retention/open time. However, the workability of these mortars is often difficult. Also the sag resistance, especially with heavier tiles and slabs, often needs improvement.

Composition	Polymer modified hectorite clay
Appearance	Off-white, finely divided powder
Density, [g/cm^3]	1.63
Non-volatile content, [%]	100

Key benefits

The hectorite clay based BENAQUA® 4000 is a rheological additive are designed to partly replace cellulose ether and to the provide :

- High viscosity and structure build at low-shear
- Outstanding sag control
- Excellent flow properties for easy application

Incorporation and levels of use

BENAQUA® 4000 is typically added to the dry mix/ powder blend. The compound can then be mixed with water on site in accordance with the mortar producer`s instructions.

Typical levels of use for BENAQUA® 4000 in tile mortars are 0.05% to 0.3% by weight on total formulation. However, this is strongly system dependent and influenced by the cellulose ether used.

Test system

The present system is a C2T tile mortart (in accordance with DIN EN 12004).The required minimum tensile strength is 1 N/mm^2.

Compound	Concentration [%]
Portland cement CEM I 42.5 R	35.4
Quartz sand 0.2 - 0.7 mm	22.8
Quartz sand 0.1 - 0.4	18.2
Quartz sand 0.06 - 0.2 mm	20.2
Redispersible latex powder	3.0
Rheological additive	0.4
Total	100

Water concentration

241 ml/kg per dry powder (in all cases constant)

Sample preparation

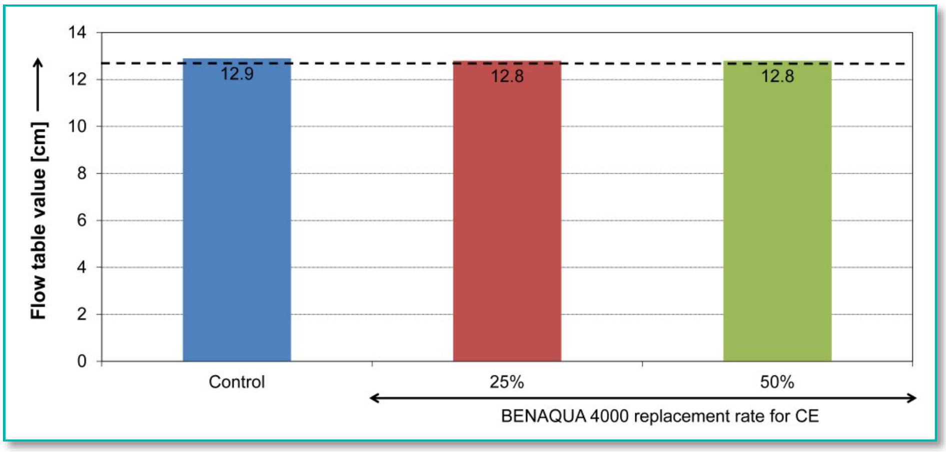
- Put the water into the bowl of the Hobart mixer.
- Add the dry powder over 15 seconds under stirring.
- Stir for 45 seconds.
- Stop the mixer and wait for 2 minutes. Stir for another 15 seconds.

Practical examples

The use of BENAQUA® 4000 as a partial replacement for cellulose ether in a cementitious thinset tile mortar is illustrated in this leaflet. The abbreviation CE indicates cellulose ether. The replacement rates in the figures are related to 100% of the original cellulose ether quantity. The control sample is formulated with the pure cellulose ether.

Consistency/Spread rate

Figure 1

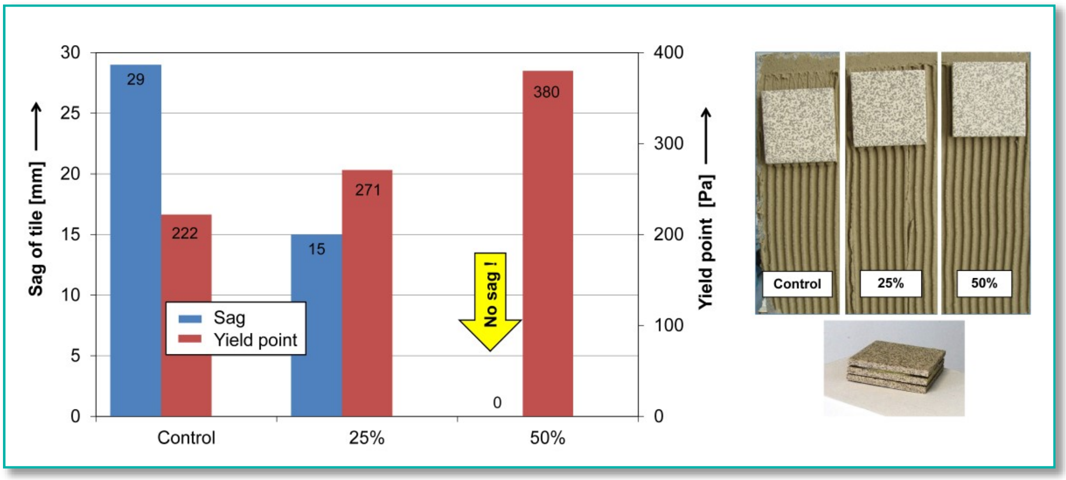


All tested samples showed almost identical flow table values of approximately 13 cm. This means that the viscosity does not change with increasing replacement rates of BENAQUA® 4000.

Sag resistance and yield point

In figure 2, the sag resistance and the yield values are illustrated. The stability against sagging (plotted in blue) is defined as the slip distance of the tile: the smaller the value the better is the performance. Note, that a severe method to test the sag resistance was chosen to differentiate the performance of the individual samples more clearly. The yield point (plotted in red) is defined as the shear stress necessary to disrupt the internal structure of the material: the higher the value, the better the performance.

Figure 2

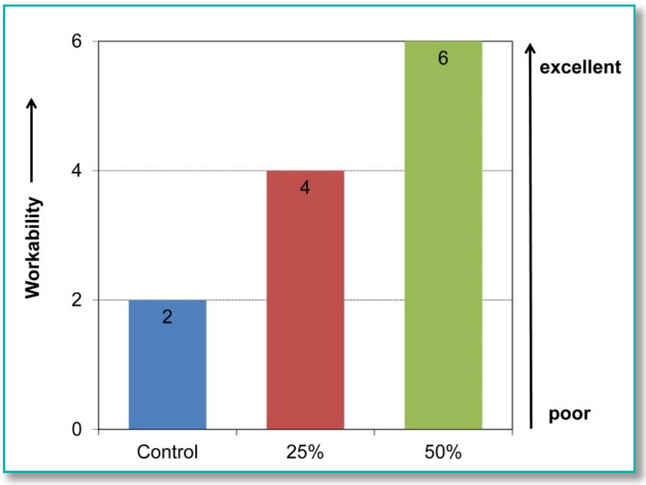


With increasing BENAQUA® 4000 quantity a significant improvement in the sag resistance and a constant increase of the yield point are observed. Already with a replacement of 25% of the original cellulose ether by BENAQUA® 4000 a noticeable improved sag resistance is achieved.

Ease of application-workability

In figure 3, the application properties are illustrated. The workability is defined as the ease of application: reduction of the stickiness and resistance to spread out with a serrated trowel. The higher the value the better the performance.

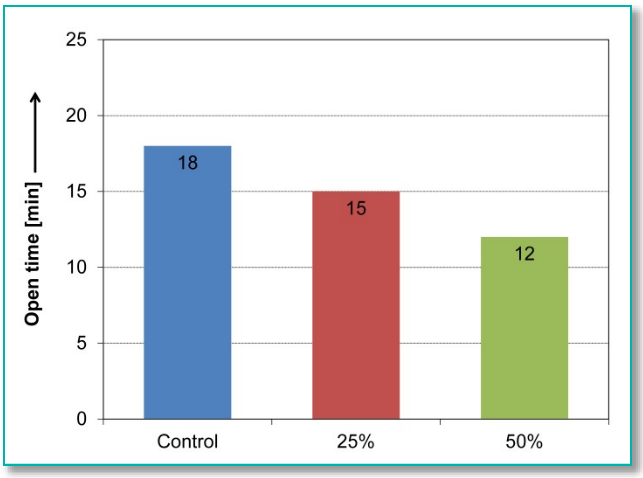
Figure 3



With increasing replacement rates of BENAQUA® 4000 application becomes easier compared to the original sample.

Open time

Figure 4

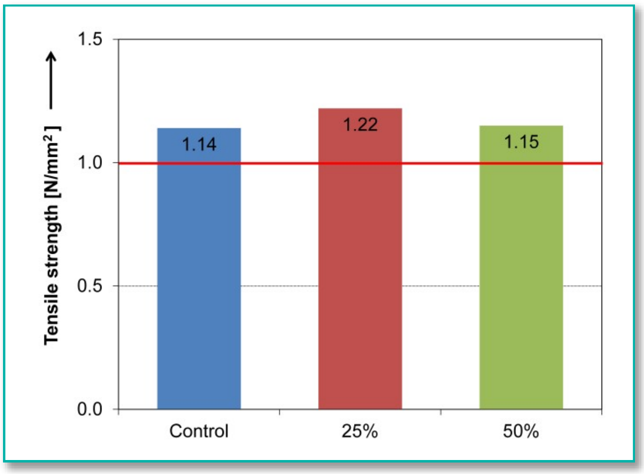


With increasing replacement a slight reduction in the open time occurs.

Tensile strength

In figure 5, the influence the tensile strength of the cured tile adhesives is demonstrated.

Figure 5



All testes samples are in line with the required minimum value in the Norm, of 1.0 N/mm^2 . Both samples with partial replacement of cellulose ether by BENAQUA 4000 show only minor variations to the control sample equipped with pure cellulose ether.

Conclusion

BENAQUA® 4000 is an excellent replacement for cellulose ether used in cementitious thinset tile mortars. With increasing replacement rates of BENAQUA® 4000 the workability with a serrated trowel becomes easier and the sag resistance of the tiles improves. Also BENAQUA 4000 does not affect the tensile strength of the cured mortar. However, this can also slightly shorten the open time.

Appendix

Test methods

- The flow table value was measured with the Haegermann flow table desk (DIN 18555, Part 2).
- The sag resistance was determined according to a modified version of test method EN 1308. The tile adhesive was applied using a serrated trowel (6 x 6 mm) on the smooth side of a paving slab made from exposed aggregate concrete. After 2 minutes, 3 earthenware tiles 10 x 10 cm glued on top of each other (510 g) were placed with their rough side into the adhesive and weighted with 5 kg for 30 seconds. Then the concrete slab was positioned vertically and stored for 10 minutes. After this period sag of tiles was measured in centimeters (cm).
- Yield point was determined with a Anton-Paar MCR 3000 rheometer, measuring geometry BM 12 (ball measuring system; ball diameter 12 mm), at a temperature of 23 °C.
- Workability or application properties were evaluated by applying the tile adhesive with a serrated trowel on a vertically positioned concrete slab. The stickiness on the tool and the force required during the application were noted subjectively.
- Open time was tested in accordance with DIN 18156, Part 2, at normed climate temperature of 20 °C and moisture content of 65% ±4%. The tile adhesive was applied with a serrated trowel (6 x 6 mm) on the smooth side of a paving slab of exposed aggregate concrete. After 3 minutes an earthenware tile of 5 x 5 cm was placed with its rough side on the adhesive and weighed down with 1 kg for 30 seconds. Tiles of equal size were applied into the adhesive after 3 minute intervals in the same manner. After 10 minutes all tiles were turned over to assess wetting on the back of each with adhesive. The open time was determined as the time at which > 50% of the adhesive had stuck to the back.
- Water retention was tested according to DIN 18155, Part 7, with the filter plate method.
- The tensile strength has been tested in accordance with EN 1348 after 28 days curing/storage under dry conditions at room temperature of 23 °C.

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