

Insight Paper

# TILE ADHESIVE STANDARDS AND THEIR RELEVANCE FOR TILE INSTALLATION

Tile sales are increasing globally. So is the variety of tiles and substrates. How do you choose the right tile adhesive? Standards give important guidelines.

Tile sales are increasing globally. So is the variety of tiles and substrates. Large-format, porcelain tiles that look like natural stone and glittery, glass-like tiles in very small patterns are now installed on concrete, gypsum plasterboard, wood or even old tiles. In most cases this can only work with technically advanced, polymer-modified tile adhesives. But how do you choose the right tile adhesive?



What kind of tile adhesive does it take to fix these tiles to a wall?

# THERE IS NO SUCH THING AS A “ONE-SIZE-FITS-ALL” ADHESIVE



For secure adhesion on drywalls even small tiles require a C1 tile adhesive.

The adhesive must fit the tile, the substrate and the surrounding conditions. Thin-bed tile adhesives started to replace the thick-bed method in Germany in the 1960s and later in all of Europe; in response, European Standard EN 12004 was ultimately developed in 1995 and has since then become a global reference for the classification of tile adhesives. These are divided into two major classes depending on their adhesion strength.

## C1

### Normal Adhesive: C1

C1 adhesives are recommended for ceramic and porcelain tiles with higher water absorption and for installation on underfloor heating systems, outdoors, in areas of high humidity and on drywall or waterproofing materials. For more demanding substrates and conditions, C1 adhesives should be modified with a higher dosage of dispersible polymer powder in order to increase their flexibility and bonding power and to safeguard the durability and visual appearance of the tiling. It should not be used for tiles larger than 30 x 30 cm.

**Their adhesion strength must be at least 0.5 MPa (0.5 N/mm<sup>2</sup>).**

## C2

### Improved Adhesive: C2

These are recommended for all types of ceramic and porcelain tiles and for almost any type of substrate, including old tiles. Tile formats can be up to 60 x 60 cm for standard C2.

**Adhesion strength is at least 1 MPa (1 N/mm<sup>2</sup>).**



Laying tiles on tiles is time saving but challenging for the tile adhesive. You would typically choose a C2 tile adhesive.

## S1 and S2

Both C1 and C2 tile adhesives are also classified as S1 or S2, which refers to their flexibility: S1 is a flexible adhesive; S2 is a highly flexible adhesive.

### Flexible Adhesives: S1

S1 flexible adhesives are mandatory for porcelain tiles with very low water absorption, larger formats (e.g. 30 x 60 cm) and where tiles are laid on critical substrates, such as gypsum plasterboards, floor heating and tile-over-tile applications.

### Highly Flexible Adhesives: S2

S2 adhesives are highly flexible for very large tiles and special cases.

### Adhesives with Special Characteristics: T, E and F

C1 and C2 adhesives can also offer reduced slip (T), extended open time (E) and fast setting (F).



Floor heating demand at least flexible S1 tile adhesives.

When choosing a suitable tile adhesive, this official classification system helps customers find their bearings and allows them to compare adhesives. But is this all there is to know?



To be classified as C1 or C2 according to EN 12004, the tensile adhesion strength of tile adhesives is evaluated using “standard” ceramic tiles and a “standard” concrete slab substrate. However, in real-world applications, both tiles and substrate differ from these ideal “lab” conditions. Porcelain tiles, which are associated with very low porosity and water absorption and with a very even, smooth surface, have become extremely popular of late. Tiles can also come with a prominent pattern on the back, and some very thin tiles are even supported by a fiber mesh on their back side. In contrast to the “lab” concrete slab, substrates such as old tiles, gypsum plasterboard or larger substrate areas, which can easily undergo tiny movements, can be quite demanding.

Modern tiles are often very different from the concrete slabs used for testing tile adhesives.

# WHY STANDARDS GO ONLY SO FAR

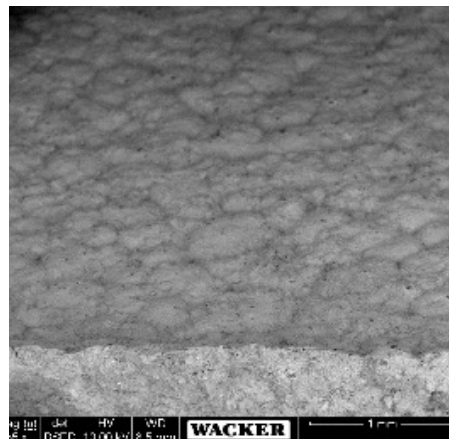
We tested different tiles on the market in comparison to the "standard" tile described in the test standard EN 12004-2. For modern porcelain tiles with very low water absorption, even a normal C2 tile adhesive can reach its limits.

Such demanding tiles require a flexible C2S1 adhesive with a higher polymer content in order to obtain a safe, long-lasting bond between the tiles and the substrate and, consequently, to safeguard the performance of the tile covering. We found interesting results.

## 1 Modern Low-Porous Porcelain Tiles Require Higher Polymer Content



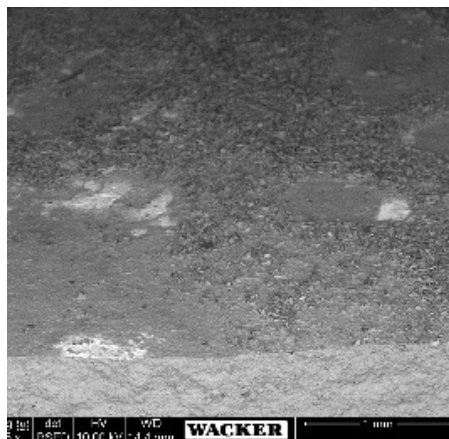
Reference tile used in tests according to EN 14411: unglazed porcelain fully vitrified, Group BI<sub>a</sub>, E<sub>b</sub> ≤ 0.5%



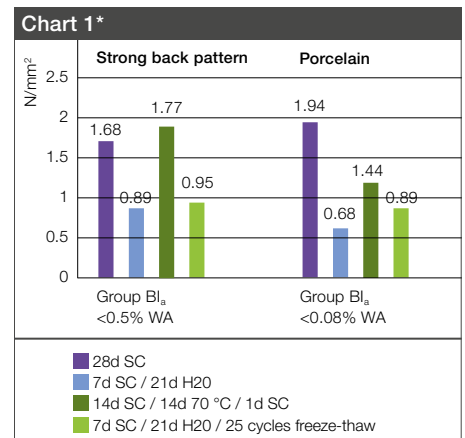
Side view under the microscope (1 mm). The surface of the back side still appears uneven when viewed under the microscope.



Glazed porcelain tiles are often used today (Group BI<sub>a</sub>, E<sub>b</sub> = 0.08%)



Side view under the microscope (1 mm). The back side is almost completely smooth when viewed under the microscope.



Tests show that bond strength is considerably lower with the glazed porcelain tile. To achieve a reliable bond, a higher polymer content is recommended.

\* C2TE S1 WACKER reference formulation with 35% Milke CEM I 52,5R, 5.5% VINNAPAS® 8118 E, 0.3% Tylose® MHF 10.015 P4, 0.5% Calcium formate and 27.5% water demand.

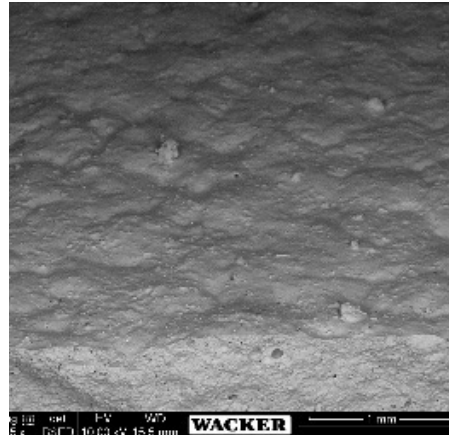
Results obtained at the WACKER Technical Competence Center. Tests conducted in accordance with EN 12004-2.

## 2

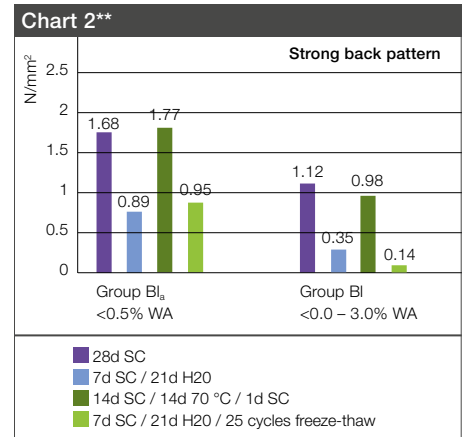
### Prominent Back Patterns Require a Contact Layer



Another problematic group consists of tiles with prominent back patterns. Example: Unglazed porcelain Group BI<sub>b</sub>,  $0.5 < E_b \leq 3.0\%$



Side view under the microscope (1 mm). Even though the surface is quite porous, tests according to EN 12004 show unsatisfying results.



Bond strength is considerably lower with the tile with the strong back pattern.



The reason for the reduced bond strength is the prominent back pattern, which prevents the tile adhesive from reaching the porous tile surface. This problem can be solved by putting a contact layer on the back side or by back buttering the tile. This technique is also recommended for tiles larger than 30 x 30 cm.

\*\* C2TE S1 WACKER reference formulation with 35% Milke CEM I 52,5R, 5.5% VINNAPAS® 8118 E, 0.3% Tylose® MHF 10.015 P4, 0.5% Calcium formate and 27.5% water demand. Results obtained at the WACKER Technical Competence Center. Tests conducted in accordance with EN 12004-2.

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