CREATING TOMORROW'S SOLUTIONS

CONSTRUCTION | TILE ADHESIVES

SHAPE THE FUTURE
WITH MODERN TILE ADHESIVES
RELY ON QUALITY
FROM THE MARKET LEADER

Tiles have been used as wall and floor coverings for over 3,500 years. They have become an indispensable finish material and are now available in almost all sizes, designs and grades. The range of applications for tiles is much wider than in the past – but tiled finishes are also subject to much stricter demands.

As the market leader in binders, WACKER has been involved in the development of modern tile adhesives for over 50 years. For example, our dispersible polymer powders enable non-porous stoneware tiles to be laid with cementitious adhesives. The same applies to the permanent adhesion of tiles under extreme environmental conditions, such as continuous immersion in water or for outdoor use. Our innovation and commitment will continue to pay off in the future.

As a construction-industry partner, our experts are eager to assist you in finding the best solution for you and your projects with both global and local support. Don’t hesitate to contact us!

Go for the Optimum!
Solutions for the Construction Industry

Silicone and polymer chemistry have changed the construction industry worldwide. WACKER offers you its expertise in a unique way – the company is:
• A worldwide leader in polymer binders for construction materials
• One of the biggest silicone producers worldwide
• Close to you through native, expert staff
• Offering individual technical assistance through our Technical Centers in all key regions

Our comprehensive portfolio, many years of experience and strong service will help you find the optimal solution for your specific application. Talk to us! www.wacker.com/construction

VINNAPAS® is a registered trademark of Wacker Chemie AG.
As a technology leader, WACKER consistently introduces innovative dispersible polymer powders and dispersions to the market.

Our Standard Offering
By using VINNAPAS® Standard polymer powders and dispersions, you can easily reach existing European application standards such as C1/D1 for tile adhesives.

To ensure that you easily find the right polymer binder for your needs, we have developed a user-friendly naming system. Basically, we have divided the VINNAPAS® portfolio into Standard and Plus products. Each product is named according to its specific characteristics.

We are constantly working on novel innovative product solutions with the best price-performance ratio in the market.

In this respect, the VINNAPAS® Standard products are the benchmark in the market.

VINNAPAS® N Class – Neutral Effect on Rheology
These products provide a high degree of formulation freedom and are ideal for various applications.
Our Plus Offering
VINNAPAS® Plus polymer powders and dispersions provide you with unique solutions. Their specific properties allow them to be used under a wide variety of special conditions and requirements and ensure you remain competitive in your market. Naturally, special usage requires special service – we have tailor-made services to help you make the most of these products.

We also offer special VINNAPAS® dispersions for high-performance applications. To find out more, please visit www.wacker.com/vinnapas

VINNAPAS® E Class – Enhanced Properties
These products have enhanced properties in a number of applications and improve essential characteristics. They ensure improved workability, increased adhesion and water resistance, to name just a few.

VINNAPAS® H Class – Hydrophobic Excellence
These products have remarkable hydrophobic properties, making them ideal for all types of plasters and tile grouts as well as for ETICS (External Thermal Insulation Composite Systems).

VINNAPAS® T Class – Thixotropic Expertise
These products are used in thixotropic tile adhesives and in troweling compounds.

VINNAPAS® L Class – Leveling Optimization
These products create smooth surfaces by displaying excellent leveling properties. They are therefore ideal for self-leveling compounds.

VINNAPAS® F Class – Flow Superiority
These products provide excellent flow properties without adding any additional synthetic superplasticizers or casein. They are ideally suited to all applications requiring fast processing with a 2-in-1 solution.
Whether stoneware tiles are fixed to plywood or porcelain tiles to concrete, the most vulnerable point is always the bond between the tile and substrate. VINNAPAS® eliminate this weakness by significantly improving the bonding strength of the adhesive to both the tile and substrate.

Traditional cement mortars have difficulty coping with the many different demands of modern construction technology. The simple reason for this is that conventional cement mortars bond by mechanical interlocking with porous substrates. The traditional way of laying tiles in mortar is to tap them into place in a thick mortar bed. This compacts the mortar, and fine cement particles migrate into the porous back of the tile, and into the substrate. The mortar hardens to provide the mechanical interlocking.

Today, however, neither the tiles nor the substrate are sufficiently porous for this type of installation. Beginning in the 1950s, liquid polymer binders were added to mortars to improve the bond strength. Unfortunately, these liquid additives proved awkward and difficult for the installer to handle.
The breakthrough came in 1953, when WACKER developed the first polymer binders in the form of dispersible polymer powders. These dispersible polymer powders form the ideal complement to mineral binders such as cement. This combination yields a mortar with outstanding synergistic properties and characteristics that a single binder cannot offer on its own.

Moreover, these polymer binders can also be added in precisely metered amounts during factory pre-mixing of the dry-mix mortar. A pre-mixed mortar is then delivered to the building site, and only needs to be mixed with water. These polymer-modified, one-component systems decisively improve the handling and reliability of the adhesive mortars.

Today, our VINNAPAS® trademark encompasses a whole group of dispersible polymer powders available for selectively improving and modifying tile adhesives to meet specific requirements.

All classes of VINNAPAS® dispersible polymer powder improve properties such as:
- Adhesion
- Flexibility (plasticity)
- Workability
- Wetting
- Non-slump
- Open time

Using VINNAPAS® dispersible polymer powder in tile adhesives offers two unbeatable advantages: first, the tiles can be laid more efficiently. Second, you always get an attractive and durable end result.
THE THIN-BED METHOD: FASTER, MORE EFFICIENT, MORE DURABLE

Complicated, Ineffective and Expensive: the Thick-Bed Method

Tiles used to be mainly laid via the thick-bed method. This involves mixing cement and sand on site in a ratio of 1:3 to 1:5. In some countries, cement is even used without sand. The tiles and substrate are first moistened with water. Then a 15 to 30-mm-thick mortar coat is applied to the back of the tile, and the tile is pressed onto the substrate. To obtain a flush surface, the tiles are subsequently tapped into the mortar bed. This process has various practical difficulties.

Complicated Handling

The thick-bed method requires experienced tilers, since the mortar must be accurately mixed from sand and cement, and applied in exactly the right amount. The tiling itself is also time consuming and difficult because of the mortar used. Since simple cement mortars, like pure cement, do not have any slump resistance, the freshly laid tiles will slip on walls. The tiles can therefore only be laid from bottom to top using spacers. Obtaining a satisfactory result is a lengthy process requiring a high degree of skill and experience.
**Only for Porous Materials**

This method is only suitable for porous tiles and porous substrates. However, tile technology is moving progressively toward more vitrified tiles (porcelain tiles), which have now become the standard. Most industrial countries therefore now use the thin-bed method.

**Fast and Economical: The Thin-Bed Method**

The thin-bed method, instead of traditional cement mortars, uses a formulated tile adhesive. This can be easily applied over large areas with a notched trowel. Then the tiles are adjusted gently after laying to produce a uniform adhesive bed with a thickness of 2 to 4 mm.

**Easy to Work with**

High-quality tile adhesives for wall application have good non-slump properties. The freshly laid tiles therefore do not slip on the wall. It is thus possible to lay the tiles from top to bottom without using spacers. This makes it easier to produce a uniform pattern. The method is also more economical in comparison to the thick-bed technique, because material consumption is low, and the tiles are laid much faster. It even pays off on uneven substrates that require leveling beforehand.

**Excellent Results Every Time**

Modern polymer-modified pre-mixed mortars are so easy to mix and install that good results are consistently achieved, irrespective of the tile material or the substrate. By using different types of VINNAPAS® dispersible polymer powder and adjusting the amount used, the tile adhesive can be custom-mixed for the particular tile type and substrate.

**Thick-Bed**

- High material consumption
- Very time consuming
- Requires highly skilled labor
- Very limited applicability

**Thin-Bed**

- Low material consumption
- Fast, efficient tile laying
- Reliable to use
- Can be optimized for any application
LAYING LARGE TILES: A TREND MADE EASY

The trend toward large-format tiles is continuing. These tiles create a spacious and luxurious environment. At the same time, they are easier to clean and thus more hygienic than smaller tiles. However, technical challenges also increase as the tiles get larger.

Large-format tiles break more easily. In addition, they are heavier, bulkier and slide off vertical surfaces more easily. Furthermore, they are not always completely flat – just like many substrates. Yet large tiles, in particular, require a level substrate. Above all, however, the tiles are exposed to thermal and other stresses. Successful laying of large tiles depends on a variety of factors – improving the adhesion and increasing the flexibility of tile adhesives with VINNAPAS® polymer powders plays a key role here.

Substrate and Tile
The best method for achieving a completely uniform and level substrate with a sufficiently adhesive surface is to use a polymer-modified self-leveling compound. WACKER offers suitable VINNAPAS® grades for this. For example, VINNAPAS® L polymer powders improve the material’s leveling properties, defoaming capabilities, dimensional stability and uniformity. Additionally, VINNAPAS® F polymer powders impart self-plasticizing properties. More information is available at www.wacker.com/vinnapas.

Any discernible directional warping in the tiles should be taken into consideration when they are laid. It’s thus not recommended to use staggered laying patterns for concave or convex tiles.

The Right Tile Adhesive
Cement-based tile adhesives adhere very well to porous substrates such as bricks, plasters, earthenware tiles and stoneware tiles. These structures are good anchors for the calcium silicate hydrate needles that form when cement hardens. In contrast, modern porcelain stoneware tiles have extremely smooth surfaces – adding polymers such as VINNAPAS® to the tile adhesive is the only way to ensure adequate adhesion. Test series have shown that tile adhesives for large-format tiles must be highly modified to attain the necessary tensile adhesion strength coupled with high flexibility. This requires specially designed, high-quality polymers. The right VINNAPAS® grade easily satisfies the water and high-temperature storage requirements critical for large tiles, too.

Joints and Tile Grouts
Large-format tiles require high-quality grouts. Here, three properties are especially important: good adhesion at the tile edges, good abrasion resistance and limited water uptake coupled with good water-vapor permeability. Adding 1 - 2% VINNAPAS® H powder optimizes precisely these properties. High-quality grouts play another important role in the laying of large-format tiles: like flexible tile adhesives, they compensate for any stresses that may arise. To do so, they should satisfy a minimum joint width of 3 mm; 5 mm is even better.
Decoupling Tile Surfaces
Wherever vertical and horizontal surfaces meet and where rooms merge into each other, a movement joint is obligatory. Here, it’s important to decouple the surfaces completely. To achieve this, there should be no contact between the surfaces and no residual tile adhesive or grout in the gaps. With WACKER’s ELASTOSIL® silicone sealants, you can seal joints permanently without crack formation.

To successfully lay large tiles, all components must match: tiles, laying design, substrate, tile adhesive, grouting and decoupling of the surfaces. With many decades of applications expertise, WACKER offers suitable products for formulating specific materials. The WACKER ACADEMY supports with regular training courses.

www.wacker.com/wacker-academy
DISPEROSIBLE POLYMER POWDERS: THE BEST SOLUTION ON SITE

The best solution is a powder. VINNAPAS® dispersible polymer powders enable the use of one-component systems with their many practical advantages.

When the thin-bed method was developed in the early 1950s, two-component tile adhesives were used. A polymer binder in the form of an aqueous polymer dispersion was mixed with a simple pre-mixed dry mortar (cement, sand and water retention agent).

Disadvantages of Two-Component Systems
This proved not entirely suitable for a number of reasons: the aqueous polymer dispersion must be added in precisely metered amounts shortly before the mortar is used. On a busy construction site, it is easy to use the wrong amount, which would lead to significant variations in the properties and performance. The logistics of two-component systems also causes problems. The polymer dispersion must be protected against freezing during transportation and storage, and is also prone to microbial attack.

The Breakthrough: Dispersible Polymer Powder from WACKER
When WACKER invented the polymer binder in the form of a powder in 1953, it became possible for the first time to use a one-component cement system. A dry mortar is modified with VINNAPAS® dispersible polymer powder in the factory, and only needs to be mixed into water on site. The result is a high-quality polymer-modified cement mortar with clearly defined properties.

Greater Reliability
Factory pre-mixed mortars can be produced with the correct proportions of cement, fillers, additives and VINNAPAS® dispersible polymer powders. This eliminates serious construction-site mixing errors. Any errors in adding the gauging water are not serious, since the tile adhesive becomes difficult or impossible to use. The error can then be easily corrected by adding more dry mortar or water.

No Storage Problems, Less Packaging Waste
Unlike liquid dispersions and mastic products, such as dispersion tile adhesives, factory pre-mixed dry mortars are not at risk from bacterial growth. They are also much easier to transport and store. Furthermore, the packaging is easier to dispose of and has less environmental impact. Only paper bags have to be disposed of, instead of the drums for dispersions.

High Functionality
VINNAPAS® dispersible polymer powder offers the same functionality as liquid polymer dispersions without their disadvantages. As can be seen from the electron micrograph, they ensure good adhesion, even to smooth, non-porous surfaces.
WITH VINNAPAS®,
YOU SET THE STANDARD

Tile adhesives must meet high technical standards, but also be economically priced. VINNAPAS® meets this twofold challenge. It provides tile adhesives with the properties needed on site: fast, reliable and economical processing, high functionality and durability.

Good Workability
VINNAPAS®-modified tile adhesives have a creamy consistency. They can be quickly and easily applied with very little effort, and offer other properties that make work more efficient.

Good Water Retention
The high water retention of the wet mortar makes it unnecessary to pre-wet the tiles or substrate. High water retention also ensures adequate hydration of the cement, even without such pre-wetting, and a long open time and correction time. In tile adhesives, this water retention is obtained by suitable modification with cellulose ethers.

Excellent Non-Slump Properties
Thixotropic VINNAPAS® T dispersible polymer powders can be used to formulate sag-resistant tile adhesives. By preventing the tiles from slipping, they allow the efficient laying of large, heavy tiles on walls.

Figure 1: Open Time acc. EN 1346

The open time is determined by the adhesion strength [N/mm²] (EN 1346) of a cementitious tile adhesive (40% Portland cement, 0.5% cellulose ether) with earthenware tiles under standard conditions (28 days at 23°C, 50% relative humidity).

An adhesive mortar is best for laying tiles, since it provides both a long open time and long adjustment time, even at high ambient temperatures.

The open time of a cementitious tile adhesive is determined by:
- Its wettability
- Skin forming time
- Its water retention
- The adhesion and cohesion characteristics after hardening.

Tests show that VINNAPAS® dispersible polymer powder improves these parameters, and therefore the open time as defined by European Standard EN 12004 (Figure 1).
Properties of the Hardened Tile Adhesive

Most of all, though, VINNAPAS® improves the quality of the hardened tile adhesive, and therefore the durability of the adhesive bond.

Good Adhesion to a Wide Variety of Materials, High Cohesion

It is important for every tile adhesive to produce good adhesion between the tile and substrate, and to have high internal cohesive strength. VINNAPAS® offers this for many different material combinations. Whether you want to bond natural stone to concrete, or ceramic to plaster, VINNAPAS® dispersible polymer powders can modify tile adhesives to maintain adhesion and cohesion over long periods, even under extreme and cyclical conditions such as freeze/thaw, water immersion and changing temperatures.

High Flexibility

Tile adhesives, as the interface between the tile and substrate, also act as a kind of flexible buffer. For example, the mortar should be able to compensate for differences in thermal expansion between the tile and substrate. It should prevent the tile from cracking or lifting as a result of stresses between the substrate and tile layer. VINNAPAS® can be used to adjust the adhesive’s modulus of elasticity to a value lower than that of the tile and substrate.

Table 1: Standards and Requirements for Tile Adhesives in Europe

<table>
<thead>
<tr>
<th>Standard</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitions and terminology</td>
<td>EN 1322</td>
</tr>
<tr>
<td>Slip</td>
<td>EN 1308 &lt; 0.5 mm (class T)</td>
</tr>
<tr>
<td>Wetting capacity</td>
<td>EN 1347</td>
</tr>
<tr>
<td>Tensile adhesion strength (tensile test); storage conditions</td>
<td>EN 1348 Minimum requirement: &gt; 0.5 N/mm² for all storage conditions (class C1)</td>
</tr>
<tr>
<td>Storage under normal conditions: 28 days s.c.</td>
<td></td>
</tr>
<tr>
<td>Water immersion: 7 days s.c. + 21 days in water</td>
<td></td>
</tr>
<tr>
<td>Heat aging: 14 days s.c. + 14 days 70 °C + 1 day s.c.</td>
<td></td>
</tr>
<tr>
<td>Freeze/thaw storage: 7 days s.c. + 21 days</td>
<td></td>
</tr>
<tr>
<td>In water + 25 freeze/thaw cycles</td>
<td></td>
</tr>
<tr>
<td>Open time</td>
<td>EN 1346 &gt; 20 min; or &gt; 30 min (class E)</td>
</tr>
<tr>
<td>Deformability/flexibility with determination of deformation</td>
<td>EN 12002 S1 deformable mortar, deformation ≥ 2.5 mm and &lt; 5 mm</td>
</tr>
<tr>
<td>Tile adhesives – definitions and specifications</td>
<td>EN 12004 S2 highly deformable mortar, deformation ≥ 5 mm</td>
</tr>
<tr>
<td>Shear strength</td>
<td>EN 1324 Only for dispersion adhesive</td>
</tr>
</tbody>
</table>

Table 1 shows the most important technical requirements for a cementitious tile adhesive in Europe, and the associated test methods.

Raw materials, climatic conditions, aesthetic requirements and regulations differ from region to region. This is why we support you with local Technical Centers and local experts. They help you adapt formulations to your specific needs, drawing from a pool of global knowledge from all climate zones.
ADHESION: KEEPING A PROMISE

Adhesion
The adhesion of tiles to various substrates is determined by the tensile adhesion strength in N/mm² (Figure 2).

Summary:
Without polymer modification, the tile adhesive does not have sufficient adhesion (tensile adhesion strength ≤ 0.5 N/mm²) after heat aging. 1.5% VINNAPAS® dispersible polymer powder in this dry-mix formulation is enough to meet the minimum requirements of EN 12004 (C1 adhesive) for this important criterion.

Heat Aging
The heat-aging test shows whether a tile adhesive, after hardening, has sufficient deformability (flexibility) to compensate the forces caused by the different coefficients of expansion between the tiles and substrate at high temperatures (Figures 2 + 3).

Summary:
The tensile-adhesion test shows that cementitious tile adhesives without significant amounts of polymer modifier can only pass the heat-aging test if highly porous earthenware tiles are used. With modern, less-porous frostproof stoneware tiles, as defined in the new European Standard, only the sufficient addition of polymer guarantees that the test requirements can be met.

Figure 2: Tensile Adhesion Strength acc. EN 1348

Tensile adhesion strength of a cementitious tile adhesive (40% Portland cement) acc. to EN 1348 for stoneware tiles to concrete slabs after different storage conditions.

Figure 3a: Tensile Adhesion Strength acc. EN 1348 after 28d sc Influence of Water Absorption of the Tile

Tensile adhesion strength of a cementitious tile adhesive (40% Portland cement) acc. to EN 1348 with different types of tile materials on concrete slabs after standard climate and heat-storage conditions (water absorption of tiles in parentheses).

Figure 3b: Tensile Adhesion Strength acc. EN 1348 after Heat Aging Influence of Water Absorption of the Tile
As a pioneer in the polymer modification of tile adhesives, WACKER has contributed to many standardization committees. As a result, our experts are very well acquainted with both national and international standards and their backgrounds. Our technical centers are equipped to carry out all standards-related tests for you.
Adhesion to Difficult Substrates
The tensile-adhesion test on difficult substrates, such as PVC, wood or smooth non-absorbent tiled surfaces, shows that the cement mortar can only achieve the required adhesion if it contains sufficient polymer (Figure 4).

Summary:
The tile adhesive bonds well to extremely diverse substrates provided it has been modified with enough of a suitable VINNAPAS® dispersible polymer powder.

Adhesion of Porcelain Tiles according to EN 1348/EN 12004
Adequate amounts of polymer modifiers are necessary for laying non-porous tiles that have extremely low water absorption. That is the intention of European standard EN 1348, which mandates stoneware tiles with 0.5% water absorption as test tiles. The EN 12004 standard defines two classes of cementitious tile adhesives, C1 and C2. Compared to C1, C2 requires increased adhesive strength of over 1 N/mm². For permanent laying of highly vitrified, glass or porcelain tiles, flexible C2S1 or C2S2 tile adhesives are preferable. These high-quality tile adhesives are usually modified with 4 – 20% of a suitable VINNAPAS® dispersible polymer powder.

Figure 4

<table>
<thead>
<tr>
<th>Tensile adhesion strength (N/mm²)</th>
<th>PVC</th>
<th>Steel</th>
<th>Wood</th>
<th>Porcelain tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% VINNAPAS®</td>
<td></td>
<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>2% VINNAPAS®</td>
<td></td>
<td>0.4</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>5% VINNAPAS®</td>
<td></td>
<td>0.6</td>
<td>0.8</td>
<td>1.0</td>
</tr>
</tbody>
</table>
A Result to Be Proud of
VINNAPAS® dispersible polymer powders based on VAc/E copolymer technology ensure high flexibility without the addition of external plasticizers. Because they stay flexible, they even retain their mechanical strength under extreme climatic conditions. However, this doesn’t apply to externally plasticized VAc/VeoVa copolymers (Figure 5), since these become brittle over time.

Shear Strength
Non-European standards require a shear test instead of the tensile-adhesion measurement to determine the adhesion to the substrate (Figure 6).

Summary:
A shear test according to DIN 18156/3 (modified test with earthenware tiles and an adhesive joint of 3 mm) with a cement mortar containing 35% Portland cement produced similar shear strength values as the tensile adhesion strength values after heat aging (EN 1348). The higher the VINNAPAS® dispersible polymer powder content, the higher the shear and adhesion strength values – especially after heat aging. Like the European Standards, the ISO standards for tile adhesives also use tensile adhesion strength as a measure of the bonding capacity of a tile adhesive.
The long-term durability and functionality of a tile adhesive depend crucially on its flexibility (or deformability). The mortar needs sufficient flexibility to absorb the stresses and loads occurring between the tiles and substrate. Tests have shown that VINNAPAS® decisively improves mortar flexibility.

Absorbing Stresses
Stresses between the tiles and substrates can occur as a result of:
• Irreversible, differential movements, such as shrinkage and creep of the substrate (e.g. fresh concrete that is still shrinking)
• Reversible movements of the substrate (vibrations or dimensional changes)
• Thermal movement as a result of differences in the expansion of the tiles and substrate – due to their different coefficients of thermal expansion (e.g. in the case of underfloor heating systems or if the tile surface is heated by direct exposure to sunlight).
Compensating for Shear Forces
The adhesion-strength test after heat aging according to EN 1348 gives some idea of the adhesive’s flexibility. Due to the differing expansion coefficients of concrete slabs and tiles, shear stresses form during aging between the tile and substrate, which the adhesive has to compensate. Tile adhesives with little or no polymer modifier show very poor adhesion, if any. Since tiles used in practice are in excess of the standard 5 x 5 cm size, much higher shear stresses are encountered than in the standard test. Therefore, a higher polymer content is even more important.

Greater Deformability
The higher the deformability of a tile adhesive, the more capable it is of compensating for stresses between the substrate and tile and of absorbing shocks from dropped objects without damage to the tile surface. Deformability depends on the amount of polymer used in the formulation.

Determining Deformability
The deformability of a mineral tile adhesive is determined in accordance with EN 12002. Thus, 3-mm-thick mortar prisms are subjected to a 3-point flexibility test. The deformation is measured until the prism breaks. Figure 9 shows the relationship between the polymer content and the ultimate deformation of a tile adhesive. It is obvious that deformability rises as a result of increased polymer content. A C2 adhesive needs a polymer content of approx. 4% to reach the S1 class (minimum deformation ≥ 2.5 mm) and some 10% to reach the S2 class (minimum deformation ≥ 5 mm).

Secure Laying of Tiles
To securely lay all types of tiles and tile formats on various substrates – which plays a major role during renovation – only tile adhesives with sufficient flexibility (e.g. at least class S1 with minimum deformation ≥ 2.5 mm in accordance with EN 12002) should be used. For universal application, including outdoors, the tile adhesives should also fulfill class C2 demands in accordance with EN 12004. Thus for the most common cases, class C2S1 ensures a high level of laying security.
Tile grouts must serve both aesthetic and functional purposes. They must be attractive over the long term, and also perform important functions in ensuring the durability of tiled surfaces. VINNAPAS® dispersible polymer powders make an important contribution here.

Joints perform an aesthetic function in the design of a surface. It must be possible to color the grout mortar to coordinate with individual color schemes, and it should sustain its color for as long as possible without fading or showing efflorescence.

Important Durability Factors
Tile grouts also have an important effect on durability and functionality. Whether in narrow or wide joints, indoors or outdoors, joint mortars must absorb stresses occurring between the tiles and protect the substrate against penetration of water. To ensure that it performs these functions, it is important that the mortar bonds well to the tile edges and does not shrink significantly. It should also be easy to install and have good abrasion resistance when used on floors.

Greatly Superior: VINNAPAS®
VINNAPAS® dispersible polymer powders optimize adhesion to the tile edges and increase deformability and abrasion resistance. The grouts are usually modified with VINNAPAS® H dispersible polymer powders. These special dispersible polymer powders improve not only adhesion, cohesion, abrasion resistance and flexibility, but also the hydrophobicity of the tile grout mortar. As a result, they reduce the water absorption and protect against dirt, discoloration and efflorescence.
Abrasion resistance of a cementitious tile grout mortar acc. to EN 12808-2.

Water absorption (g) of a cementitious tile grout mortar according to EN 12808-5 with an 8 x 4 x 4 cm mortar prism (stored for 28 days under standard climatic conditions), water immersion for 30 min and 240 min.

Table 2: Technical Specifications for a Cementitious Tile Grout Mortar according to European Standards EN 13888 and EN 12808

<table>
<thead>
<tr>
<th>Standard</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion resistance</td>
<td>Minimum requirement: volume abrasion after test ≤ 2,000 mm³</td>
</tr>
<tr>
<td></td>
<td>Additional requirement: volume abrasion after test ≤ 1,000 mm³</td>
</tr>
<tr>
<td>Compressive and flexural strength</td>
<td>Flexural strength (FS) and compressive strength (CS) determined on 16 x 4 x 4 cm prisms; Storage 28 days s.c. and after freeze/thaw cycles; Requirement: FS ≥ 3.5 N/mm², CS ≥ 15 N/mm²</td>
</tr>
<tr>
<td>Shrinkage</td>
<td>Shrinkage determined with 16 x 4 x 4 cm prisms; storage for 28 days s.c.; Requirement: ≤ 3 mm/m</td>
</tr>
<tr>
<td>Water absorption</td>
<td>Water absorption (WA) determined on 8 x 4 x 4 cm prisms; Minimum requirement: WA after 30 min ≤ 5g; WA after 240 min ≤ 10g Additional requirement: WA after 30 min ≤ 2g; WA after 240 min ≤ 5g</td>
</tr>
<tr>
<td>Deformability</td>
<td>Test acc. to EN 12002 (no requirement)</td>
</tr>
</tbody>
</table>
FORMULATIONS:
GETTING THE RIGHT MIX
The amount of VINNAPAS® determines quality, durability and the range of applications.

A) Very Simple Tile Adhesives without Polymer Binders
These do not comply with the European EN 12004 standards, and have very poor durability.
Application:
They are used for small, porous tiles on porous, sound mineral substrates that are not subject to either frost or heat.

B) Simple Standard Tile Adhesives Containing 1 – 3% VINNAPAS®
These show improved adhesion and generally correspond to class C1 defined in EN 12004.
Application:
They are used for small to medium-sized earthenware and stoneware tiles on moderately porous but sound mineral substrates.

C) Standard Flexible High-Quality Tile Adhesives Containing 3 – 8% VINNAPAS®
These meet the European Standards.
Application:
They are used for large tiles on non-porous but sound mineral substrates, indoors and outdoors. In standard applications, these polymer-modified cementitious tile adhesives ensure good reliability and durability.

D) Highly Flexible Tile Adhesives
These are polymer-modified high-quality mineral tile adhesives with very good adhesion to all substrates and higher deformability (or flexibility). They usually contain between 7% and 9% VINNAPAS® dispersible polymer powder. Highly flexible, specialty tile adhesives may even contain up to 20%. These tile adhesives are characterized by the following:
- Wide range of applications
- Ease of handling during installation
- Long-term durability and service life, regardless of the tile material or substrate.

Applications:
Porcelain tiles (water absorption < 0.1%) and natural stone tiles in all formats, on non-porous mineral and non-mineral substrates – even when the substrate is subject to a certain degree of shrinkage and deformation movement.
Typical applications are therefore:
- Tiles subject to the effects of heat (floor heating systems or sunlight)
- Tiles on tiles
- Tiles on difficult substrates, such as cement fiberboards, chipboards, mineral water-proofing membranes, thermal insulation panels, acoustic panels, porous concrete, etc.

Classes B, C and D cover over 75% of all tile adhesive applications in Europe. To meet all the requirements of the construction industry and its new technologies and materials, very high-quality adhesives have been developed for specialty applications. These include, for example:
- Highly flexible adhesives for laying tiles on relatively fresh screeds or concrete
- Fast-setting tile adhesives
- Adhesives with improved flow properties for floor areas (flow-bed mortars)
- Medium-bed adhesives
- Adhesives for natural stone based on white cement
- Adhesives based on gypsum
- Slurries for smoothing porous substrates. (The slurry is applied before the tile installation using the same dry-mix mortar as the thin-set material.)

With VINNAPAS®, WACKER also offers solutions for these specialty applications. As an innovative partner to the construction industry, WACKER helps to support its developments, and offers solutions to modern challenges.

Table 3: Basic Formulations for Different Qualities of Tile Adhesives

<table>
<thead>
<tr>
<th>Tile Adhesive</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland cement CEM I 32.5 R</td>
<td>30 – 35%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland cement CEM I 42.5 R or CEM I 52.5</td>
<td>30 – 35%</td>
<td>35 – 40%</td>
<td>25 – 40%</td>
<td></td>
</tr>
<tr>
<td>Sand (0.05 – 0.5 mm)</td>
<td>64.7 – 69.7%</td>
<td>61.7 – 68.7%</td>
<td>46.5 – 61.5%</td>
<td>29.5 – 66.5%</td>
</tr>
<tr>
<td>Cellulose ether</td>
<td>0.3%</td>
<td>0.3%</td>
<td>0.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>VINNAPAS® dispersible polymer powder</td>
<td>–</td>
<td>1 – 3%</td>
<td>3 – 8%</td>
<td>8 – 20%</td>
</tr>
<tr>
<td>Additives (for special requirements)</td>
<td>–</td>
<td>–</td>
<td>0 – 5%</td>
<td>0 – 5%</td>
</tr>
</tbody>
</table>

Typical formulations for various cementitious tile adhesives.
A = Very simple formulation without polymer modification, B = Simple standard formulation with polymer modification, C = Standard flexible high-quality tile adhesive with polymer modification, D = High-quality, flexible tile adhesive with polymer modification.

Please note that we offer special VINNAPAS® dispersions for high-performance applications. To find out more, visit www.wacker.com/vinnapas. Also, our Technical Centers are glad to assist you by adapting and improving formulations.
GO FOR THE OPTIMUM!

Second best is never enough. To always get the best solution, rely on our uncompromising quality and unique services.

Local Experts
WACKER’s local experts, who know your market, ensure optimum solutions including cooperation on your production process and adaption of delivery forms.

Technical Center
Our fully equipped Technical Center in Mumbai will support your market success, testing, for example, the workability and properties of our products in your specific formulations.

WACKER ACADEMY
At the WACKER ACADEMY, you can attend seminars and network on today’s and tomorrow’s industry requirements in a unique combination of theory and practice.

Two Technological Platforms
To serve your needs, we can revert to inorganic, organic and hybrid chemistry. Two fully integrated technology platforms grant high supply security.

German Quality
Production follows the same quality procedures worldwide, ensuring high product quality for smooth and economic processing on your side.

Long-Term Partnerships
WACKER operates on long-term perspectives and is very interested in a long-term partnership with you. We are fair and responsible with respect to the environment, the safety of our employees and the impact of our products.

To fully profit from our products and expertise, watch out for the “Original German Quality” emblem.
WACKER is one of the world’s leading and most research-intensive chemical companies, with total sales of €4.91 billion. Products range from silicones, binders and polymer additives for diverse industrial sectors to bio-engineered pharmaceutical actives and hyperpure silicon for semiconductor and solar applications. As a technology leader focusing on sustainability, WACKER promotes products and ideas that offer a high value-added potential to ensure that current and future generations enjoy a better quality of life based on energy efficiency and protection of the climate and environment. Spanning the globe with five business divisions, operating 25 production sites, WACKER is currently active in over 100 countries. The Group maintains subsidiaries and sales offices in 29 countries across Europe, the Americas and Asia – including a solidly established presence in China. With a workforce of 17,200, WACKER sees itself as a reliable innovation partner that develops trailblazing solutions for, and in collaboration with, its customers. WACKER also helps them boost their own success. Our technical centers employ local specialists who assist customers worldwide in the development of products tailored to regional demands, supporting them during every stage of their complex production processes, if required. WACKER e-solutions are online services provided via our customer portal and as integrated process solutions. Our customers and business partners thus benefit from comprehensive information and reliable service to enable projects and orders to be handled fast, reliably and highly efficiently. Visit us anywhere, anytime around the world at: www.wacker.com

All figures are based on fiscal 2011.
The data presented in this brochure are in accordance with the present state of our knowledge but do not absolve the user from carefully checking all supplies immediately on receipt. We reserve the right to alter product constants within the scope of technical progress or new developments. The recommendations made in this brochure should be checked by preliminary trials because of conditions during processing over which we have no control, especially where other companies’ raw materials are also being used. The information provided by us does not absolve the user from the obligation of investigating the possibility of infringement of third parties’ rights and, if necessary, clarifying the position. Recommendations for use do not constitute a warranty, either express or implied, of the fitness or suitability of the product for a particular purpose.