

HOW TO CHECK THE PERFORMANCE OF A FAST SET ADHESIVE? TESTS AND COMPARISONS

GEOFLEX EXPRESS

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Fast-drying adhesives, such as ATLAS Geoflex Express, considerably accelerate tiling. We have checked the performance of our product in field and laboratory tests and compared it with other adhesives of this class offered on the market.



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How to check if a C2FT adhesive sets quickly?

There is no defined test method to verify if the adhesive mortar has set sufficiently so that it is safe to walk on the tiles, to start grouting or to put load on the tiles. Tilers apply several methods to test the readiness of the adhesive:

1. They step on a tile and sometimes turn on the spot and check if the tile sinks or moves. It is a fairly effective testing method, but it will not prevent rapid onset of foot traffic (e.g. on ceramic tiles in passageways) from causing displacement and, consequently, the breaking of the adhesion (bond) between the tile and the mortar.
2. They try to tear off a tile by means of a handle with suction cups. This method will also not save you from possible problems later on.
3. They test to what extent the adhesive has set with a putty knife or a trowel - if the tool can be inserted under the tile to any depth, it means

that the adhesive has not set yet and it is not possible to walk on the tiles. However even fast-setting mortars after 2-4 hours of setting will not yet possess sufficient mechanical strength (hardness) to resist such a test. Whether we are able to shove a tool under the tile does not prove anything.

4. They knead a "tooth" formed with a trowel in the adhesive - if it crumbles, you still have to wait. In this test, the hardness of the adhesive of the trowel-formed "tooth" is important - how difficult it is to crumble it, whether crumbs form under pressure or whether the adhesive spreads. Also the colour of the mortar at the breakage must be checked - if it is light or medium grey, it means that the mortar has set sufficiently to allow walking on the tiles. If it is still dark grey (as after mixing with water) or if you can smudge it, you cannot yet walk on the tiles.



Photos 1, 2, 3
ATLAS Geoflex Express adhesive mortar - tiling in summer conditions, ambient temperature 28.5°C, layer thickness 3 mm, tests after 1.5 hours. From the left: 1. Load test (with rotation) - no sinking or loosening of the tile, 2. Pull-off test (with a handheld pull-off tester), 3. Hardness test - the trowel goes a few mm under the tile.

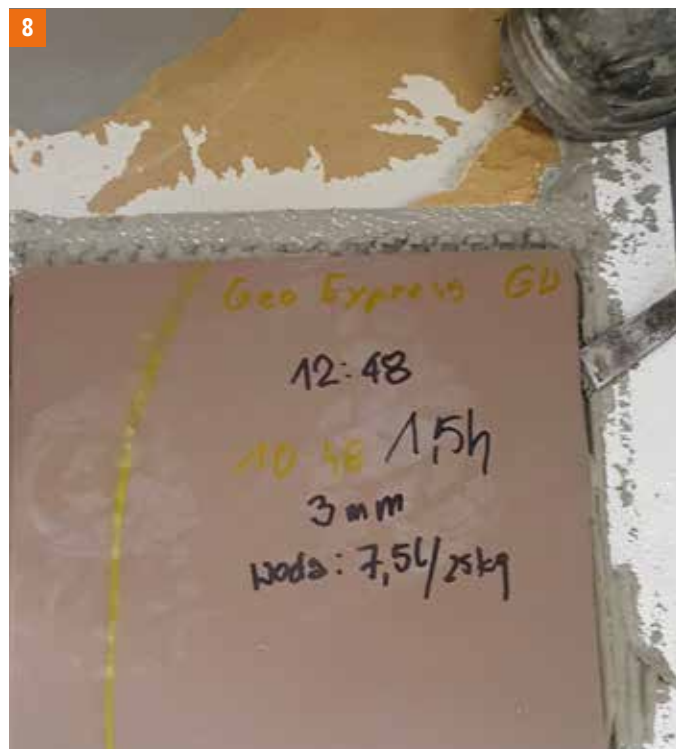
The first three methods are destructive, which means that a negative test result - i.e. the adhesive has not set sufficiently - entails the necessity to reinstall the test tile.



Photos 4, 5, 6 Geoflex Express. Hardness test of the adhesive mortar performed on the bonded „ridges” after 1.5 hours: strong pressure causes the mortar to crumble, the colour at the break is medium grey. The tiled surface can support load and grouting is already possible.



Photos 7 Geoflex Express. Pull-off test on a tile after 1.5 hours: the adhesive broke away together with the substrate (in this case plasterboard).



Photos 8, 9 Geoflex Express. Pull-off test on a tile after 1.5 hours, but with the maximum amount of mixing water (7.5 l/25 kg): the pull-off test caused the destruction of the substrate.



Field tests with Geoflex Express

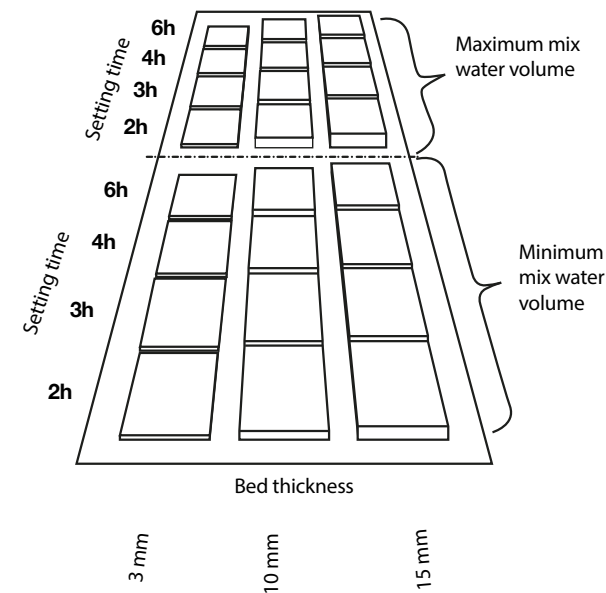
In order to obtain information on when it is safe to walk on tiles and start grouting, we decided to carry out a number of tests on fast set adhesives. We tested Geoflex Express and two adhesives from competing companies (photos 10, 11, 12).

Conditions:

1. Adhesive layer thickness: tiles were fixed on a substrate of drywall with adhesive layers in three thicknesses: 3 mm, 10 mm and 15 mm.
2. Test times: the tiles were torn off 2, 3, 4 and 6 hours after being fixed.
3. Mixing water: the tests were carried out parallelly with the minimum and maximum amount of mixing water indicated by the manufacturer.
4. Temperature and humidity: the ambient temperature (closed room) was 20.2 °C, the humidity 48 % (at the start of the tests).

The tests were carried out on a total of 24 tiles size 33 x 33 cm fixed with each of the products (fig. 1).

Fig. 1. Tile arrangement for one product testing



Photos 10, 11, 12 Pull-off test results for selected adhesives as shown in Fig. 1. Apart from the pull-off behaviour, attention should also be paid to the degree of adhesive discolouration under the tile, which indicates the rate of moisture loss in adhesive mortars, the increase in bond strength and the possibility of commencing grouting of ceramic coverings.



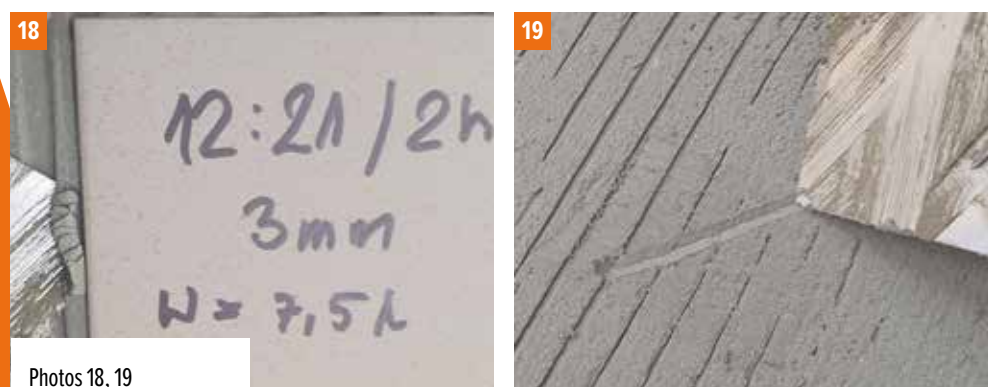
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A crowbar was used to tear off the tiles. The rupture usually occurred in the adhesive mortar layer or at its interface with the tile. With time, rupture occurred in the substrate or the drywall was broken through. The mortar was so hard that it could not be damaged with a finger, it was possible to scratch it or to scrape it off superficially with a spatula or trowel (photos 13, 14, 15).



Photos 13, 14, 15 Geoflex Express. The first two photos show the result of a pull-off test on a tile glued on a 3 mm thick adhesive layer using a crowbar. The adhesive layer broke. It cannot be damaged with a finger, but only with sharp tools and a lot of force. Photo no. 15 - layer with a thickness of 15 mm: the mortar is pulled off the tile and can only be damaged superficially.

Photos 16, 17 Geoflex Express. Under strong pressure the protruding "ridges" of adhesive mortar crumble. The mortar is hard, there is a clear lack of cohesion, the colour is medium grey.



Photos 18, 19 Repetition of the tests of Geoflex Express adhesive with a water ratio of 7.5/25 kg: the trowel penetrates slightly under the tile, it is possible to scratch the mortar only with its corner.



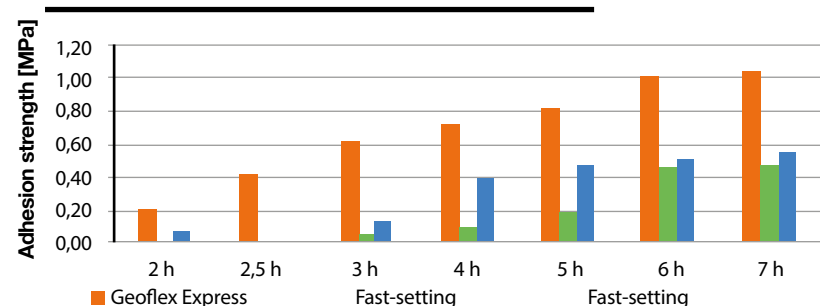
Photos 20, 21 Geoflex Express. Pull-off test of a tile glued on a mortar layer with a thickness of 3 mm after 3 hours - the substrate is destroyed.

Laboratory tests with Geoflex Express

The field tests confirm that the adhesive Geoflex Express achieves a very high increase in strength and adhesion in the first 2 hours of setting. However, the question to be

answered is: do these parameters allow the safe use and grouting of the freshly fixed tiles? **For this purpose, laboratory tests** were conducted on the adhesion (bonding strength) of Geoflex Express and two competitive fast set adhesives after 2, 2.5, 3, 4, 5, 6 and 7 hours of setting under standard conditions. These tests confirmed that all the tested adhesives meet the standard requirements and guarantee an adhesive strength of 0.5 MPa after 6 hours of setting. The test results are presented in fig. 2. The advantage of Geoflex Express over competing products is clearly visible. This adhesive reaches an adhesive strength of >0.2 MPa after 2 hours, allowing you to walk on the tiles and start grouting. Within another 30 minutes the adhesive strength increases twofold. **In less than 3 hours Geoflex Express reaches**

Fig. 2 Comparison of early adhesion of C2FT fast-setting adhesives.



the adhesive strength which the standard requires for fast-setting adhesives after 6 hours. Adhesion after 6 hours is of 1.0 MPa - the level C2FT-class adhesives reach after 28 days!

Comparable competitive adhesives show a much slower increase in adhesive strength. The minimum adhesive strength of 0.2 MPa required in order to walk on ceramic tiles is reached by one of the other products after 3.5 hours and by the second one after 5 hours.

Summary

Based on the field and laboratory tests we can answer the most frequent questions of tilers:

1. From when is it possible to walk on tiles and start grouting?

First perform the simple tests shown in photos 16 and 17. The attempt to lever or tear off a tile may cause extra work without providing a result.

2. To which adhesive layer thickness do the times given for walking on the tiles apply?

With Geoflex Express it does not matter how thick the adhesive mortar is applied. Under standard conditions, you can walk on the tiles after only 2 hours.

3. How does an elevated ambient temperature affect the time until it is possible to walk on the tiles and start grouting?

At a high temperature of approx. 30 °C this time is shorter and it is possible to walk on the tiles after 90 minutes. Please note that, in this case, also the pot life of the adhesive will be shortened from 45 to 30 min (with minimum water addition) – this must be taken into account in terms of the amount of mortar you prepare.



Photos 22, 23 Geoflex Express. The surface temperature of the tile within 5.5 hours of setting was stable and did not exceed 23.2°C for the 3 mm layer and 24.9°C for the 15 mm layer, i.e. a maximum of 4.7°C above the ambient temperature (heat of hydration). This indicates a stable progression of the hydration reaction.

4. To what extent does the amount of water added affect the setting speed of Geoflex Express?

It is a gel adhesive and contains additives which can accumulate excess water and release accumulated water, if necessary. This is to ensure optimum conditions for cement hydration, so that the mortar achieves the highest possible strength parameters (mainly: adhesion). The amount of mixing water added according to the specified proportion of 6,25-7,5 l does not affect the setting speed of the adhesive or the time after which you can walk on the tiles and start grouting.

5. Is it possible to start grouting the moment you can walk on the tiles without having to worry about efflorescence?

The silicate gel contained in Geoflex Express is a kind of moisture accumulator. Part of the water added by the tiler must ensure the continuity of the cement setting reaction (hydration) and in traditional mortars the rest is used to obtain the right consistency of the mortar. In the case of the gel adhesive Geoflex Express, this excess water is accumulated by the gel, which significantly improves the consistency of the mortar and its working parameters. This means, there is no free water in the system which could cause efflorescence at the joints. Gel adhesives ensure fast and safe grouting.

6. Can Geoflex Express be used safely when working in stages, does it not cause the tiles to be "sucked in"?

This adhesive is not subject to sudden shrinkage, therefore the tiles are not sucked in. The tiler can work with this product day after day on one surface without having to worry about difference in the levels of tiles laid one day and those laid two, three days previously.



Maciej Salamon
tiler

I tested three fast set adhesives (adhesive layer thickness - 6-8 mm) on a construction site - in a garage, at an ambient temperature of 18 °C, with an ambient humidity of 49 %, on a cement screed. Geoflex Express is very easy to mix with

water and combines quickly with it. During the application it sticks to the float, it does not fall off and has a buttery and very pleasant consistency. It has a long pot life of up to 60 minutes.



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Conclusions

The tests of the adhesive Geoflex Express show (photos 24, 25) that after 1.5 hours and after 2 hours it is possible to insert a sharp tool under the tile, regardless of the amount of water added or the thickness of the mortar layer. After that time, in all the relevant cases, when stepping strongly on a tile, stopping and turning on the spot, no sagging of the tile or its corners and no disconnection of the tile from the adhesive layer occurred (photo 26).

The exact same tests conducted with other adhesives showed that after 2 hours the adhesives were still soft under the tile and that the tiles were easy to separate from the adhesive. With greater layer thicknesses, the setting process is considerably slower (photos 27-33).

Photos 27, 28, 29, 30 Fast-setting adhesive no. 1 (class "F"): test after 2 hours of setting with a layer thickness of 3 mm. Hardness test with a trowel - similar to the test described above (photos 13,14,15). The tile came off with part of the adhesive layer. The adhesive can be easily wiped off the surface of the tile with a finger, with a sharp edge of the trowel it is possible to scratch the substrate.



Photos 24, 25 Geoflex Express. With considerable force, it is possible to press the trowel into the adhesive mortar layer, regardless of its thickness of 3 or 15 mm. Photo 26 Regardless of the thickness of the mortar layer, abrupt treading on the tile and rotating the foot do not cause the tile to sink or move.



Photos 31, 32, 33 Fast-setting adhesive no. 1 (class "F") with a layer thickness of 15 mm - the setting process is comparable to that of traditional adhesives.

Photos 34, 35 Hardness test on fast-setting adhesive no. 2 (class "F"). After 2 hours of setting, the 3 mm thick layer shows little hardness (the adhesive can be easily crushed at the "ridges" formed by the trowel) and the structure still contains considerable moisture - it crumbles, but the colour at the break is dark grey (photo 35).



Photos 36, 37, 38, 39 Fast-setting adhesive no. 2 (class "F"). When the tile is lifted, it is obvious that the detachment occurred in the adhesive layer. The adhesive is only partially bonded and be easily rubbed off with a finger or tool.

Comparison of the test results

- 1 There are many class "F" adhesives on the market which meet the standard requirement of achieving adhesion (bonding strength) to the substrate of 0.5 MPa after 6 hours.
- 2 The information on the products as to "walking on tiles after ... hours", "grouting after ... hours" is sometimes exaggerated and not always corroborated by practice.
- 3 In the case of the traditional class "F" adhesives, the layer thickness of the mortar and the amount of mixing water play an essential role.
- 4 With the gel adhesive Geoflex Express these factors are not important and have no influence on the time after which the tiles can be walked on and grouted.
- 5 Low and high ambient temperatures undeniably have an important impact on the setting speed of all adhesives.
- 6 Good fast-setting adhesives with short times for walking on the tiles and grouting also have a relatively short pot life. That is the price for a fast-setting mortar.
- 7 The methods used by some tilers to check if they can walk on the tiles should be reviewed as they do not provide a reliable assessment of the setting speed of adhesives.
- 8 The fact that some adhesives need a longer time to set does not constitute a technical defect and does not disqualify the relevant products. The adhesive Geoflex Express ensures very short times until it is possible to walk on the tiles and grout them and thereby offers the tiler unprecedented opportunities to plan and execute the work.
- 9 Solutions based on the gel technology represent a significant convenience for the tiler (adaptation of the consistency of the mortar to preferences and needs) and ensure safety of the works (absorbent substrates, increased temperature). ■



Jan Jakóbič
tiler

I had the opportunity to test three fast set adhesives - Geoflex Express and two competitors - in a kitchen, at an ambient temperature of 18 °C, a humidity of 55 %, on a cement screed. In the case of Geoflex Express, when poured into the bucket, the dust formation was optimal. After mixing, the consistency was very good to work with - sticky and not running off the tools. The adhesive was very comfortable to work with, it is easy to mould and rub into the substrate. The positioning of the tiles could be corrected over a long time. I did not observe any sinking of the tiles after the setting of the adhesive.



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