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# TEST REPORT

**|SQM_384_2022|**

## DETERMINATION OF ADHESION BY TRACTION (UNI EN 14891 STANDARD) OF A WATERPROOFING PRODUCT NAMED "BASECRETE," PROVIDED BY THE COMPANY "CDC S.R.L.," MILAN (MI)-ITALY.

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| PLACE AND DATE OF ISSUE: | Faenza, 22nd October 2021 |
| COMPANY: | **CdC S.r.l.** |
| LEGAL HEADQUARTER: | Via Montenapoleone, 8 – 20122 Milan (MI) |
| PRODUCTIVE ESTABLISHMENT: | Via Roma, 188 – 26813 Graffignana (LO) |
| TYPE OF PRODUCT: | *Liquid applied waterproofing agents for use under ceramic tiles bonded with adhesives* |
| APPLIED STANDARD: | UNI EN 14891:2012 |
| DATE OF RECEIPT OF SAMPLES: | 25th June 2021 |
| TESTING DATE: | August - October 2021 |
| TEST PERFORMED AT: | CertiMaC, Faenza |

*NOTE: The results contained in this test report refer exclusively to the sample subjected to the tests described below. It is also for the exclusive use of the Principal within the limits of the mandatory regulations and may not be reproduced (in hard copy or digital form) in part, without the written approval of the laboratory.*

| Execution | Written | Approved |
|---|---|---|
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# 1 Introduction

This report describes the tests of:

- *determination of initial tensile adhesion,*
- *determination of tensile adhesion after immersion in water,*
- *determination of tensile adhesion after heat action,*
- *determination of tensile adhesion after freeze/thaw cycles,*
- *determination of tensile adhesion after immersion in water saturated with limestone,*

carried out on a type of waterproofing product called "Basecrete" sent to the CertiMaC laboratory in Faenza by the Client on 22nd April 2021 (Ref.2-a, 2-b).

The test was carried out in accordance with the standards given in Ref. 2-c, Ref. 2-d and taking into account the requirement-types related to the materials used for the tests as stated in Ref. 2-e, Ref. 2-f.

# 2 References

a. Estimate: prot. 21351/lab dated 16th June 2021.

b. Order confirmation: e-mail dated 14th July 2021.

c. Standard UNI EN 12004:2012. Tile adhesives - Requirements, conformity assessment, classification and designation.

d. Standard UNI EN 14891:2012 – Liquid applied waterproofing products for use under adhesive bonded ceramic tiles. Requirements, test methods, conformity assessment, classification and designation.

e. Standard UNI EN 14411:2016. Ceramic tiles. Definitions, classification, characteristics, evaluation and verification of constancy of performance, and marking.

f. Standard UNI EN 1323:2007. Adhesives for tiles. Concrete test slabs.

# 3 Test object

The test was performed on a waterproofing product delivered to the laboratory in the form of:

- No. 1 10-kg container bucket.

The test was conducted on 10 samples made ad hoc for each of the five test conditions and consisting of a ceramic tile applied by adhesive to a concrete substrate covered with the waterproofing product.

# 4 Test apparatus

Tests for the determination of adhesion by traction, carried out according to the standard in Ref. 2-d, were conducted by means of a universal MTS machine, imposing stroke control on the actuator piston and recording the time course of both the applied load and the displacement (stroke) of the actuator (with a sampling rate of 20 Sa/s), so as to ensure a load increment of 250±50 N/s.

# 5 Performing the test and reporting of results

## 5.1 Samples preparation

The waterproofing product was laid on a concrete substrate complying with the requirements of the standard in Ref. 2-f, and then type V1 ceramic tiles were bonded in accordance with the standard in Ref. 2-d, paragraph A.6.1, using a class C2 adhesive according to the standard in Ref. 2.c.

## 5.2 Determination of adhesion by traction

The test, which was performed in full compliance with Ref. 2.d in order to determine adhesion by tensile testing, was conducted with the system in a horizontal position according to the following steps:

- Laying of a layer of waterproofing product on the concrete substrate;
- Maturation of the waterproofing product;
- Laying a thin layer of adhesive on the waterproofing product using a smooth trowel;
- Laying a thicker layer of the adhesive by means of a notched trowel;
- Placing the ceramic tiles of type V1 on the adhesive layer at a relative distance of at least 50 mm after waiting for 5 minutes;
- Imposition of a load on the tile equal to 20 N and holding it for 30 s;
- Removal of the load and curing under reference conditions based on the different treatments described below, followed by bonding of the 50x50 mm metal plates using appropriate epoxy adhesive;
- Determination of adhesion, after an additional 24 h under reference conditions, imposing in stroke control a feed rate of 3 mm/min and such as to ensure a load increment of 250±50 N/s.

Based on the above procedure and parameters, the tensile adhesion coefficient As (N/mm2) was determined as follows:

$$A_s = \frac{L}{A}$$

Where:

- L = Maximum applied load (N).

- A = Bonding area subjected to tension (2500 $mm^2$).

In order to calculate the "correct" mean value of adhesion, values outside ± 20% of the mean value of adhesion, preliminarily evaluated as the arithmetic mean of the 10 experimentally obtained values, are not considered.

Appendix A of Ref. 2.c provides for the following failure modes (also in graphic form):

- Adhesive Breakage (AF-S or AF-T): failure at the interface between adhesive and substrate and at the interface between tile and adhesive, respectively;

- Cohesive Breakage in the Adhesive (CF-A): breakage in the adhesive layer;

- Cohesive breakage in the substrate or tile (CF-S or CF-T): breakage in the substrate or tile body, respectively, to be understood as the MINIMUM limit of adhesion;

- Breakage in the adhesive layer between tile and traction plate (BT): INVALID BREAKAGE.

## 5.3 Initial tensile adhesion

The test requires a curing time of 27 days under reference conditions. After that, the tensile adhesion values As are evaluated taking into account a nominal bonding area A of 2500 $mm^2$, on the basis of the above-described procedure and parameters.

Table 1 shows the adhesion values derived from the initial adhesion test.

| Sample | Total load L (N) | Adhesion Value $A_{si}$ ($N/mm^2$) | Breakage Mode | Notes | Total average value As ($N/mm^2$) | Average corrected value As ($N/mm^2$) |
|---|---|---|---|---|---|---|
| 1 | 1354 | 0,54 | AF-T | --------- | 0,54 | **0,53** |
| 2 | 1698 | 0,68 | AF-T | out of range | | |
| 3 | 1229 | 0,49 | AF-T | --------- | | |
| 4 | 1539 | 0,62 | AF-T | --------- | | |
| 5 | 1369 | 0,55 | AF-T | --------- | | |
| 6 | 1751 | 0,70 | AF-T | out of range | | |
| 7 | 1275 | 0,51 | CF-A | --------- | | |
| 8 | 1257 | 0,50 | CF-A | --------- | | |
| 9 | 754 | 0,30 | AF-T | out of range | | |
| 10 | 1288 | 0,52 | AF-T | --------- | | |

**Table 1. Results of initial tensile adhesion test.**

## 5.4 Initial tensile adhesion after immersion in water

The test requires immersion of the specimens in water for 20 days after curing the samples for 7 days under reference conditions. After that, the specimens are taken out of the water and metal plates are bonded to the tile surface, dried with a cloth. After an additional 7 hours, the specimens are immersed in water for 24 hours, then the samples are immediately subjected to tensile adhesion test taking into account the same parameters and calculation conditions described in the previous paragraph.

Table 2 shows the adhesion values derived from the adhesion test after immersion in water.

| Sample | Total load L (N) | Adhesion Value $A_{si}$ (N/mm²) | Breakage Mode | Notes | Total average value As (N/mm²) | Average corrected value As (N/mm²) |
|---|---|---|---|---|---|---|
| 1 | 1685 | 0,67 | AF-T | --------- | 0,57 | **0,58** |
| 2 | 1341 | 0,54 | AF-T | --------- | | |
| 3 | 2157 | 0,86 | AF-T | out of range | | |
| 4 | 1101 | 0,44 | AF-T | out of range | | |
| 5 | 1514 | 0,61 | AF-T | --------- | | |
| 6 | 1189 | 0,48 | AF-T | --------- | | |
| 7 | 1571 | 0,63 | CF-A | --------- | | |
| 8 | 1444 | 0,58 | 50%CF-A_50%AF-T | --------- | | |
| 9 | 958 | 0,38 | CF-A | out of range | | |
| 10 | 1402 | 0,56 | AF-T | --------- | | |

**Table 2. Tensile adhesion test results after immersion in water.**

## 5.5 Tensile adhesion after heat action

The test requires curing under reference conditions for 14 days. Then, 14 days in a stove with forced air circulation at 70 ± 3 °C are foreseen. After that, the metal plates are bonded to the tiles. After additional 24 hours of conditioning treatment, the specimens are subjected to tensile adhesion test.

Table 3 shows the adhesion values derived from the adhesion test after heat action.

| Sample | Total load L (N) | Adhesion Value $A_{si}$ (N/mm²) | Breakage Mode | Notes | Total average value As (N/mm²) | Average corrected value As (N/mm²) |
|---|---|---|---|---|---|---|
| 1 | 1420 | 0,57 | CF-A | --------- | 0,51 | **0,50** |
| 2 | 1626 | 0,65 | CF-A | out of range | | |
| 3 | 1729 | 0,69 | CF-A | out of range | | |
| 4 | 1169 | 0,47 | AF-T | --------- | | |
| 5 | 1089 | 0,44 | AF-T | --------- | | |
| 6 | 1307 | 0,52 | AF-T | --------- | | |
| 7 | 1313 | 0,53 | CF-A | --------- | | |
| 8 | 1120 | 0,45 | CF-A | --------- | | |
| 9 | 606 | 0,24 | CF-A | out of range | | |
| 10 | 1298 | 0,52 | CF-A | --------- | | |

**Table 3. Tensile adhesion test results after heat action.**

### 5.6 Tensile adhesion after freeze-thaw cycles

The specimens, prepared as described above and conditioned for 7 days under reference conditions, are then immersed in water for 21 days at the reference temperature, then subjected to 25 freeze/thaw cycles.

Each of the 25 cycles, lasting about 6 hours and 45 minutes considering the time for draining and filling with water, consists of the following steps:

- cooling of the air inside the climatic cell so as to reach -15 ± 3°C in 2 hours ± 20 minutes;
- permanence, at the temperature of -15 ± 3°C, for 2 hours ± 20 minutes;
- subsequent heating, by flooding with water at a temperature of 20 ± 3°C, so that the specimens are maintained at a temperature of 15 ± 3°C for at least 2 hours;
- draining of the water and start of a further cycle.

At the end of the 25 freeze/thaw cycles, the specimens are removed from the water and, on the dried tile surface with a cloth, metal plates are bonded.

After an additional conditionining treatment of 24 hours, the specimens are tested for tensile adhesion.

Table 4 shows the adhesion values derived from the adhesion test after freeze/thaw cycles:

| Sample | Total load L (N) | Adhesion Value $A_{si}$ (N/mm²) | Breakage Mode | Notes | Total average value As (N/mm²) | Average corrected value As (N/mm²) |
|---|---|---|---|---|---|---|
| 1 | 1628 | 0,65 | AF-T | out of range | 0,83 | **0,82** |
| 2 | 1832 | 0,73 | AF-T | --------- | | |
| 3 | 2036 | 0,81 | AF-T | --------- | | |
| 4 | 1779 | 0,71 | AF-T | --------- | | |
| 5 | 2368 | 0,95 | AF-T | --------- | | |
| 6 | 2293 | 0,92 | AF-T | --------- | | |
| 7 | 2252 | 0,90 | AF-T | --------- | | |
| 8 | 2793 | 1,12 | AF-T | out of range | | |
| 9 | 1827 | 0,73 | AF-T | --------- | | |
| 10 | 2055 | 0,82 | AF-T | ---------- | | |

**Table 4. Adhesion test results after freeze/thaw cycles.**

### 5.7 Tensile adhesion after immersion in water saturated with limestone

The waterproofing product is applied on the upper face of the specimens prepared as described above, while the remaining faces are sealed with a water-impermeable coating material, thus ensuring the complete integrity of the coating on all edges and joints.

The specimens are conditioned under reference conditions for 28 days and then immersed for 7 days in water saturated with lime (pH>12) at a temperature of 40°C.

At the end of this procedure, the specimens are removed from the lime water, rinsed with clean water and, on the dried tile surface with a cloth, the metal plates are bonded.

After an additional conditioning treatment of 24 hours, the specimens are subjected to tensile adhesion test.

Table 5 shows the adhesion values derived from the adhesion test after immersion in saturated water with limestone.

| Sample | Total load L (N) | Adhesion Value $A_{si}$ (N/mm²) | Breakage Mode | Notes | Total average value As (N/mm²) | Average corrected value As (N/mm²) |
|---|---|---|---|---|---|---|
| 1 | 1705 | 0,68 | AF-T | --------- | 0,58 | **0,63** |
| 2 | 1569 | 0,63 | AF-T | --------- | | |
| 3 | 1472 | 0,59 | AF-T | --------- | | |
| 4 | 1523 | 0,61 | AF-T | --------- | | |
| 5 | 1682 | 0,67 | AF-T | --------- | | |
| 6 | 1602 | 0,64 | AF-T | --------- | | |
| 7 | 1807 | 0,72 | CF-A | out of range | | |
| 8 | 1067 | 0,43 | CF-A | out of range | | |
| 9 | 796 | 0,32 | CF-A | out of range | | |
| 10 | 1400 | 0,56 | CF-A | --------- | | |

**Table 5. Tensile adhesion test results after immersion in saturated lime water.**

## 6 Conclusions

The standard of Ref. 2-d requires that waterproofing products should have initial tensile adhesion, after immersion in water, after action of heat, after freeze/thaw cycles and after immersion in water saturated with lime ≥ 0.5 N/mm2.

The following tensile adhesion values are declared for the "Basecrete" product on the basis of the conducted experimentation:

- Initial tensile adhesion: **0,53 N/mm²**.

- Tensile adhesion after immersion in water: **0,58 N/mm²**.

- Tensile adhesion after heat action: **0,50 N/mm²**.

- Tensile adhesion after freeze/thaw cycles: **0,82 N/mm²**.

- Tensile adhesion after immersion in water saturated with limestone: **0,63 N/mm².**

## 7 Distribution list

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