# REPORT 244/L DATE 06.05.2016

| | |
|---|---|
| Laboratory | GFC Chimica Srl<br>Laboratorio Chimico<br>Viale Marconi, 73<br>44122 Ferrara |
| Customer | Giolli S.r.l. Industria Colori<br>Via Enzo Ferrari, sn<br>61030 Calcinelli di Saltara (PU) |
| Samples identification[1] | 31031601 - GIOLLICRYL |
| Samples description | Acrylic wall coating thickness |
| Samples receiving (date) | 31.03.2016 |
| Analysis beginning (date) | 01.04.2016 |
| Analysis end (date) | 06.05.2016 |
| Ref. | Sig. Pietrelli |

## 1 Introduction

GFC Chimica has tested by order of Giolli S.r.l. di Calcinelli di Saltara (PU), herein called "the customer", a waterborne coating thickness (external render), identified and described as reported in the table above.

As stated between the parties, the GFC Chimica laboratory has assessed the sample in order to:

a) determinate the liquid water permeability (method UNI EN 1062-3:2008),
b) determinate the water-vapour transmission rate (method UNI EN ISO 7783:2012),
c) measure of bond strength by pull-off (method UNI EN 1542:2000)
d) determinate the design thermal values (calculated by table) (method UNI EN 1745:2012 table A.12).

The tests refer to the initial type tests (ITT) reported in the test method UNI EN 15824:2009 as required by the customer.

The sampling of the product has been carried out by the customer.

## 2 Results

### *2.1 Determination of liquid water permeability*

The product was applied by spatula in one hand (mass about 40 gr) on 3 substrate based on cement with high water absorption coefficient. The superficial area of specimen is 0.02 $m^2$.

[1] The code 31031601 is an internal code of GFC Chimica used for the traceability of the sample during the tests



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R.E.A. 167744 • Cap. Soc. € 567.584 I.V.

After the application the specimens were dried for 7 days at T = 23±2 °C and HR=50±5% and conditioned using the following cycles (carried out 3 times):

- 24 h in water at T= 23 ±2 °C
- 24 h in oven at T = 50 ±2 °C

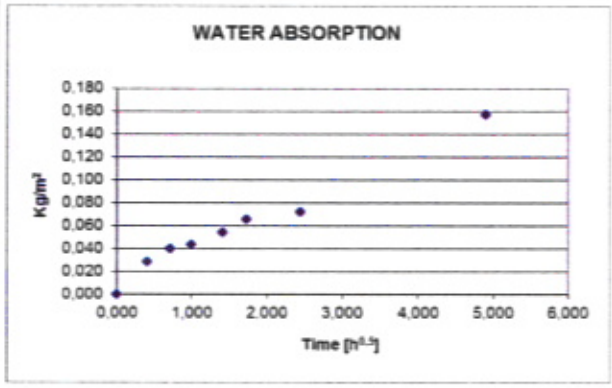
After the last cycle the specimens were stored at T= 23 ± 2 °C and HR = 50 ± 5% for 24h.

The liquid water absorption offered from the product is obtained through the determination of the water coefficient absorbed for unit of surface in the time unit (w). In order to standardize the result the value of the coefficient was calculated after 24 hours.

**FIRST DATA**

**Coated area = 0.018142 m²**

| Weight (g) | Water absorbed (g) | Time (min) | Weight (g) | Water absorbed (g) | Time (min) |
|---|---|---|---|---|---|
| 1122,79 | 0,00 | 0 | 0,000 | 0,000 | 0,000 |
| 1123,29 | 0,50 | 10 | 0,167 | 0,028 | 0,408 |
| 1123,50 | 0,71 | 30 | 0,500 | 0,040 | 0,707 |
| 1123,57 | 0,78 | 60 | 1,000 | 0,044 | 1,000 |
| 1123,76 | 0,97 | 120 | 2,000 | 0,054 | 1,414 |
| 1123,96 | 1,17 | 180 | 3,000 | 0,066 | 1,732 |
| 1124,07 | 1,28 | 360 | 6,000 | 0,072 | 2,449 |
| 1125,59 | 2,80 | 1440 | 24,000 | 0,157 | 4,899 |

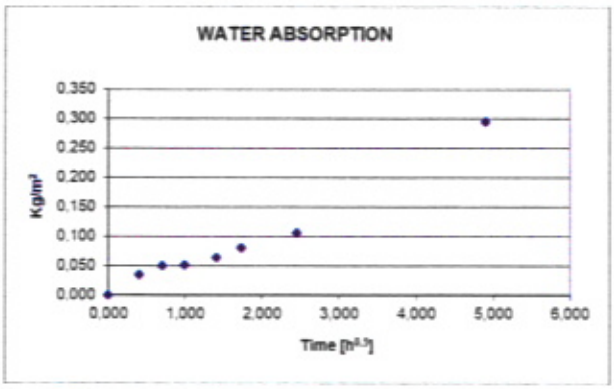



$W_{24}$ = 0.052 kg/(m²h$^{0.5}$)

**SECOND DATA**

**Coated area = 0.017949 m²**

| Weight (g) | Water absorbed (g) | Time (min) | Weight (g) | Water absorbed (g) | Time (min) |
|---|---|---|---|---|---|
| 1036,15 | 0,00 | 0 | 0,000 | 0,000 | 0,000 |
| 1036,73 | 0,58 | 10 | 0,167 | 0,034 | 0,408 |
| 1037,01 | 0,86 | 30 | 0,500 | 0,050 | 0,707 |
| 1037,02 | 0,87 | 60 | 1,000 | 0,051 | 1,000 |
| 1037,23 | 1,08 | 120 | 2,000 | 0,063 | 1,414 |
| 1037,54 | 1,39 | 180 | 3,000 | 0,081 | 1,732 |
| 1037,97 | 1,82 | 360 | 6,000 | 0,106 | 2,449 |
| 1041,20 | 5,05 | 1440 | 24,000 | 0,294 | 4,899 |

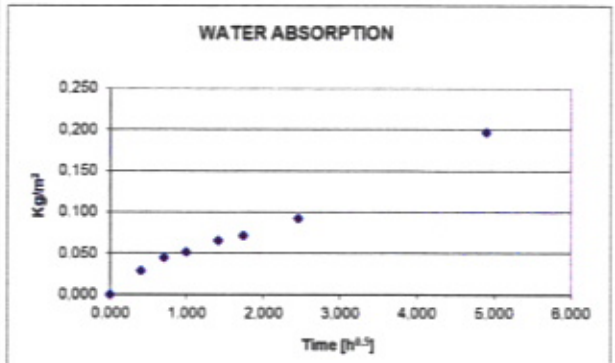



$W_{24}$ = 0.060 kg/(m²h$^{0.5}$)

**THIRD DATA**

**Coated area = 0.017177 m²**

| Weight (g) | Water absorbed (g) | Time (min) | Weight (g) | Water absorbed (g) | Time (min) |
|---|---|---|---|---|---|
| 1009,48 | 0,00 | 0 | 0,000 | 0,000 | 0,000 |
| 1010,01 | 0,53 | 10 | 0,167 | 0,029 | 0,408 |
| 1010,29 | 0,81 | 30 | 0,500 | 0,044 | 0,707 |
| 1010,42 | 0,94 | 60 | 1,000 | 0,051 | 1,000 |
| 1010,69 | 1,21 | 120 | 2,000 | 0,066 | 1,414 |
| 1010,80 | 1,32 | 180 | 3,000 | 0,072 | 1,732 |
| 1011,18 | 1,70 | 360 | 6,000 | 0,092 | 2,449 |
| 1013,09 | 3,61 | 1440 | 24,000 | 0,196 | 4,899 |




$W_{24}$ = 0.040 kg/(m²h$^{0.5}$)

**Coefficient of water absorption – $w_{24}$ = 0.044 ± 0.004 kg/(m²h$^{0.5}$)**

The value of uncertainty is expressed as expanded uncertainty with a confidence level of 95% (coverage factor K = 2).

From the classification stated in the method[2], it can be concluded that the product has a **low permeability to liquid water (Class $W_3$)**.

### *2.2 Determination of water-vapour transmission rate (permeability)*

The product was applied by spatula in one hand (mass about 20 gr) on 3 substrate based on fiber glass (thickness about 200 µm; area 113 cm²) then it was assessed using the test method UNI EN ISO 7783 (method of wet cup) as supported film. After the application the specimens were dried for 7 days at T = 23±2 °C and HR=50±5% and conditioned using the following cycles (carried out 3 times):

- 24 h in water at T= 23 ±2 °C
- 24 h in oven at T = 50 ±2 °C

as indicated in the method for the products for external use (Method B).

After the last cycle the specimens were stored at T= 23 ± 2 °C and HR = 50 ± 5% for 24h.

The water vapour permeability is expressed as the thickness value equivalent of air (Sd), that is the resistance to the transport of the water offered from the external render in examination. The coefficient of permeability to the vapour ($\mu$) is considered, too. The values of Sd and µ are calculated using the following diagrams.

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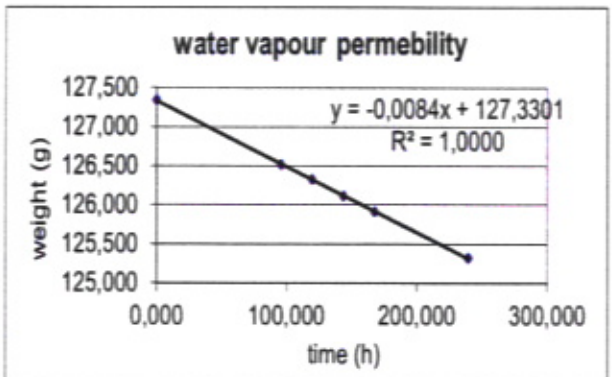
[2] Classification of liquid water permeability:
CLASS $W_1$ (HIGH PERMEABILITY) $w_1 > 0.5$ Kg/m²h$^{0.5}$
CLASS $W_2$ (MEDIUM PERMEABILITY) $0.1 < w_2 \leq 0.5$ Kg/m²h$^{0.5}$
CLASS $W_3$ (LOW PERMEABILITY) $w_3 \leq 0.1$ Kg/m²h$^{0.5}$

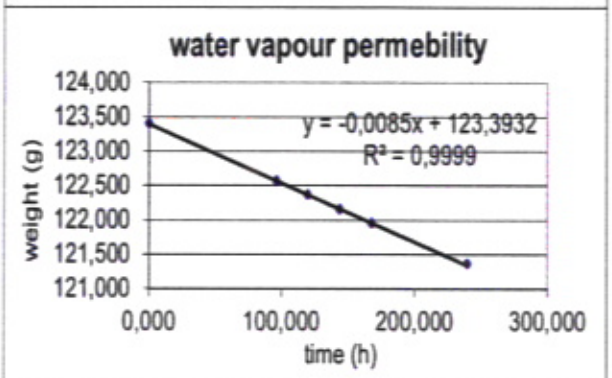
First data

| Time (h) | Weight (gr) |
|---|---|
| 0,000 | 127,334 |
| 96,000 | 126,518 |
| 120,000 | 126,320 |
| 144,000 | 126,114 |
| 168,000 | 125,908 |
| 239,500 | 125,317 |



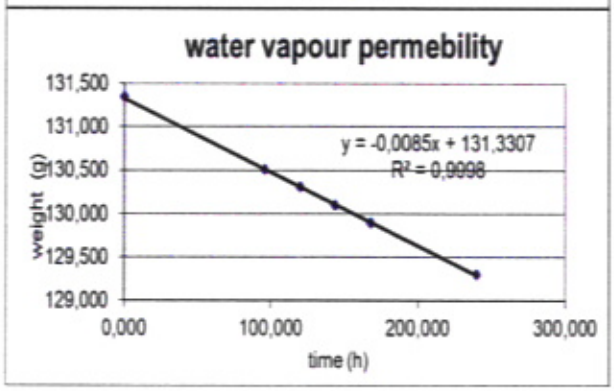

Second data

| Time (h) | Weight (gr) |
|---|---|
| 0,000 | 123,402 |
| 96,000 | 122,566 |
| 120,000 | 122,365 |
| 144,000 | 122,161 |
| 168,000 | 121,956 |
| 239,500 | 121,359 |




Third data

| Time (h) | Weight (gr) |
|---|---|
| 0,000 | 131,342 |
| 96,000 | 130,504 |
| 120,000 | 130,303 |
| 144,000 | 130,099 |
| 168,000 | 129,894 |
| 239,500 | 129,302 |




Starting from the resistance of the substrate (Sd = 0.0563 m) for the product in examination, the following average value of resistance to the transport is obtained:

**Sd = 1.0802 ± 0.2160 m**

The value of uncertainty is expressed as expanded uncertainty with a confidence level of 95% (coverage factor K = 2).

From the value of the thickness applied (s), equal to 2,35 mm, the permeability to the vapour obtained is:

**μ = Sd/S = 459**

Starting from the classification reported in the test method[3] it can be concluded that the product has a **medium permeability to the vapour (Class $V_2$).**

### *2.3 Determination of bond strength by pull-off*

The pull-off strength (commonly referred to as adhesion) is determined as the greatest perpendicular force (in tension) that a coated surface area can bear before a plug of material is detached. The pull-off strength is applied using a steel dolly (diameter 50 millimeter; thickness 20 millimeter) glue on the surface of the external render using a 2K epoxy adhesive.
The adhesion ($f_h$) is expressed as the ratio between the breaking load ($F_h$) and the area of the surface ($4/\pi D^2$):

$$f_h = 4F_h / \pi D^2$$

The adhesion measure was carried out using the adhesion tester CONTROLS cod. 58-C0215/T with load capability of 16kN and resolution 0,001 kN.

The types of detachment, that carry to valid results, are the following:

| | |
|---|---|
| A | Detachment for lacked cohesion in the concrete substrate |
| A/B | Detachment for lack of adhesion between the substrate and the first layer |
| B | Detachment for lack of cohesion in the first layer |
| B/C | Detachment for lack of cohesion between the first and the second layer |
| C | Detachment for lack of cohesion in the second layer |
| -/Y | Detachment for lack of adhesion between the last layer and the adhesive |
| Y | Detachment for lack of cohesion in the layer of adhesive |
| Y/Z | Detachment for lack of adhesion between the adhesive layer and the dolly |

The adhesion test was carried out applying the external render, in vertical, by spatula in one hand on support of dried and blasted concrete (dimensions 300x300x10 millimeter; aggregate max. 10 millimeter). The thickness is approximately 2 millimeter. At the end of the application, the specimen is dried for 28 days at T =23 ± 2 °C and UR=50 ± 5% as indicated in the test method UNI EN 15824:2009. The test was carried out only on dry support. The average calculated on 5 specimens is expressed to the next 0.1 MPa.

[3] Classification of water vapour permeability
CLASS $V_1$ (HIGH PERMEABILITY) Sd < 0.14 m
CLASS $V_2$ (MEDIUM PERMEABILITY) 0.14 ≤ Sd < 1.4 m
CLASS V3 (LOW PERMEABILITY) Sd ≥ 1.4 m

The obtained result are the following:

| Sample | Breaking load [N] | Diameter Position [mm] | Adhesion [MPa] | Type of detachment |
|---|---|---|---|---|
| 31031601 - GIOLLICRYL | 1219 | 50 | 0.6 | 80% A - 20% B |
| | 894 | 50 | 0.5 | 30% A - 70% B |
| | 897 | 50 | 0.5 | 80% A - 20% B |
| | 1257 | 50 | 0.6 | 60% A - 40% B |
| | 1573 | 50 | 0.8 | 20% A - 80% B |
| **Average** | **1168** | **50** | **0.6** | |

### *2.4 Determination of the design thermal values*

The thermal conductivity ($\lambda_{10,\,dry}$) has been determined using the table of appendix A, prospect A.12, of the test method UNI EN 1745. The value of thermal conductivity is gained considering the dry volumic mass of the external. Nevertheless this method is specific for mortars and not for renders. For this reason the dimensions of the specimens were modified, in fact it was not possible to prepare prismatic specimens with dimensions 160x40x40 millimeter.
Therefore the test was carried out on specimens with dimensions 70x85x2 millimeter. About the hardening and drying conditions, the method UNI EN 15824 was used; this method suggests to dry the specimens for 28 days at T =23 ± 2 °C and HR=50 ± 5%. The constant mass is obtained drying the specimens in oven at T=60 ± 5 °C.

The conductivity can be express as fractile (P) of 50% and/or 90% of the existing range of values of λ for materials with a determined volumic mass.

The obtained result are the following:

| Sample | Dry volumic mass [kg/m$^3$] | Thermal conductivity $\lambda_{10,dry}$ (P=50%) [W/mK] | Thermal conductivity $\lambda_{10,dry}$ (P=90%) [W/mK] |
|---|---|---|---|
| 31031601 - GIOLLICRYL | 1730 | 0,82 | 0,89 |

## 3 Conclusions

| Test | Result |
|---|---|
| Liquid water permeability<br>Method UNI EN 1062-3 | $W_{24}$ = 0.044 kg/($m^2h^{0.5}$)<br>Class $W_3$ (low permeability) |
| Water-vapour transmission rate (permeability)<br>Method UNI EN ISO 7783 | Sd = 1.0802 m<br>Thickness = 2.35 mm<br>$\mu$ = 459<br>Class $V_2$ (medium permeability) |
| Bond strength by pull-off<br>Method UNI EN 1542 | $f_h$ = 0.6 MPa |
| Thermal conductivity<br>Method UNI EN 1745 | $\lambda_{10,dry}$ = 0.82 W/m·K (P=50%)<br>$\lambda_{10,dry}$ = 0.89 W/m·K (P=90%) |

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END OF THE REPORT