ISB Block und Becker Beratende Ingenieure PartGmbB

Dr.-Ing. habil. Klaus Block
fon +49 (0) 231 – 13727652
fax +49 (0) 231 – 13727655
klaus.block@isb-ing.de

5th June 2020

Project number
20-023-K

Summary report no. 20-023-2

to determine several material properties of the adhesive Würth WIT-PE 1000

Client

Adolf Würth GmbH & Co. KG
Reinhold-Würth-Straße 12-17

DE-74653 Künzelsau

Table of content

References

[1] Orlowsky, J. Prüfbericht I0119 zu ausgewählten Materialeigenschaften eines Polymermörtels – 2. Fassung, TU Dortmund, WdB – Werkstoffe des Bauwesens, 4. Juli 2019

[2] Telle, R., Tonnesen, Th.
Prüfbericht GA-Nr. 4033, Bestimmung der Wärmeleitfähigkeit und Berechnung der Wärmekapazität einer Mörtelprobe der Bezeichnung „EP Harz“ nach DIN EN 993-15 mit dem Heizdrahtverfahren (Paralleldrahtmethode), RWTH Aachen, Institut für Gesteinskunde, 17. April 2019

[3] Weißgerber, T.
Technischer Bericht Nr. 20190524 ISB Widerstandsmessung, Weißgerber Engineering GmbH – Dortmund, 24. Mai 2019

1. General

The ISB Block und Becker PartGmbB had been authorized to determine several material properties, like mechanical, thermal and electrical properties, of the adhesive WIT-PE 1000 of the Adolf Würth GmbH & Co. KG.

These had been in detail:

Material property	Test method
Flexural strength	DIN EN 196-1
Compressive strength	DIN EN 196-1
Tensile strength + coefficient of elasticity (Young´s Modulus) and strain at fracture	DIN EN ISO 527-2
Shrinkage	DIN 52450
Shore-hardness A	DIN EN ISO 868
Density	Weighing
Thermal conductivity	DIN EN 993-15
Specific heat capacity	DIN EN 993-15
Specific electrical contact resistance	DIN IEC 93

2. Test Results

2.1 Mechanical Properties

According to /1/ the values shown in table 1 to 5 can be given after 24 hours hardening time. The statistical assessment had been carried out with a normal distribution and a confidence level of 90%.

Table 1 Flexural- and compressive strengths after 7 days and after 3 months

Test-No.	Flexural strength [N/mm²]		Compressive strength [N/mm²]	
after	7d	3M	7d	3M
1	69,4	72,8	116,4	119,9
2	67,1	77,4	124,4	123,6
3	61,9	47,5	121,9	116,6
4			123,5	126,9
5			123,4	123,5
6			121,1	120,0
Mean value	66,0		121,8	
Variation			2,6%	
5%-Quantil			114,1	

The compressive strengths after 7 days and after 3 months do not differ. These values can be assumed as one population. The mean value of the twelve compressive strength results is 122 N/mm². The 5%-characteristic value is 114 N/mm². The coefficient of variation is 2,6%.

The mean value of the flexural strength is 66,0 N/mm². The values after 7 days and after 3 month differ causes by the scatter. One value can be an outlier. Therefore only the mean value should be given.

The tensile strength, coefficient of elasticity (Young´s Modulus) and strain at fracture are given in table 2.

Table 2 coefficient of elasticity, fracture stress f_t and strain at fracture $\varepsilon_{fracture}$

Test No.	E_t	f_t	$\varepsilon_{fracture}$
	[N/mm²]		[%]
119-1	6.492	48,1	1,01
119-2	6.250	40,1	0,84
119-3	6.195	46,9	1,01
119-5	6.499	44,9	0,92
PK0	6.101	43,0	0,98
06-01	6.134	42,2	1,03
06-02	6.213	49,0	1,23
06-03	6.286	45,4	1,09
06-04	6.093	45,6	1,15
06-05	6.405	46,7	0,95
mean value	6.267	45,2	1,02
variation		6,1%	
5%-Quantil		38,1	

The mean value of tensile strength can be determined to 45 N/mm². The 5%-characteristic value is 38 N/mm². The coefficient of variation is 6,1%.

The coefficient of elasticity can be given to 6.300 N/mm² (mean value)

The mean strain at fracture is about 1,0%.

Shrinkage had been measured at six specimens up to 48 hours. The results are shown in table 3 and figure 1.

Figure 1 shows, that shrinkage is almost completed after 28 hours. It can be assumed, that the mean value of the final shrinkage strain is less than 1,4‰.

Table 3 Shrinkage deformation in dependence of the time

Time	ε_S specimen 1	ε_S specimen 2	ε_S specimen 3	ε_S specimen 4	ε_S specimen 5	ε_S specimen 6	$\varepsilon_{S,mean}$
[h]	[mm/m]						
5	0,00	0,00	0,00	0,00	0,00	0,00	0,00
6	-0,55	-0,47	-0,58	-0,37	-0,32	-0,45	-0,46
21,5	-1,52	-1,40	-1,74	-1,29	-1,04	-1,09	-1,35
24	-1,52	-1,40	-1,75	-1,31	-1,11	-1,20	-1,38
28,0	-1,55	-1,43	-1,77	-1,32	-1,11	-1,21	-1,40
48,0	-1,55	-1,40	-1,77	-1,31	-1,11	-1,22	-1,39

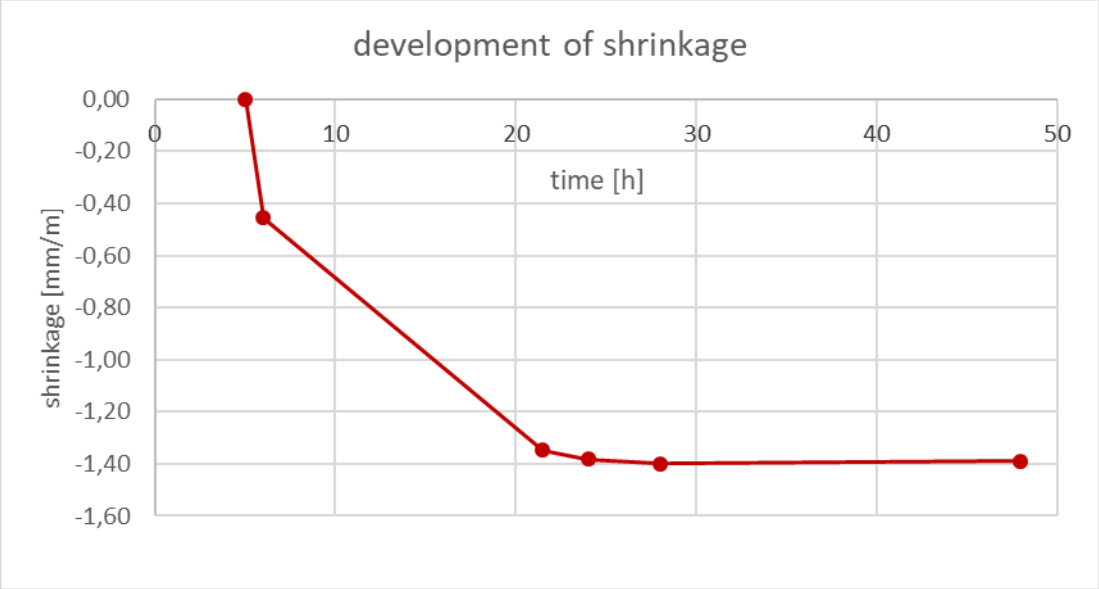

Figure 1 Shrinkage over time – determined as mean value of six tests

The results of the hardness measurements are shown in table 4. All together 24 measurements had been performed, 12 for shore-hardness A and 12 for shore-hardness D.

The mean value of the shore-hardness A is 99,4 with a coefficient of variation of 1,4%.
The mean value of the shore-hardness D is 86,1 with a coefficient of variation of 0,8%.

The density had been measured with three weightings to 1,780 kg/dm³.

Table 4 Results of shore-hardness A and shore-hardness D

Measurement No.	Shore-Härte A	Shore-Härte D
1	95,2	85,6
2	99,9	87,0
3	100	87,0
4	100	86,2
5	100	85,1
6	100	85,6
7	100	86,3
8	100	85,9
9	100	85,0
10	98,8	86,0
11	100	86,6
12	99,0	86,6
Mean value	99,4	86,1
Coefficient of variation	1,4%	0,8%

The density had been measured with three weightings to 1,46 kg/dm³.

2.2 Thermal characteristic

The thermal characteristic had been proofed in report /2/ and are shown in table 5.

Table 5 Thermal conductivity according to DIN EN 993-15 and specific heat of the adhesive WIT-PE 1000

	thermal conductivity [W/mK]	spec. heat [J/kg K]
	0,490	1.321
	0,520	1.318
	0,496	1.413
mean values	0,502	1.351
standard deviations	0,016	54,0

The mean value of the thermal conductivity is 0,50 W/mK and the mean value of the specific heat is 1.350 J/kg K.

2.3 Electrical resistance

The electrical resistance had been tested in /3/ according to DIN IEC 93:1993-12. According to this, the specific electrical surface resistance had been determined to

$$\sigma = 8{,}0 \pm 3{,}1\ 10^{12}\ \Omega.$$

3. Summary

The several mechanical, thermal and electrical material properties of the adhesive WIT-PE 1000 had been proofed according to the relevant technical rules. The results are summarised in Annex 1.

Dortmund, 5th June 2020

Dr. Klaus Block

INGENIEURKAMMER-BAU NORDRHEIN-WESTFALEN
BERATENDER INGENIEUR
740329

Annex 1

Summary of the

Material properties of the adhesive “Würth WIT-PE 1000”

Material properties	Test Method	Mean values	5%-quantils
Compressive strength	DIN EN 196-1	122 N/mm²	114 N/mm²
Flexural strength	DIN EN 196-1	66,0 N/mm²	
Tension strength	DIN EN ISO 527-2	44,2 N/mm²	38,0 N/mm²
Young´s modulus		6.300 N/mm²	
Strain at fracture		1,0%	
shrinkage	DIN 52450	≤ 1,4 $^{0}/_{00}$	
Shore-hardness A	DIN EN ISO 868	99,4	
Shore-hardness D	DIN EN ISO 868	86,1	
Density		≤ 1,50 kg/dm³	
Thermal conductivity	DIN EN 993-15	0,50 W/mK	
Spec. heat	DIN EN 993-15	1.350 J/kg K	
spec. electrical resistance	DIN IEC 93	$8{,}0 \cdot 10^{12}$ Ω	