

Alchimica SA  
13, Oryzomylon street  
12244 ATHENS  
GRIECHENLAND

**Letter**

**14737-7/2014**

Our Ref.: (5100/837/14)-Lau  
Customer No.: 17063  
Official in charge: Ms. Meyer-Laurien  
Dept. BEA  
Contact: 0531-391-8252  
n.meyer-laurien@ibmb.tu-bs.de

Your Ref.:  
Your message of:

Date: 22-04-2015

**Order 5100/837/14**  
**tests for liquid applied roof waterproof according ETAG 005 part 6,**  
**AQUASMART PU-2K with reinforcement**

Dear Sirs or Madams,

you commissioned the Civil Engineering Materials Testing Institute (MPA) in Braunschweig to test (on the basis of ETAG 005-6) a roof waterproofing system using liquid plastics. The product name is

AQUASMART PU-2K.

The test results are shown in the annex.

Yours sincerely  
i. A.

Nicole Meyer-Laurien  
Department Building Conservation, Building Waterproofing

Anlage 1: table

Verification method in accordance with ETAG 005-1	Test conditions	Test results	Requirements
<b>5.2.2</b> Reaction to fire	DIN EN ISO 11925-2 DIN EN 13501-1	class E	class E
<b>5.3.1.1</b> Water vapour transmission properties	DIN EN 1931 23°C-0/75% RH Method: free film Number of specimens: 3 Thickness of dry coat: 1490 µm	Water vapour diffusion current density  $V = 6.85 \text{ [g/(m}^2 \cdot \text{d)]}$  Water vapour diffusion equivalent air layer thickness  $S_d = 5.2 \text{ [m]}$  Diffusion resistance  $\mu = 3487 \text{ [-]}$ $\mu_k = 3234 \text{ [-]}$ $\mu_G = 3626 \text{ [-]}$	-
<b>5.3.1.2</b> Water tightness	TR-003: DIN EN 1928 Method A Test period 24 h Water column 1 m Number of specimens: 3	watertight	watertight
<b>5.3.3.1</b> Resistance against wind load	TR-004: Indenter $\varnothing$ 100 mm Load increase rate 100 N/sec. Number of specimens: 5	On concrete: $x = 2.14 \text{ N/mm}^2$ $g = 2.19 \text{ N/mm}^2$ $k = 2.10 \text{ N/mm}^2$  On galvanised steel plate: $x = 1.34 \text{ N/mm}^2$ $g = 1.62 \text{ N/mm}^2$ $k = 1.17 \text{ N/mm}^2$  On wood: $x = 1.60 \text{ N/mm}^2$ $g = 1.66 \text{ N/mm}^2$ $k = 1.53 \text{ N/mm}^2$  On EPS: $x = 0.13 \text{ N/mm}^2$ $g = 0.14 \text{ N/mm}^2$ $k = 0.11 \text{ N/mm}^2$	$x \geq 0.05 \text{ N/mm}^2$  $x \geq 0.05 \text{ N/mm}^2$  $x \geq 0.05 \text{ N/mm}^2$  $x \geq 0.05 \text{ N/mm}^2$

Legend:  $x$  = mean value  $s$  =  $\pm$  standard deviation  $k$  = lowest value  $g$  = highest value

Table: Characteristics of the "AQUASMART PU-2K" waterproofing system

Verification method in accordance with ETAG 005-1	Test conditions	Test results	Requirements
<b>5.3.3.2</b> Resistance against mechanical damage as a result of dynamic and static indentation <ul style="list-style-type: none"> <li>Impermeability to water in the loaded state</li> </ul>	<u>Load characteristics</u> <ul style="list-style-type: none"> <li><b>Dynamic indentation acc. to TR-006</b></li> <li>24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>Number of specimens: 3</li> </ul> <u>Load characteristics</u> <ul style="list-style-type: none"> <li><b>Static indentation acc. to TR-007</b></li> <li>24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>Number of specimens: 3</li> </ul>	Substrate: concrete P4: 6-mm indenter: tight  Substrate: mineral wool DAA <sup>*)</sup> : P4: 6-mm indenter: tight  Substrate: concrete P4: 250-N imposed load: tight  Substrate: mineral wool DAA <sup>*)</sup> : P4: 250-N imposed load: tight	tight  tight  tight  tight
<b>5.3.3.3</b> Fatigue resistance	TR-008: Test temperature: -10°C Initial crack width: 1.0 mm Change in crack width: $\pm 1$ mm No. of cycles: 500 (W2) Test rate: 16 mm/h Number of specimens: 3	no cracks	no (incipient) cracks
<b>5.3.3.4</b> Resistance against the effects of high surface temperatures	<b>Low temperatures:</b> <u>Load characteristics</u> <ul style="list-style-type: none"> <li><b>Dynamic indentation acc. to TR-006</b></li> <li>Substrate: concrete</li> <li>24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>Number of specimens: 3</li> </ul> <b>Extremely low temperatures:</b> TR-013: Test temperature: -30°C Crack width: 1.5 mm Test rate: 0.5 mm/min Specimens: 3  <b>High temperatures:</b> <u>Load characteristics</u> <ul style="list-style-type: none"> <li><b>Static indentation acc. to TR-007</b></li> <li>Substrate: concrete</li> <li>24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> </ul>	Test temp.: -30°C (TL 4) P4: 6 mm indenter: tight    wattertight    Test temp.: +90°C (TH 4) P4: 250-N imposed load: tight	tight    wattertight   According to ETAG 005, no test required for PUR

Legend: x = mean value s =  $\pm$  standard deviation k = lowest value g = highest value  
classification in acc. with DIN 4108-10

Table: Characteristics of the "AQUASMART PU-2K" waterproofing system

Verification method in accordance with ETAG 005-1	Test conditions	Test results	Requirements
<p>Resistance against the effects of aging</p> <p><b>5.3.3.5-1</b> Resistance against thermal aging</p>	<p>TR-011: 80°C/ 100 d</p> <p><b>Low temperature test:</b> <b>Load characteristics</b></p> <ul style="list-style-type: none"> <li>• <b>Dynamic indentation</b> acc. to TR-006 Substrate: concrete</li> <li>• 24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>• Number of specimens: 3</li> </ul> <p><b>Fatigue resistance in accordance with 5.3.3.3</b></p> <p>TR-008: Test temperature: -10°C Initial crack width: 1.0 mm Change in crack width: ± 1 mm No. of cycles: 500 Test rate: 16 mm/h Number of specimens: 3</p> <p><b>Tension tests in accordance with DIN EN ISO 527</b></p> <ul style="list-style-type: none"> <li>• Test rate: 200 mm/min</li> <li>• Specimen 1B</li> <li>• Number of specimens: 5</li> </ul>	<p>Test temp.: -30°C (TL 4) P4: 6 mm indenter: tight</p> <p>no cracks</p> <p>Tensile strength x = 9.97 MPa k = 9.59 MPa    g = 10.2 MPa</p> <p>Strain at max. force x = 31.5 % k = 30.8 %    g = 32.4 %</p> <p>→ No significant changes</p>	<p>tight</p> <p>no (incipient) cracks</p> <p>No significant changes in comparison with the condition when supplied</p>

Legend: x = mean value, k = lowest value g = highest value

Table: Characteristics of the "AQUASMART PU-2K" waterproofing system

<b>Verification method in accordance with ETAG 005-1</b>	<b>Test conditions</b>	<b>Test results</b>	<b>Requirements</b>
<p>Resistance against the effects of aging</p> <p><b>5.3.3.5-1</b> Resistance against thermal aging</p>	<p>TR-011: 80°C/ 200 d</p> <p><b>Low temperature test:</b> <u>Load characteristics</u></p> <ul style="list-style-type: none"> <li>• <b>Dynamic indentation</b> acc. to TR-006 Substrate: concrete</li> <li>• 24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>• Number of specimens: 3</li> </ul> <p><b>Fatigue resistance in accordance with 5.3.3.3</b></p> <p>TR-008: Test temperature: -10°C Initial crack width: 1.0 mm Change in crack width: ± 1 mm No. of cycles: 500 Test rate: 16 mm/h Number of specimens: 3</p> <p><b>Tension tests in accordance with DIN EN ISO 527</b></p> <ul style="list-style-type: none"> <li>• Test rate: 200 mm/min</li> <li>• Specimen 1B</li> <li>• Number of specimens: 5</li> </ul>	<p>Test temp.: -30°C (TL 4) P4: 6 mm indenter: tight</p> <p>no cracks</p> <p>Tensile strength</p> <p>x = 8.52 MPa k = 8.35 MPa    g = 8.75 MPa</p> <p>Strain at max. force</p> <p>x = 30.2 % k = 28.2 %    g = 32.5 %</p> <p>→ No significant changes</p>	<p>tight</p> <p>no (incipient) cracks</p> <p>No significant changes in comparison with the condition when supplied</p>

Legend: x = mean value, k = lowest value g = highest value

Table: Characteristics of the "AQUASMART PU-2K" waterproofing system

Verification method in accordance with ETAG 005-1	Test conditions	Requirements	Requirements
<b>5.3.3.5-2</b> UV exposure in the presence of moisture	TR-010: 400 MJ/m <sup>2</sup>  <b>Low temperature test: (-10 °C):</b> <u>Load characteristics</u> <ul style="list-style-type: none"> <li>• <b>Dynamic indentation</b> acc. to TR-006 Substrate: concrete</li> <li>• 24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>• Number of specimens: 3</li> </ul> <b>Tension tests in accordance with DIN EN ISO 527</b> <ul style="list-style-type: none"> <li>• Test rate: 200 mm/min</li> <li>• Specimen 1B</li> <li>• Number of specimens: 5</li> </ul>	P4: 6 mm indenter: tight   Tensile strength x = 9.57 MPa k = 8.91 MPa    g = 10.2 MPa  Strain at max. force x = 31.7 % k = 30.9 %    g = 32.2 %  → No significant changes	tight          No significant changes in comparison with the condition when supplied
<b>5.3.3.5-2</b> UV exposure in the presence of moisture	TR-010: 1000 MJ/m <sup>2</sup>  <b>Low temperature test: (-10 °C):</b> <u>Load characteristics</u> <ul style="list-style-type: none"> <li>• <b>Dynamic indentation</b> acc. to TR-006 Substrate: concrete</li> <li>• 24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>• Number of specimens: 3</li> </ul> <b>Tension tests in accordance with DIN EN ISO 527</b> <ul style="list-style-type: none"> <li>• Test rate: 200 mm/min</li> <li>• Specimen 1B</li> <li>• Number of specimens: 5</li> </ul>	results may be present til week 22	tight          No significant changes in comparison with the condition when supplied

Legend:        x = mean value, k = lowest value g = highest value

Table: Characteristics of the "AQUASMART PU-2K" waterproofing system

Verification method in accordance with ETAG 005-1	Test conditions	Requirements	Requirements
Resistance against the effects of aging  <b>5.3.3.5-3</b> Resistance against aging in water	TR-012: 60°C/ 90 d  <b>High temperature test:</b> <u>Load characteristics</u> <ul style="list-style-type: none"> <li>• <b>Static indentation</b> acc. to TR-007 Substrate: concrete</li> <li>• 24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>• Number of specimens: 3</li> </ul> <b>Resistance against wind load</b>  TR-004: Indenter Ø 100 mm Load increase rate 100 N/sec. Number of specimens: 5	Test temp.: +90°C (TH 4) P4: 250-N imposed load: tight          On concrete: x = 2.61 N/mm <sup>2</sup> g = 3.00 N/mm <sup>2</sup> k = 2.08 N/mm <sup>2</sup>	tight          x ≥ 0.05 N/mm <sup>2</sup>
Resistance against the effects of aging  <b>5.3.3.5-3</b> Resistance against aging in water	TR-012: 60°C/ 180 d  <b>High temperature test:</b> <u>Load characteristics</u> <ul style="list-style-type: none"> <li>• <b>Static indentation</b> acc. to TR-007 Substrate: concrete</li> <li>• 24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>• Number of specimens: 3</li> </ul> <b>Resistance against wind load</b>  TR-004: Indenter Ø 100 mm Load increase rate 100 N/sec. Number of specimens: 5	Test temp.: +90°C (TH 4) P4: 250-N imposed load: tight          On concrete: x = 2.52 N/mm <sup>2</sup> g = 3.00 N/mm <sup>2</sup> k = 2.29 N/mm <sup>2</sup>	tight          x ≥ 0.05 N/mm <sup>2</sup>

Legend: x = mean value, k = lowest value g = highest value

Table: Characteristics of the "AQUASMART PU-2K" waterproofing system

Verification method in accordance with ETAG 005-1	Test conditions	Requirements	Requirements
<b>5.7.1</b> Effects of deviations (fitness for use)	<u>Load characteristics</u> <ul style="list-style-type: none"> <li>• <b>Dynamic indentation acc. to TR-006</b></li> <li>• 24-hour exposure to a 0.1-metre water column (test method 5.3.1.2)</li> <li>• Number of specimens: 3</li> </ul> <b>Tension tests in accordance with DIN EN ISO 527</b> <ul style="list-style-type: none"> <li>• Test rate: 200 mm/min</li> <li>• Specimen 1B</li> <li>• Number of specimens: 5</li> </ul>	<u>Film produced at + 5 °C</u> Substrate: concrete P4: 6-mm indenter: tight  <u>Film produced at +40 °C</u> Substrate: concrete P4: 6-mm indenter: tight  <u>Film produced at + 5 °C</u> Tensile strength x = 6,39 MPa k = 5,64 MPa    g = 6,95 MPa  Strain at max. force x = 26,4 % k = 25,0 %    g = 28,3 %  <u>Film produced at + 40 °C</u> Tensile strength x = 9,19 MPa k = 8,45 MPa    g = 10,6 MPa  Strain at max. force x = 26,3 % k = 25,8 %    g = 26,7 %  → No significant changes	tight   tight           No significant changes in comparison with the condition when supplied (see annex 5)
<b>5.7.2</b> Effects on construction joints	<b>Resistance against wind load</b> TR-004: Indenter Ø 100 mm Load increase rate 100 N/sec. Number of specimens: 5	On concrete: x = 2.03 N/mm <sup>2</sup> k = 1.78 N/mm <sup>2</sup> g = 2.33 N/mm <sup>2</sup>	x ≥ 0.02 N/mm <sup>2</sup>

Legend: x = mean value

s = ± standard deviation

k = lowest value    g = highest value

Table: Characteristics of the "AQUASMART PU-2K" waterproofing system



Characteristics of the waterproofing system	Test conditions	Test results
<b>Thickness</b>	DIN EN 1849-2	<p>Sample condition when supplied:  x = 1.55 mm  k = 1.43 mm      g = 1.68 mm</p> <p>Samples for static and dynamic indentation (free films):  x = 1.51 mm  k = 1.41 mm      g = 1.62 mm</p> <p>Samples for fatigue resistance tests:  x = 1.52 mm  k = 1.44 mm      g = 1.74 mm</p> <p>Samples for thermal aging tests:  x = 1.52 mm  k = 1.28 mm      g = 1.60 mm</p> <p>Samples for UV aging tests:  x = 1.58 mm  k = 1.50 mm      g = 1.68 mm</p> <p>Samples produced at + 5 °C:  x = 1.38 mm  k = 1.24 mm      g = 1.64 mm</p> <p>Samples produced at + 40 °C:  x = 1.43 mm  k = 1.28 mm      g = 1.68 mm</p> <p>Samples for determination of the effects of construction joints:  x = 3.00 mm  k = 2.90 mm      g = 3.15 mm</p>
<b>Weight per unit area</b>	EN 29073-1	x = 2700 g/m <sup>2</sup> k = 2460 g/m <sup>2</sup> g = 2875 g/m <sup>2</sup>
<b>Reaction in the tension test</b>	DIN EN ISO 527 Specimen 1b Number of specimens: 5 v= 200 mm/min lo = 115 mm	<p>Max. force  x = 114 N/10 mm      s = 10.7</p> <p>Tensile strength  x = 7.19 MPa      s = 0.67  k = 6.68 MPa      g = 8.26 MPa</p> <p>Strain at max. force  x = 33.4 %      s = 1.32  k = 31.5 %      g = 34.8 %</p>

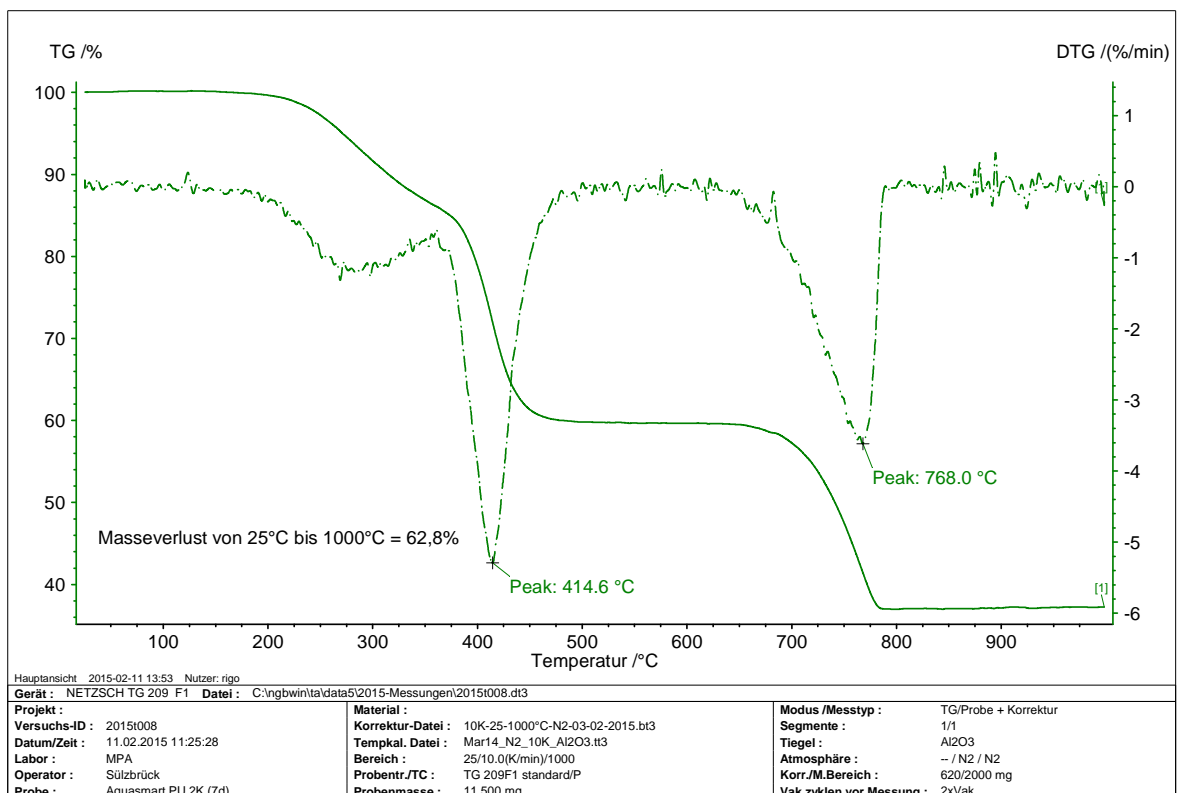
Legend:      x = mean value      s = ± standard deviation      k = lowest value      g = highest value

Table: Characteristics of the "AQUASMART PU-2K" waterproofing system

Characteristics of the waterproofing system	Test conditions	Test results
<b>Shore hardness</b>	DIN 53505	Shore A Median =75 [-]
<b>Ash determination</b>	DIN EN ISO 3451-1 Method A Heat treatment: 950 °C	Mass fraction ash x = 32.3 %
<b>Thermogravimetric analysis (TGA)</b>	DIN EN ISO 11358 Temperatures between 25 and 1,000 °C Heating rate 10 K/min.	Weight loss x = 63.3 %  Diagram see below

Legend: x = mean value s = ± standard deviation k = lowest value g = highest value

Table: Characteristics of the "AQUASMART PU-2K" waterproofing system



Thermogravimetric analyses for liquid component "AQUASMART PU-2K"

Characteristics of the fabric	Test conditions	Test results
Weight per unit area	EN 29073-1	x = 105 g/m <sup>2</sup> k = 100 g/m <sup>2</sup> g = 110 g/m <sup>2</sup>
Reaction in the tension test	DIN EN ISO 527 specimen 360 x 50 mm <sup>2</sup> Number of specimens: 5 v = 100 mm/min l <sub>0</sub> = 200 mm	Max. force  longitudinal    x = 137 N/10 mm    s = 4.00 transversal    x = 122 N/10 mm    s = 15.8  Strain at max. force  longitudinal    x = 78.6 %            s = 5.63 transversal    x = 66.7 %            s = 5.98

Legend:      x = mean value      s = ± standard deviation      k = lowest value      g = highest value  
"Longitudinal" and "transversal" relate to direction of manufacture direction of the fabric

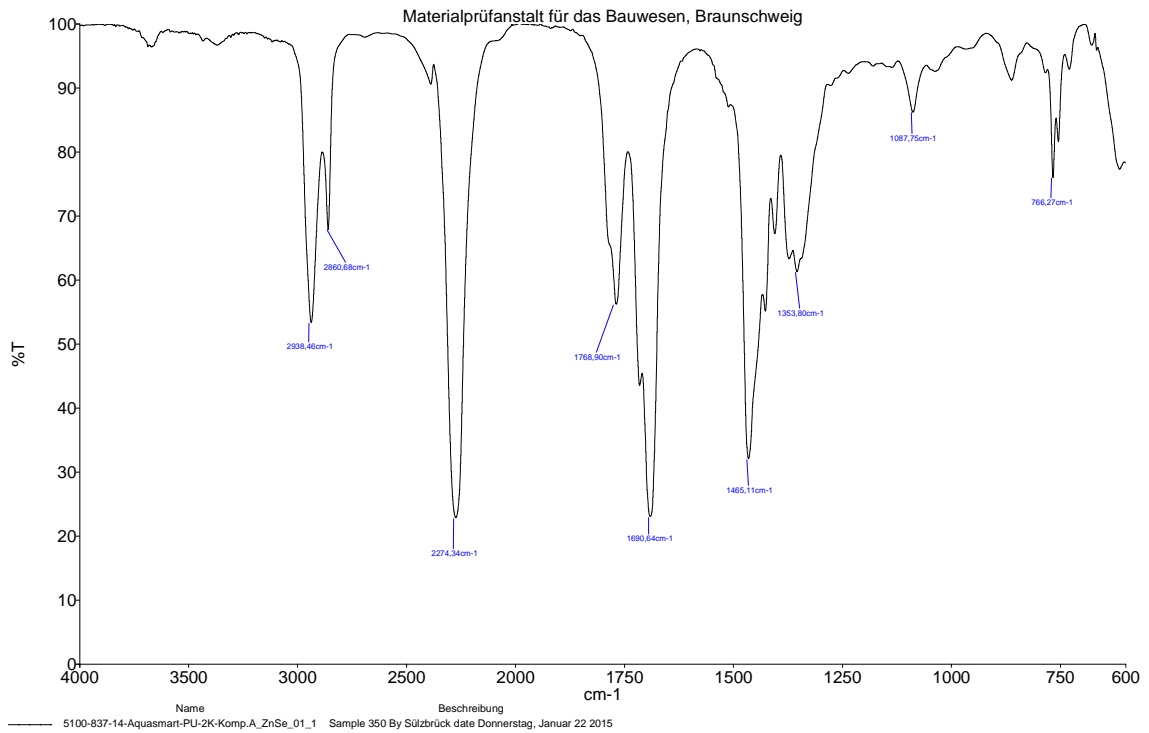
Table: Characteristics of the fabric

Characteristics of the liquid components	Test conditions	Test results
Dynamic viscosity	EN ISO 3219 Test temperature 23°C Shear rate 10 [1/s]	x = 4100 mPa • s
Density	DIN EN ISO 2811-1 Test temperature 23°C	A:    x = 1.149 g/ cm <sup>3</sup> B:    x = 1.351 g/ cm <sup>3</sup>
IR spectra	see below	Annex 10

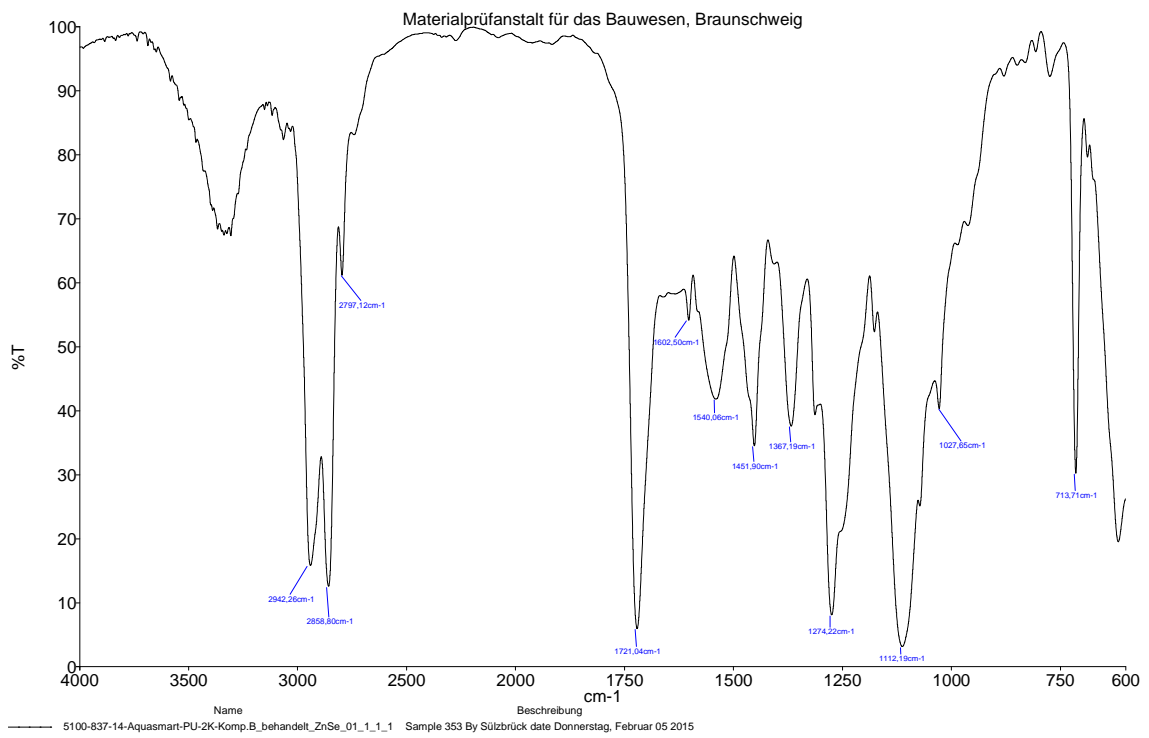
The IR analyses were made with a Perkin-Elmer FTIR unit of type Spectrum 2000 Explorer, wave number range 4000 cm<sup>-1</sup> to 600 cm<sup>-1</sup>.  
The sample quantity was selected so that the DIN 51451 requirements respecting extinction conditions were complied with.  
The spectra of the liquid components shown in **Annex 10** are electronically smoothed. The original graphs are kept in the testing laboratory archives.

Legend:      x = mean value

Table: Characteristics of the liquid component "AQUASMART PU-2K"



IR spectrum of the liquid component "AQUASMART PU-2K", A



IR spectrum of the liquid component "AQUASMART PU-2K", B