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Final Report

Expert Report no.: 05.17452 S

Material examination

This report includes 6 pages plus Annex/(es).
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project: approval of Flexiliner S
building project: Abu Dhabi
manufacturer:: KRT Kanalsanierungs-Technik AG
material: EP synthetic fibre
sample description: test liner
pipe geometry DN 300
order date: October 25, 2005
samples received on: October 31, 2005

client: KRT Kanalsanierungs-Technik AG
Dienstleistungszentrum (Service Centre)
Luzernerstrasse 19
CH – 6204 Sempach, Switzerland

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1 Determining the component and material properties

1.1 Test of bending strength and determination of bending Young's modulus acc. to DIN EN ISO 178 (in combination with DIN EN 13566-4) on 15 pipe sections each

Table: summary of test results (mean values) :

sample description	test direction	bending strength σ_{bB} [N/mm ²]	bending Young's modulus E [N/mm ²]	wall thickness [mm]
test liner	radial	48.0	3,064	6.19
test liner	axial	57.1	3,022	6.10

The individual test logs are enclosed as Annex.

1.2 Determination of the creep tendency and determination of the 24h Young's modulus acc. to DIN EN ISO 899-2 on 6 pipe wall sections, test direction: radial

Table: summary of test results :

sample description	test date	creep tendency K_{N24h} [%]	Young's modulus E_{24h} [N/mm ²]
test liner, section 1	Jan. 09, 2006	9.6	2,539
test liner, section 2	Jan. 09, 2006	9.8	2,330
test liner, section 3	Jan. 09, 2006	9.4	2,105
test liner, section 4	Jan. 09, 2006	9.4	2,102
test liner, section 5	Jan. 09, 2006	9.0	2,271
test liner, section 6	Jan. 09, 2006	8.7	2,191
mean value		9.3	2,256

The individual test logs are enclosed as Annex.

1.3 Determination of the creep tendency and determination of the 24h Young's modulus acc. to DIN EN ISO 899-2 on 6 pipe wall sections, test direction: axial

Table: summary of test results:

sample description	test date	creep tendency K_{N24h} [%]	Young's modulus E_{24h} [N/mm ²]
test liner, section 1	Jan. 15, 2006	8.8	2,269
test liner, section 2	Jan. 15, 2006	9.2	2,231
test liner, section 3	Jan. 15, 2006	9.8	2,604
test liner, section 4	Jan. 15, 2006	11.6	2,673
test liner, section 5	Jan. 15, 2006	9.9	2,863
test liner, section 6	Jan. 30, 2006	6.5	3,315
mean value		9.3	2,659

The individual test logs are enclosed as Annex.

1.4 Test of ring stiffness in a short-term vertical crushing strength test acc. to DIN EN 1228 / DIN 53769-3

300 mm long ring sections were exposed to a vertical crushing strength test under radial load on the samples. Each ring section was tested in three spots with a 60° offset between them.

Table: summary of test results (mean values):

sample description	test date	circumferential Young's modulus E [N/mm ²]	ring stiffness S_R [N/mm ²]
test liner, section 1	Nov. 22, 2005	3,302	0.021
test liner, section 2	Nov. 22, 2005	3,427	0.022
test liner, section 3	Nov. 22, 2005	3,487	0.022
test liner, section 4	Nov. 22, 2005	3,631	0.024
test liner, section 5	Nov. 22, 2005	3,763	0.023
test liner, section 6	Nov. 22, 2005	3,646	0.023

The individual test logs are enclosed as Annex.

1.5 Determination of 24h creep modulus and determination of 24 h creep tendency acc. to DIN EN 761 / DIN 53769-3 on 6 wall sections

Table: summary of test results:

sample description	test date	Young's modulus _{24h} [N/mm ²]	creep tendency K _{N24h} [%]
test liner, section 1	Jan 12, 2006	2,719	11.2
test liner, section 2	Jan 12, 2006	2,857	11.5
test liner, section 3	Jan 12, 2006	2,832	10.6
test liner, section 4	Jan 12, 2006	2,929	8.9
test liner, section 5	Jan 12, 2006	2,923	11.8
test liner, section 6	Jan 12, 2006	2,996	10.3
mean value		2,876	10.7

The individual test logs are enclosed as Annex.

1.6 Test of tensile strength and of elongation at break in axial direction on 15 wall sections acc. to DIN EN ISO 527-4

Table: summary of test results (mean values):

sample description	test date	tensile strength σ_{max} [N/mm ²]	maximum elongation ϵ_{max} [%]	wall thickness [mm]
test liner	Nov 24, 2005	26.8	0.92	6.44

The individual test log is enclosed as Annex.

1.7 Determination of material density on 5 test specimens acc. to DIN 53479

Density was determined using the buoyancy method.

Test results (mean value):

sample description	test date	density [g/cm ³]
test liner	Oct. 26, 2005	1.1546

The measurement log is enclosed as Annex.

**1.8 Test of water tightness of the laminate on 5 sections
acc. to DIN EN 1610**

Test result

sample description	duration [min]	test vacuum [bar]	result
test liner	30	-0.5	impermeable to water

2 Determining the material-specific key parameters

**2.1 Determination of the raw material composition of the reactive resins by
IR spectral analysis**

Analysis results:

sample description	resin type
test liner	epoxy resin

The IR spectrum is enclosed as Annex.

The analysis proved that a resin matrix based on epoxy resin was used.

Oststeinbek, January 30, 2006

Chief Technician
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Tester in charge
F. Meyer

Annexes:
test logs