



Wall thickness

IKT tested samples of tube liners from several hundred building sites. The results of the IKT tests show how different rehabilitation companies fared.

At the beginning of the year IKT 2004 published its research project 'Quality Determinants of Tube Liners' (see bi-Umweltbau Nr.1/2004). The results showed a positive response to the use of tube liners but that their quality has to be strictly supervised and tested neutrally. As tube liners only develop their true characteristics - and geometry traits on site, the risk of installation faults are relatively high. Therefore the choice of a suitable restoration company is very important. It is helpful to look at the results of the Gelsenkirchen institute which in its LinerReport 2003/2004 publishes test results taken from building sites of numerous network operators and private utility companies all over Germany. The aim is to give potential clients an overview of the quality

actually achieved. The IKT-LinerReport is therefore similar to the breakdown statistic of the German automobile association, the ADAC.

Analysis 2003/2004

In the specialized laboratories of IKT's Material Testing Center liner samples are submitted to stringent tests, including Modulus of Elasticity (Young's Modulus), flexural strength, wall thickness and leak tightness. The laboratory testing looks at the liners hardening and its load bearing capacity. The clients get detailed test reports for each repair project in order to be able to judge the quality of the installed liners.

But the important question is: What is the overall picture? Which companies deliver continuous and overall high quality work? What do clients have to watch out for in the future? Answers can be found in the IKT Liner report, which will now be published in regular intervals, regularly updated with the latest test results.

Data for IKT-LinerReport

In the past 18 months the IKT tested many hundreds of liner samples taken on restoration sites. The current IKT-LinerReport gives a summary of the test results from January 2003 to June 2004. Neither clients nor restoration companies can influence the IKT-LinerReport. Only the test results of the neutral and independent IKT Material Testing Center are entered. Rehabilitation companies are included if their products were tested within the time span of the report.

Test results from the building site

At least 25 samples of each type of liner had to be submitted to the Institute from building projects in 5 different local government areas.

Companies missing from the findings are not without importance, but failed to submit sufficient samples. It is important to note that the IKT report is based on past results. It is almost impossible to predict the quality of future performance for certain companies as conditions and staff on site varies. However, results of future tests will be contained in subsequent IKT reports.

● Liner Types

Rehabilitation Company	Liner type
Brandenburger Kanal-sanierungs-GmbH	Brandenburger
Fleer Tech GmbH	FT-Schlauchliner*
Hans Brochier GmbH & Co. KG	Saertex and Norditube
Insituform Rohrsanierungstechniken GmbH	Insituform
Kalender GmbH & Co. KG	Saertex
KMG Rohrtechnik GmbH	KM Inliner
Mennicke Rohrbau GmbH	Saertex
R+S Rohrtechnik GmbH	Berolina and Inpipe
Umwelttechnik Strobel GmbH	Easy-Liner*

*Not quality marked under the pipe quality scheme of DIBt

Interpretation of results

The main content of the IKT report is a performance analysis of site samples. For each sample the previously mentioned 4 criteria are tested, to see if the actual value equals at least the reference value. The percentage of tests with a positive outcome is shown. In addition it analyses the percentage of tests that do not pass, and shows the average and maximum values by which the expected performance is undercut. Conditions at the construction site, the method by which samples were taken, or the choice of sample sites are not taken into consideration when analyzing the samples.

IKT obtained liner samples from different manufacturers. Some rehabilitation companies use more than one liner type. The table on page 1 gives an overview.

Modulus of Elasticity (Young's Modulus)

Depending on its location, a tube liner has to carry different loads, e.g. water, road traffic and earth thrust. It has to be suitable and adequate to carry such loads. The central mechanical

● Test Results Modulus of Elasticity (short term)

Rehabilitation Company	tests passed %	Shortfall under reference value	
		average %	maximum %
Hans Brochier GmbH & Co. KG	98,3	2,5	2,5
Kalender GmbH & Co. KG	97,5	5,8	8,3
R+S Rohrtechnik GmbH	96,3	9,9	9,9
Mennicke Rohrbau GmbH	94,4	11,5	19,0
Umwelttechnik Strobel GmbH	92,0	15,6	29,9
Brandenburger Kanalsanierungs-GmbH	86,7	13,9	23,3
Insituform Rohrsanierungstechniken GmbH	85,6	12,9	42,1
Fleer Tech GmbH	82,9	15,8	22,0
KMG Rohrtechnik GmbH	73,9	14,1	34,0

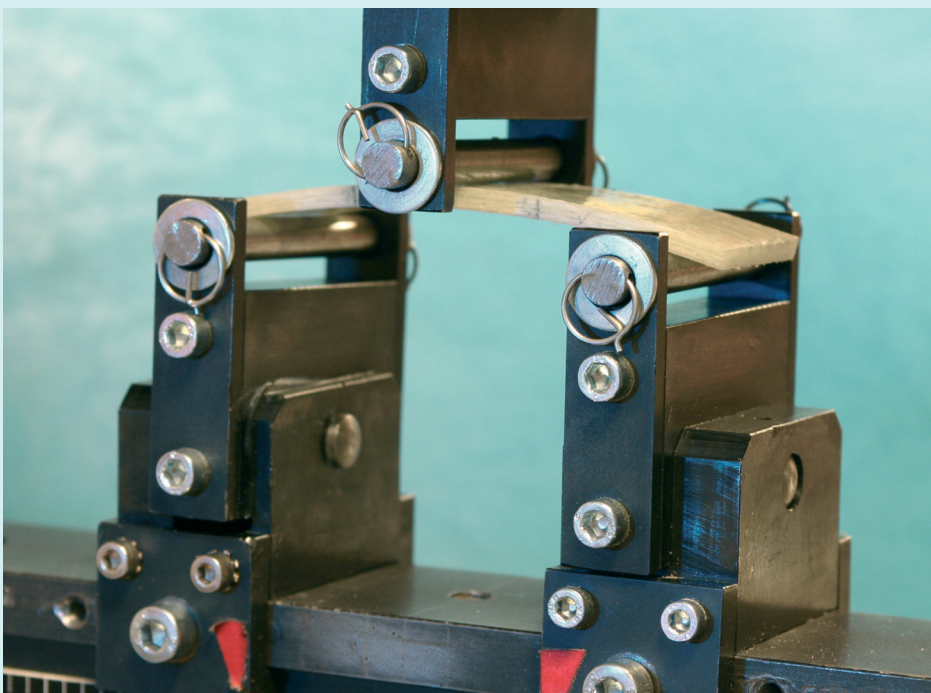
IKT-LinerReport, January 2003 – June 2004

reference for this is the Modulus of Elasticity. The test method for site samples is the three point bending test which IKT uses as a short term test according to DIN EN ISO 178 and

DIN EN 13566-4. The sample passes the test if it reaches at minimum the reference value. The expected performance must relate to the manufacturers information based on trials and suitability tests, but also must meet the minimum specification of the client.

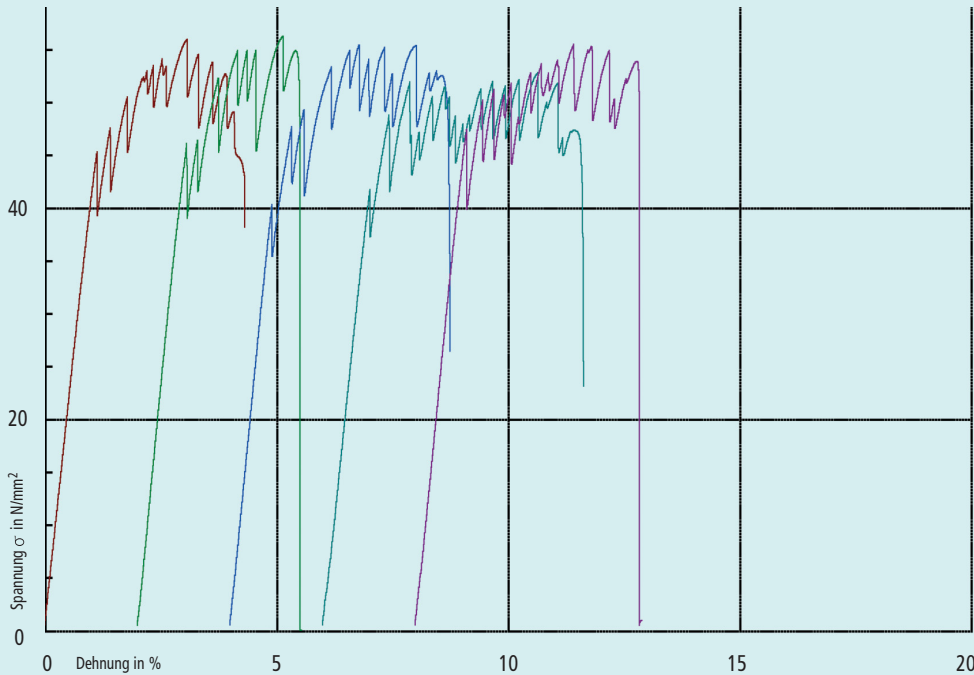
Flexural Strength

Another criteria to measure the liners load bearing capacity is its Flexural Strength. This is the moment when a liner cannot withstand a given pressure. If the Flexural Strength is too low a liner can break even before an acceptable deformation has been achieved. The testing method for this is the Three Point Bending Test whereby pressure is applied until the point of failure. This moment marks the start of breaking point (Flexural Strength).



Three point bending test

Felt liners stress/strain curve



Test Results Flexural Strength (short term)

Rehabilitation Company	tests passed %	Shortfall under reference value	
		average %	maximum %
Brandenburger Kanalsanierungs-GmbH	100,0	—	—
Mennicke Rohrbau GmbH	100,0	—	—
Kalender GmbH & Co. KG	99,2	12,4	12,4
Hans Brochier GmbH & Co. KG	98,3	4,7	4,7
Fleer Tech GmbH	97,6	30,0	30,0
Umwelttechnik Strobel GmbH	96,0	5,0	5,0
R+S Rohrtechnik GmbH	92,6	20,5	31,2
Insituform Rohrsanierungstechniken GmbH	78,4	10,7	44,4
KMG Rohrtechnik GmbH	78,3	14,7	28,1

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Wall thickness

The third relevant criteria is the wall thickness. To determine this, an estimate in the static calculation is taken which later has to be reached when the liner is produced at the site. As the final liner form is only established after hardening, the wall diameter is tested on site as a

quality control using the following test method. A precision caliper rule, measures the static carrying capacity of the wall thickness in 6 places. During the test, inner and outer foils as well as excess resin are not taken into account.

Leak tightness

An important criteria is leak tightness, as liners are used to seal damaged waste water pipes. Test method: depending on the type of liner the outer foil is first removed from the sample and the inner foil is cut to a certain pattern. Then, red colored water is dripped onto the inside, whilst the outside is put under a negative pressure of 7,25 psi. If drops, foam or moisture appear on the outside, the liner is leaking.

Conclusion

The IKT-LinerReport 2003/2004 evaluates statistically the institute's liner data for the period January 2003 to June 2004. The overall impression concerning performance of the tested rehabilitation companies is positive. Most of the liner samples were watertight which is vital mainly for ground water protection. Notably companies that used glass fiber liners (GFK) achieved good results on water tightness (100%). Followed closely by companies using Felt liners with above 90% water tightness. Bearing in mind the often difficult conditions on site and pipes which were in places, in a very bad state, these results are satisfactory.

On the other hand there are more obvious quality differences in load bearing capacity. None of the reconstruction companies had managed to reach the Modulus of Elasticity consistently. A third of companies achieved very good results, with more than 95% of tests passed. The remainder of the companies only passed around 74% of the tests. Problems with a too low Modulus of Elasticity can occur when the liner had to support the old pipe or there is high ground water pressure.

The Flexural Strength criteria looks at lot more positive. All but 2 of the restoration companies passed over 90% of tests. This is a satisfactory result. Results are mixed when it comes to wall thickness. Three of the tested companies have a success rate of over 90%, two are well below that level.

● Test Results Wall Thickness

Rehabilitation Company	tests passed %	Shortfall under reference value	
		average %	maximum %
Hans Brochier GmbH & Co. KG	100,0	—	—
KMG Rohrtechnik GmbH	97,5	11,4	11,4
Kalender GmbH & Co. KG	93,9	10,5	21,4
Insituform Rohrsanierungstechniken GmbH	87,6	10,4	30,3
R+S Rohrtechnik GmbH	79,2	5,6	10,0
Brandenburger Kanalsanierungs-GmbH	*		
Fleer Tech GmbH	*		
Mennicke Rohrbau GmbH	*		
Umwelttechnik Strobel GmbH	*		

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* Should-Be-value unknown

● Test Results Leak Tightness

Rehabilitation Company	tests passed %
Brandenburger Kanal-sanierungs-GmbH	100,0
Kalender GmbH & Co. KG	100,0
Mennicke Rohrbau GmbH	100,0
R+S Rohrtechnik GmbH	100,0
Hans Brochier GmbH & Co. KG	98,3
KMG Rohrtechnik GmbH	93,5
Fleer Tech GmbH	92,7
Umwelttechnik Strobel GmbH	92,0
Insituform Rohrsanierungs-techniken GmbH	91,0



Testing of leak tightness

In general the IKT report confirms the findings of the IKT research project from the beginning of 2004: Tube liners (CIPP) are useful for rehabilitation as long as there are independent and neutral tests of site samples. There is a responsibility for clients who must make sure that liner samples are taken on site and sent to the laboratory with correctly completed paperwork. The choice of test institute must not be made by the rehabilitation company but has to be made by the client.

source: bi umweltbau 5/2004

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