

## Lateral liner wanted: fitted, no crease and tight

**Fitting accuracy, flat surface and leaktightness: the latest IKT-Product-Test „Liners for Laterals” shows which liners fulfil the requirements of the network operators. The marks range from „VERY GOOD” to „POOR”. Even the best liner, however, is not always free of malfunction.**

### Rehabilitation of public and private sewers

The rehabilitation of laterals is becoming increasingly important. With high proportions of extraneous water the cost-intensive rehabilitation only really makes sense if the private sewers are rehabilitated, too. However, laws as well as standards require tight laterals such as §61a NRW-Wassergesetz (water regulations North Rhine Westphalia) and DIN 1986.

The technical demands on the rehabilitation of laterals with cured-in-place pipes (CIPP) are tremendous. They have far smaller diameters (e. g. DN 150 and smaller) than public collector lines. They are often marked by tight bends up to 90 degrees. Furthermore, in many cases the accessibility is far more limited than in public space. In addition, numerous practical investigations by IKT show that their damage rate is clearly higher than the one of „large” sewers, namely more than 70%.

For this reason the NRW Ministry of Environment and 14 sewer network operators wanted to learn more about the suitability of cured-in-place pipes for rehabilitating laterals. They all put the IKT – Institute for Underground Infrastructure in charge of the product test „Liners for laterals”. The following network operators participated in the product test:

- Eigenbetrieb Abwasser Stadt Alsdorf
- Abwasserwerk Stadt Bergisch Gladbach
- Stadt Dinslaken
- Stadtentwässerungsbetrieb Düsseldorf
- Stadt Gladbeck
- Stadtentwässerung Göttingen
- Stadt Hilden
- Stadtentwässerungsbetriebe Köln AöR
- Stadt Neuss
- Niederrheinische Versorgung und Verkehr AG (NVV)
- Stadtwerke Quickborn
- Stadt Recklinghausen
- Entsorgungsbetriebe Warendorf
- Staatliches Hochbauamt Würzburg



Meeting of the steering committee: network operators examine liner samples

Together with IKT, in the meetings of the steering committee the 14 network operators developed the test programme, selected the test candidates and assessed the test results afterwards.



Installation of the laterals at the IKT large-scale test facility

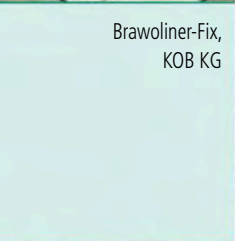
### Liner in the test

The IKT-testers assessed the following eight liners:

- BendiLiner, EasyLiner GmbH
- Brawoliner-Fix, KOB KG
- DrainLiner, epros GmbH
- DrainPlusliner, epros GmbH
- Flex-Liner, ALOCIT Chemie GmbH
- Konudur Homeliner, MC Bauchemie Müller GmbH & Co. KG
- ProFlex Liner (prototype), VFG AG
- SoftLiner, EasyLiner GmbH



BendiLiner,  
EasyLiner GmbH



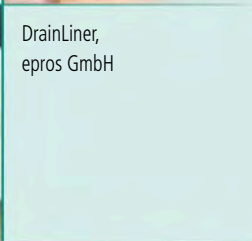
Brawoliner-Fix,  
KOB KG



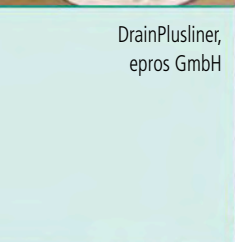
DrainLiner,  
epros GmbH



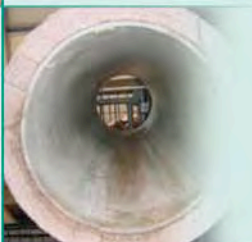
DrainPlusliner,  
epros GmbH



Flex-Liner,  
ALOCIT Chemie GmbH



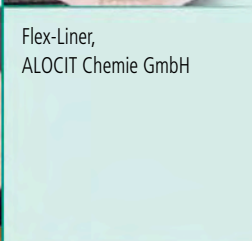
Konudur Homeliner,  
MC Bauchemie Müller  
GmbH & Co. KG



ProFlex Liner (Prototype),  
VFG AG



Soft-Liner,  
EasyLiner GmbH



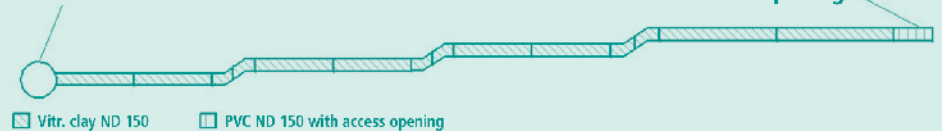
Two other liner manufacturers declined to take part in the product test. For details see result tables.

## Test set-up

For the product test the IKT-testers installed laterals with defined damages in the IKT large-scale test facility. Here, they differentiated between two applications:

„Standard situation”: vitrified clay sewer DN 150 with several bends and damages, rehabilitation via an inspection opening at the ground surface.

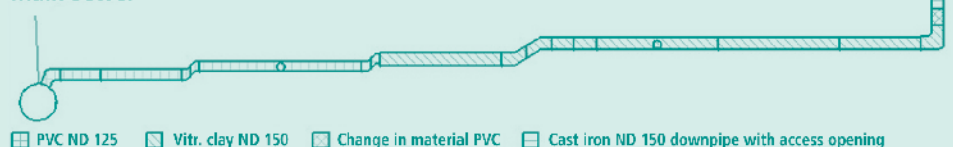
## Main sewer



Standard situation

„Extreme situation”: vitrified clay sewer DN 150 with change of dimension and material transition to PVC sewer DN 125 as well as several bends and damages, rehabilitation via an inspection opening at a downpipe.

## Main sewer



Extreme situation

in the very important leaktightness test. Here, only three of the eight tested liners are „GOOD” and better.

## Varying quality

All cured-in-place liners showed variations in the liner properties. The IKT-testers noticed these variations in the circumference of the liners, e.g. when measuring the wall thickness, as well as in the length of the liner, e.g. when determining the density. The results of the leaktightness tests according to the APS guideline underline the varying quality of the liners. The dispersion

of the results even partially leads to apparent contradictions in the test results. So due to these variations the „Brawoliner-Fix” performs better in the extreme situation („VERY GOOD”) than in the standard situation („GOOD”).

## Test results

### Overall result

The winner of the test is the „Brawoliner-Fix” by KOB with an overall score of „GOOD” in the standard situation and „VERY GOOD” in the extreme situation.

The „Flex-Liner” by ALOCIT Chemie GmbH and the „ProFlex Liner” by VFG AG, of which only a prototype entered the race, were at the bottom of the list. It could be observed that all test candidates improved the operability of damaged laterals even in extremely bent laterals. Numerous liners, however, presented disappointing results



Testing bodies (30 cm) with tight (2) and leaking (4 und 5) spots



### Operation strains with minor influence

The strains introduced during HP cleaning and mechanical cleaning (spiral machine with various fittings) do not noticeably affect the liner quality. The dispersion of the material properties obviously dominates the result of the leaktightness tests. As a consequence of the strains usually only the inner foil is roughened or damaged in some parts. The IKT-testers did not notice changes in the carrier material.



Light damages in the inner foil after mechanical strains

### Conflict of aims between operability and tightness

Nearly all tested liners achieved better results in the recovery of operability than in leaktightness. A rehabilitation can be considered successful if the liner does not show any or only few creases and edges. To achieve this the liner material needs to have adequate flexibility especially in bends. This flexibility, however, can oppose the leaktightness of the material.

In the test this became particularly clear when several liner suppliers used different liners for rehabilitating the standard and the extreme situation. So „DrainPlusliner“ and „BendiLiner“, which were exclusively used in the extreme situation, showed far less creases in bends than the ones used in the standard situation „DrainLiner“ and „SoftLiner“. But, less creases in these cases led to clear loss in the sealing effect and thus to a worse overall result.

### Quality assurance in preparation

Merely the test winner is able to convince in quality assurance with the score „VERY GOOD“. Most suppliers provided incomplete or even no documents at all. Partially the documents refer to other materials than used in the test. However, many providers stated that they were currently improving the quality assurance of their products. According to this, three providers applied for a license by the Deutsches Institut für Bautechnik (DIBt) for their liners.

### Additional investigations of practice

In addition to their laboratory experiments, the IKT-Product-Testers visited selected construction sites where they inspected the procedures of the rehabilitating personnel and assessed the rehabilitation results. The gained impressions confirm the results gathered at IKT. It was found out that with the procedures liners can be installed under practical conditions (little working space, time pressure). Still the IKT testers found variations in quality, in the length of the liner and its circumference by carrying out random leaktightness tests.



Liner inversion under difficult basic conditions

### Conclusions

Liners are not only suitable for rehabilitating public sewers, but just as well for rehabilitating smaller laterals. Here, there are numerous constructional challenges, however, under equally high demands on fitting accuracy, flat surfaces and leaktightness. The test shows that there are indeed liners that meet these requirements – but

until today still too less. This is why property owners should take a closer look by means of which liner they have their laterals rehabilitated. For liner suppliers with less good results shows the test primarily the potential for improvements. The results clarify which product characteristics still need improvement. Hopefully, the suppliers regard the results as helpful criticism and act in a corresponding way. After all the aim of the independent and neutral IKT-Product-Tests is to build up pressure on the market quickening technical innovations and thus contributing to better products and methods.

Source: IKT-eNewsletter November 2005

Tables with the results see following pages...



Main sewer

Access opening



□ Vitr. clay ND 150 □ PVC ND 150 with access opening

Standard situation<sup>1</sup>

Refurbishment of three vitrified clay lateral pipes 150mm diameter, correct connection with a connection fitting in the springer of the main pipe; inversion through access openings at the start of the vitrified clay sewer; vertical bends: 45° and 30°; applied damage: longitudinal cracks, transverse cracks, fragmenting, missing pipe pieces.

Liner supplier	KOB KG	epros GmbH	MC Bauchemie Müller GmbH & Co. KG	EasyLiner GmbH	ALOCIT Chemie GmbH	VFG AG	epros GmbH	EasyLiner GmbH	Mr. PIPE GmbH	Instituform Rohr-sanierungs-technik GmbH
Tube liner	BRAWOLINER - FIX	DrainLiner	Konudur Homeliner	SoftLiner	Flex-Liner	ProFlex Liner (Prototyp)	DrainPlusliner	BendLiner	Mr. PIPE-Liner	Instituform-Liner
Basic material	Polyester high-strength fabric with PU foil	Polyester needle felt with PVC foil	Polyester needle felt with PU foil	Polyester needle felt with PU foil	Knitted polyester fabric with PVC foil	Mashed felt with PU foil				
Resin system	Brawo I	EPROPOX VIS A4/B4	Konudur 160 PL-XL	EasyPox 3008	ALOCIT A 480, B 48 48 resp. 48 84*	Biresin LS				
IKT test mark: standard situation	GOOD (1.6)	SATISFACTORY (2.6)	SATISFACTORY (2.8)	SATISFACTORY (3.3)	ADEQUATE (4.2)	ADEQUATE (4.4)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
System test (weighting 80%)	good (1.6)	good (2.3)	good (2.1)	satisfactory (3.0)	adequate (3.7)	adequate (4.0)				
Refurbishment result (80%)	1.7	2.4	2.2	2.9	2.6	2.1				
Operability <sup>2</sup> (40%)	1.8	2.7	1.8	3.5	3.5	4.3				
Tightness <sup>3</sup> (60%)	1.0	1.0	2.7	1.0	4.3	4.3				
Tightness after HP cleaning <sup>4</sup> (20%)	1.6	2.7	2.1	4.3	4.9	5.4				
Quality assurance (weighting 20%)	very good (1.5)	adequate (4.0)	poor (5.5)	adequate (4.5)	inadequate (6.0)	inadequate (6.0)				
DIBt certification <sup>5</sup> (50%)	yes	no	no	no	no	no				
Environment compatibility test certificate submitted for the resin <sup>6</sup> (20%)	yes <sup>5</sup>	yes	no	yes <sup>7</sup>	no	no				
Procedure manual and training courses <sup>8</sup> (10%)	yes	yes	no	no	no	no				
External monitoring <sup>9</sup> (10%)	yes	yes	yes	yes	no	no				
Evidence of disposability <sup>10</sup> (10%)	no	no	no	no	no	no				
Construction site investigation	practices-orientated installation	not carried out	practices-orientated installation	practices-orientated installation	practices-orientated installation	practices-orientated installation				
Additional information: available for	70mm to 200mm	100mm to 300mm	100mm to 300mm	70mm to 1200mm	50mm to 300mm	70mm to 200mm				
Recommended improvements	Reduce fluctuations in the liner properties	Reduce fluctuations in the liner properties; extend DIBt certification to include the used resin system	Reduce fluctuations in the liner properties; improve quality assurance	Reduce fluctuations in the liner properties; improve tightness and quality assurance	Reduce fluctuations in the liner properties; improve tightness and quality assurance	Reduce fluctuations in the liner properties; improve tightness and quality assurance				

<sup>1</sup> "Standard situation" refers to the geometry of the lateral pipe

<sup>2</sup> Assessment: 100% tightness tests passed according to APTS guideline = 1.0 to 0.5 points = 6.0; marks decided by a linear function.

<sup>3</sup> Assessment: 100% tightness tests passed according to APTS guideline = 1.0 to 0.5 points = 6.0; marks decided by a linear function.

<sup>4</sup> Assessment: present = yes, not present = no; certification/confirmation/verifications must be valid for the materials used in the test.

<sup>5</sup> According to the DIBt certification, a PE protective tube is to be used between the liner and the pipe being refurbished when using the refurbishment method in areas saturated with ground water.

<sup>6</sup> The liner was not used by the participating sewerage network operators at the point in time of the site tests; the liner supplier could not name a site either. The installation procedure corresponds basically to that used for the DrainPlusliner.

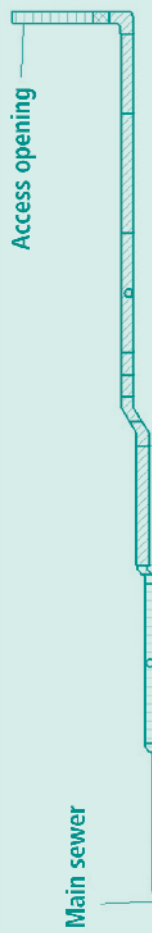
<sup>7</sup> Test certificate of the Hygiene Institute of the Ruhr area dated 1 August 2002: "Given the clear smell and taste contamination of the test water, it is advisable as a precaution to refrain from using in direct drinking water catchment areas (protection zone I) and in protection zone II". In our opinion [flavor] are no objections to using the material "EasyPox" in areas with groundwater contact, as long as these are above the saturated zone and outside drinking water protection zone II".

<sup>8</sup> Both B-components (hardeners) 48 48 resp. 48 84 were available and were used.

Assessment key for the test results: very good = 1.0 - 1.5, good = 1.6 - 2.5, satisfactory = 2.6 - 3.5, adequate = 3.6 - 4.5, poor = 4.6 - 5.5, inadequate = 5.6 - 6.0.



# IKT - Product test „Lateral Liner“



☒ PVC ND 125   
 ☒ Vitr. clay ND 150   
 ☒ Change in material PVC   
 ☒ Cast iron ND 150 downpipe with access opening

Extreme situation<sup>1</sup>

Refurbishment of three lateral pipes of vitrified clay 150mm diameter with change in dimension and material to PVC 125mm diameter; connection between crown and springer of the main sewer not correctly executed with mortar coated 67° bend; inversion through access openings in the downpipes made of cast iron 150mm diameter; vertical bends: 90°, 45° and 30°; horizontal bends: 15°; applied damage: longitudinal cracks, transverse cracks, fragmenting, lacking pipe pieces, indicated side inlets, lacking gaskets.

Liner supplier	KOB KG	MC Bauchemie Müller GmbH & Co. KG	epros GmbH	EasyLiner GmbH	VFG AG	ALOCIT Chemie GmbH	epros GmbH	EasyLiner GmbH	Mr. PIPE GmbH	Insituform Rohrspannungs-techniken GmbH
Tube liner	BRAWOLINER - FIX	Konudur Homeliner	DrainPlusliner	BendLiner	ProFlex Liner (Prototyp)	Flex-Liner	DrainLiner	SoftLiner	Mr. PIPE-Liner	Insituform-Liner
Basic material	Polyester high-strength fabric with PU foil	Polyester needle felt with PU foil	Polyester needle felt with PU foil	Polyester needle felt with PU foil	Meshed felt with PU foil	Knitted polyester fabric with PVC foil	-	-	-	-
Resin system	Brawo I	Konudur 160 PL-XL	EPROPOX VS A4/B4	EasyPox 3008	Biresin LS	ALOCIT A 480, B 48.48 resp. 48.94 <sup>4</sup>	-	-	-	-
IKT test mark: extreme situation	VERY GOOD (1.3)	SATISFACTORY (3.2)	ADEQUATE (3.9)	ADEQUATE (4.1)	POOR (4.6)	POOR (5.1)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
System test (weighting 80%)	very good (1.2)	satisfactory (2.6)	adequate (3.9)	adequate (4.0)	adequate (4.3)	poor (4.9)				
Refurbishment result	1.9	2.6	1.7	2.4	2.9	3.5				
Operability <sup>2</sup> (40%)	yes	no	yes	yes <sup>7</sup>	no	no				
Tightness <sup>3</sup> (60%)	yes <sup>6</sup>	yes	yes	yes	no	no				
Tightness after HP cleaning <sup>4</sup> (20%)	1.0	4.3	4.3	6.0	8.0	6.0				
Tightness after mechanical cleaning <sup>5</sup> (20%)	1.0	1.0	5.2	5.2	1.0	4.3				
Quality assurance (weighting 20%)	very good (1.5)	poor (5.5)	adequate (4.0)	adequate (4.5)	inadequate (6.0)	inadequate (6.0)				
DIBt certification <sup>6</sup> (50%)	yes	no	no	no	no	no				
Environment compatibility test certificate submitted for the resin <sup>7</sup> (20%)	yes	no	yes	yes <sup>7</sup>	no	no				
Procedure manual and training courses <sup>8</sup> (10%)	yes	no	yes	yes	no	no				
External monitoring <sup>9</sup> (10%)	yes	yes	yes	yes	no	no				
Evidence of disposability <sup>10</sup> (10%)	no	no	no	no	no	no				
Construction site investigation	practice-orientated installation	practice-orientated installation	practice-orientated installation	practice-orientated installation	practice-orientated installation	practice-orientated installation				
Additional information: available for	70mm to 200mm	100mm to 300mm	100mm to 300mm	100mm to 150mm	70mm to 200mm	50mm to 300mm				
Recommended improvements	Reduce fluctuations in the liner properties	Reduce fluctuations in the liner properties; improve quality assurance	Reduce fluctuations in the liner properties; extend DIBt certification to include the used resin system	Reduce fluctuations in the liner properties; improve tightness and quality assurance	Reduce fluctuations in the liner properties; improve tightness and quality assurance	Reduce fluctuations in the liner properties; improve tightness and quality assurance				

<sup>1</sup> "Extreme situation" refers to the geometry of the lateral pipe.

<sup>2</sup> Assessment of the operability through visual inspection of the refurbished standard situation by the sewerage network operators: 100 points = 1.0 to 0 points = 6.0; marks depicted by a linear function.

<sup>3</sup> Assessment: 100% tightness tests passed according to AFS guidelines = 1.0 to 0% tightness tests passed according to AFS guidelines = 6.0; marks depicted by a linear function.

<sup>4</sup> Both Bicomponents (hardener 48.48 resp. 48.94) were available and were used.

<sup>5</sup> According to the DIBt certification, a PE protective tube is to be used between the liner impregnated with resin and the pipe being refurbished when using the refurbishment method in areas saturated with ground water.

<sup>6</sup> Test certificate of the Hygiene Institute of the Ruhr area dated 1 August 2002: "Given the clear smell and taste contamination of the test water, it is advisable as a precaution to refrain from using in direct drinking water catchment areas (protection zone I) and in protection zone II". "In our opinion (there) are no objections to using the material 'EasyFor' in areas with groundwater contact, as long as these are above the saturated zone and outside drinking water protection zone II".

<sup>7</sup> Test certificate of the Hygiene Institute of the Ruhr area dated 1 August 2002: "Given the clear smell and taste contamination of the test water, it is advisable as a precaution to refrain from using in direct drinking water catchment areas (protection zone I) and in protection zone II". "In our opinion (there) are no objections to using the material 'EasyFor' in areas with groundwater contact, as long as these are above the saturated zone and outside drinking water protection zone II".

<sup>8</sup> Assessment key for the test results: very good = 1.0 – 1.5, good = 1.6 – 2.5, satisfactory = 2.6 – 3.5, adequate = 3.6 – 4.5, poor = 4.6 – 5.5, inadequate = 5.6 – 6.0.



# ABOUT IKT



**IKT - Institute for Underground Infrastructure** is a research, consultancy and testing institute specialized in the field of sewers. It is neutral and independent and operates on a non-profit basis. It is oriented towards practical applications and works on issues surrounding underground pipe construction. Its key focus is centred on sewage systems. IKT provides scientifically backed analysis and advice.

IKT has been established in 1994 as a spin-off from Bochum University, Germany.

The initial funding for setting up the institute has been provided by the Ministry for the Environment of the State of North-Rhine Westphalia, Germany's largest federal state.

However, IKT is not owned by the Government. Its owners are two associations which are again non-profit organizations of their own:

**a) IKT-Association of Network Operators:**  
Members are about 100 cities, among them Berlin, Hamburg, Cologne and London (Thames Water). They hold together 66.6% of IKT.

**b) IKT-Association of Industry and Service Providers:** Members are about 60 companies. They hold together 33.3% of IKT.

You can find information on projects and services at:  
[www.ikt.de](http://www.ikt.de)

