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## **Evaluation of High Pressure Flushing Test SVB-Nr. 06.18082 S**

**Test of resistance of liner type "FlexiLiner II Plus" to flushing  
by high pressure cleaning device acc. to the "Hamburg model"**

client: **KRT Kanalsanierungs-Technik AG**  
**Luzernerstr. 19**  
**CH 6204 Sempach**

inspection office: **SIEBERT Ingenieurbüro für**  
**Kunststofftechnik GmbH**  
**Münsterstraße 5**  
**D 59065 Hamm**

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## **1 Site visit**

On October 19, 2005, a site visit to the premises of KRT Kanalsanierungs-Technik AG in Sempach was conducted in order to do a high pressure flushing test on a cured-in-place pipe named "FlexiLiner II Plus" in a test pipe. A cured-in-place pipe was installed in a straight pipe section over a total of four DN 150 branch connections and two 45° bends in the main DN 300 pipe. 30 flushing cycles were planned. Due to the specific climate situation in connection with the approval of the "FlexiLiner II Plus" in Abu Dhabi the test was done without adding stone grit that is spread on roads in winter.

### **1.1. Participants / involved parties**

client:

**KRT Kanalsanierungs-Technik AG**  
**Luzernerstr. 19**  
**CH 6204 Sempach**

The company doing the pipe lining is:

**KRT Kanalsanierungs-Technik AG**  
**Luzernerstr. 19**  
**CH 6204 Sempach**

The high pressure flushing test was accompanied by the accredited inspection office.

**SIEBERT Ingenieurbüro für Kunststofftechnik GmbH**  
**Münsterstraße 5**  
**D 59065 Hamm**

## **2 Liner location and test procedure**

### **2.1 Liner location and general conditions**

The test pipe is a DN 300 concrete sewer pipe that is about 18 m long. For the test of the said inliner system it was partially repaired. According to the company KRT Kanalsanierungs-Technik AG the installed cured-in-place pipes are a liner system made up of epoxy resin and polyester needle felt (synthetic fibre) named "FlexiLiner II Plus". The impregnation log and the heating log were presented. There is no approval by DIBt, the German Institute of Construction Engineering.



Illus. 1

30 flushing cycles at 120 bar were done in accordance with the "Hamburg model for flushing tests". In addition three spot flushing cycles over three minutes each were run on the laminate area. Due to the specific climate situation in connection with the approval of the "FlexiLiner II Plus" in Abu Dhabi the test was done without adding stone grit that is spread on roads in winter.

## 2.2 Technical equipment

The parameters of the flushing vehicle employed for the test are as follows:

### Flushing vehicle:

water pressure at the vehicle	190 bar
volume flow	~320 l/min
hose length	190 m
hose diameter	1 inch



Illus. 2

The parameters of the flushing head are as follows:

**Flushing head:**

number of jets	10 pieces
jet diameter	2.3 mm
jet angle	30°
volume flow at 120 bar	about 320 l/min
pressure on the jet	about 120 bar



Illus. 3

We have no documents on the flushing vehicle and the flushing head. All data on the flushing vehicle are according to the company. The flushing head was an "Enz Golden Jet" made by Enz Technik AG Switzerland.

### **2.3 Test procedure**

The Hamburg Sewage Board developed the high pressure flushing test acc. to the Hamburg model in order to do a realistic test of the influence of annual high pressure flushing on cured-in-place pipes. One flushing cycle includes the complete travel of the flushing head forward and back through the pipe. The flushing pressure for cured-in-place pipes is 120 bar. There should be at least 8 jets with a diameter of about 2.4mm  $\pm$ 1.0mm at a 30° angle. The forward travel speed is 1.0m/sec, the return speed is between 0.1m/sec and 0.3m/sec. The flow depends on the head size, and in this case it is about 320 l/min. At the end of the test the flushing head is kept on three spots in the cured-in-place pipe for three minutes each at 120 bar in order to test the cured-in-place pipe for the effect of local attack by the head.

The number of the required flushing cycles depends on the estimated service life (about 30 years) of the cured-in-place pipe. So we decided on 15 flushing cycles.

### **3 System**

The system "FlexiLiner II Plus" is a combination of a cold-curing epoxy resin and a polyester needle felt. The synthetic fibre has no static function and just serves as a resin carrier fibre. On the one hand the resin matrix is the static, load-bearing component, on the other hand it is a sealing system preventing exfiltration and infiltration. All films and foils just facilitate work and installation, and when the curing reaction is complete they have no further function. The liner thickness is determined in advance based on the static requirements. In this case it is 6mm for a diameter of DN 300.



Illus. 4

All our statements on the system "FlexiLiner II Plus" are based on information provided by KRT Kanalsanierungs-Technik AG.

#### **4 Test conduction**

The test was conducted on October 19, 2005, on the premises of KRT Kanalsanierungs-Technik AG in Sempach, Switzerland. Mr. Petermann, the representative of KRT, and Mr. Cords, from Siebert Ingenieurbüro für Kunststofftechnik GmbH, were present.

A 21 m length of DN 300 concrete pipe was built on the premises of KRT. Four DN 150 branches and two 45° bends with diameter DN 300 were installed. Two branches were on the springing line, the other two were in the pipe apex area. A cured-in-place pipe was installed in this test pipe section. The liner thickness was 6mm. When the liner had cured the side branched were cut out by a milling robot. Hat profiles were not used. In addition to the 30 flushing cycles a total of three spot flushing tests over three minutes each were done.

All flushing was done from the main pipe.



Illus. 5

The evaluation of the flushing test was done on the basis of video recordings and photos taken when the test was conducted. The camera was used before and after the flushing test. In addition we took photos of the test pipe section. All recorded images are kept by Siebert (video and photo documentation).

The volume flow at 120 bar was specified as 320 l/min. In order to identify the 120 bar flushing pressure at the flushing head we determined the pressure drop in the hose. The flushing pressure reading at the vehicle was 190 bar. So the actual pressure at the flushing head, taking the pressure drop into account, was 120 bar.



Illus. 6

According to the operator the hose length of the flushing vehicle was 190 m. The hose diameter was specified as one inch.

The forward and backward travel speed of the flushing head was manually kept at about 1 m/sec during forward travel and in the range between 0.1 m/sec and 0.3 m/sec during the flushing process.

## **5 Result**

After the flushing process a TV camera was moved through the short liner. Following the high pressure flushing test Ingenieurbüro Siebert evaluated the recorded images.

During the evaluation we found that after the 30 flushing cycles the installed cured-in-place pipe did not exhibit any damage on the inner film nor on the laminate.

After the spot flushing tests the inner film was torn. However, we did not find any damage on the laminate surface.

In the system "FlexiLiner II Plus" the attached inner film is a help for installation and not an essential part of the finished system. So we can state that the laminate surfaces of the "FlexiLiner II Plus" did not suffer any damage from high pressure flushing at a pressure of 120 bar.

Provided that the inner film is a help for installation and that the laminate alone functions as a sealing system the tested system "FlexiLiner II Plus" can be classified as resistant to high pressure flushing up to a pressure of 120 bar.

Hamm, January 10, 2006

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Chief Technician  
Dipl.-Ing. A. Haacker

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Project engineer  
Dipl.-Ing. A. Cords

## **6 Applicable guidelines and standards**

- DIN EN 13566, Part 4, Plastic Pipeline Systems for Rehabilitating Buried Pressure-free Draining Networks, Part 4: Cured-in-place Pipes
- RSV Worksheet no. 4, Repair of Pressure-free Sewers and Pipelines by In-situ Curing Partial Inliners