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FILOseal+HD

Re-enterable Duct Sealing System

Test Reports for MD+ (FiloSeal+ & FiloSeal+ HD)

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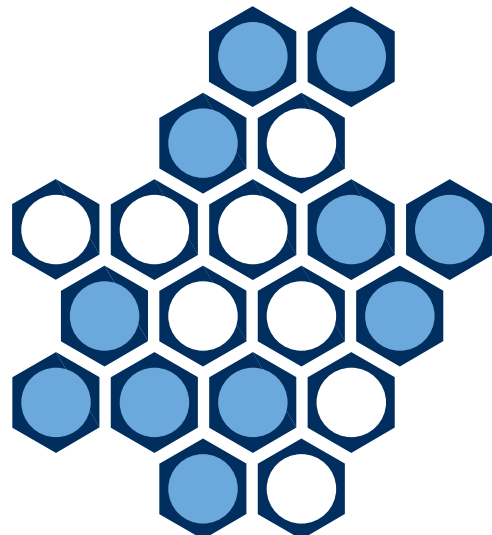
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From: Wim Ipenburg

Date: 19 Feb 2016

Ref.: MD+ with Hexagonal tubes

Introduction:

This test report describes the results for testing the pressure, bending strength and pull strength when using Filoform's hexagonal support system, and finishing with a layer of MD+

Requirements:

- Gas & Water tightness – 1 bar long term (10 metres of water)
- Gas & water tightness – 2 bar short term (20 metres of water)
- The seal to withstand the cables being bent or stood on
- The seal to withstand pulling forces on the cables

Test Description:

- The test is performed using the following materials:
- PVC Duct – I/D = 150mm
- 3 x 150mm 4 core PVC/XLPE/SWA cables each having an O/D of around 50mm

Installing & preparing the Seal

The duct seal is installed in accordance with the standard Filoform instruction:

1. The cables and duct are cleaned and given a key with some sandpaper
2. The hexagonal tubes are placed around the cables filling up all the gaps, using the large and small hexagonal backers to make the support system nice and tight. They should end up looking like a honeycomb
3. The hexagonal tubes must be installed leaving a 20mm gap at the front which is where the MD+ sealant is applied.
4. Once fully covered using the Filoform sponge to compress the sealant, so some of the sealant gets compressed into the centres of the hexagonal tubes and ensures the sealant is round each cable.
5. The sealant can take from 4 to 20 days to fully cure as it cured with air humidity. The more humidity the quicker its cures. This test was done 4 weeks after installation at:
(20°C and 50% Relative Humidity)

Picture 1



Picture 2



Picture 3



Picture 4



Test Procedures:

Pressure Test

The transit is pressurized from the inside to 1.0 bar for a period of 48 hours, then a final pressure test of 2 bar.

Bending test

The transit is brought to a pressure of 1,0 bar. One cable is bent at a distance of 10xd at an angle of 45°. After 1 minute, the cable is pushed back again into the starting position. This test is repeated in the opposite direction on the same cable. During and after this test, no leak should occur.



TEST REPORT

Subject: MD+ Pressure test, bending strength, pull strength

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Pull out test.

The transit is brought to a pressure of 1.0 bar. The cable is pulled with a force of 1000N (20 Newton x diameter in mm). After 1 minute, the weight is removed. During and after this test, no leakage should occur.

Since the transit seal is sealed both sides the applied force has been doubled to (2000N).



Final pressure test

After completion of the bending and pull strength, the seals are tested at a pressure of 2.0 bars.



Pressure test 1.0 bar: = PASSED

Bending test 45° = PASSED

Pull out test 1000N: = PASSED

Final pressure test 2 bar after the seal has been weekend by bending and pulling: = PASSED

From: Wim Ipenburg
Date: 4th April 2014
Filoform duct sealing material MD+
Ref.: MD+

Introduction:

This report describes tests carried out at the Nedlab laboratory and at the Filoform laboratory in the Netherlands, to examine the Chlorine and Methane gas resistance of the sealing compound MD+ as used in Filoform duct sealing systems FiloSeal+ & FiloSeal+HD.

Background of this requirement is that in and around waste water treatment installations the presence of Chlorine and Methane gas cannot be excluded. It is therefore of vital importance that the duct seals used in such environments should have sufficient resistance against Chlorine and Methane gas.

Description of test:

The vital material used in Filoform's duct sealing system Filoseal+ is the special sealing compound MD+.

Firstly a 600 gram block was fully cured and prepared for the exposure test of Chlorine and Methane gas. 500 grams of the original block was sent to Nedlab (a certified laboratory in the Netherlands with the capability to arrange exposure to Chlorine and Methane gas) NedLab has cut the block in small pieces for the exposure tests.

Nedlab have exposed these blocks to Chlorine and Methane gas as follows:

- Concentration of Chlorine and Methane gas: 100%
- Relative humidity: Wet (100%)
- Temperature during exposure: 23°C and 90°C
- Duration of exposure: 168 hours (7 days)

After the test, the samples are visually inspected by NedLab and also by Filoform for comparing physical values with the original: Hardness, density, tensile strength and elongation at break.

Test results:

Chlorine

After exposure 7d 23°C & 7d 90°C of cured MD+, in a maximum concentration of Chlorine, in a wet environment, some changes on the surface were noticeable of the MD+,

- Colour change - Slight Discolouration
- Surface texture – Slight roughness

Volume – Slightly increased but density remains unaffected and stays within the pass value.

Hardness, density and elongation at break values are within the standard after exposure at room temperature.

After exposure 7d at 90°, hardness, density, elongation and break values are still respectable, see: Report MD+ Methane & Chlorine resistance.

Methane

After exposure 7d 23°C & 7d 90°C of cured MD+, in a maximum concentration of Methane, in a wet environment, some changes on the surface were noticeable,

- Colour change - Slight Discolouration
- Surface texture – Slightly smoother

Volume – Slightly increased but density remains unaffected and stays within the pass value.

Hardness, density and elongation at break values are within the standard after exposure at room temperature.

After exposure 7d at 90°, hardness, density, elongation and break values are still respectable, see: Report MD+ Methane & Chlorine resistance.

Conclusions:

MD + withstands long term exposure to Methane and Chlorine without loss of functionality.

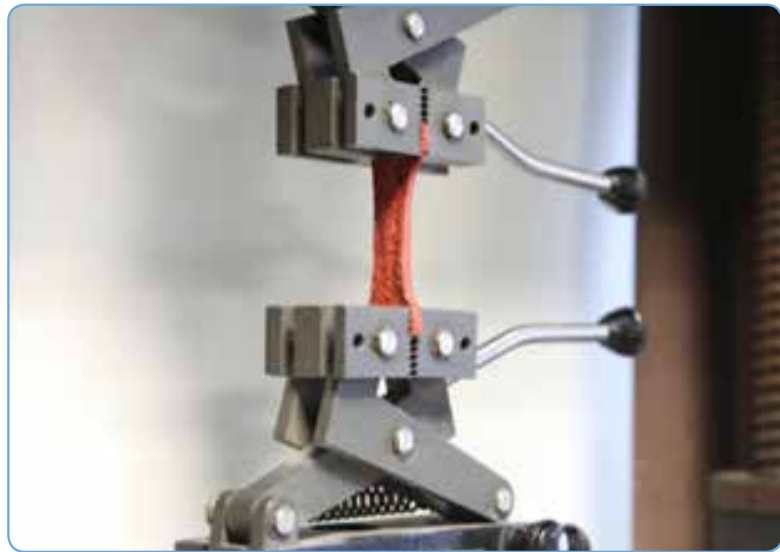
Test results table for resistance against Chlorine & Methane Gas:

		Norm	Measure - Original	Methane 7 days @ 23°C	Methane 7 days @ 90°C	Chlorine 7 days @ 23°C	Chlorine 7 days @ 90°C
Hardness	Shore A	30	29	27	21	26	23
Density	g/cm3	1.2	1.27	1.27	1.27	1.27	1.27
Elongation	%	100	220	217	248	229	176
Tensile Strength	N/mm2	0.8	0.82	0.71	0.55	0.81	0.53

Hardness Test



Tensile Strength & Elongation



Full test analysis can be seen of the MD+ from the NEDlab reports however they are in Dutch hence the outline and test results mentioned above. If you require to see the originals please contact your local office.

Additional Chemical resistances for MD+

Chemical	Rating	Chemical	Rating
Citric	1	Ammonium Hydroxide 10%	1
Hydrochloric 3%	1	Potassium Hydroxide	1
Phosphoric dilute	1	ASTM 10.1 Aliphatic 70hrs @ 300°F	1
Sulphuric 10%	1	Castor Oil 0.1	1
Nitric 7%	1	Diesel	2
Acetic	1	Linseed Oil	1
Anhydrous Ammonia	1	Mineral Oil	1
Sodium Chloride 10%	1	Silicon oil after 70Hrs @ 300°F	3
Hydrogen Peroxide 3%	1	Acetone	3
Sodium Carbonate 20%	1	Butyl Alcohol	1
Water	1	Jet fuel, JP4	2

Key: 1 = Excellent, 2 = Good (10-25% change), 3 = Fair (25-75% change), 4 = Poor (greater than 75% change), 5 = Complete fail

TEST REPORT**Subject: H2S (Hydrogen Sulphide) resistance**

From: Wim Ipenburg

Date: 28th July 2010

Ref.: MD+ used within FiloSeal+ HD

This report describes tests carried out at the Nedlab laboratory and at the Filoform laboratory in the Netherlands, to examine the H2S resistance of the sealing compound as used in Filoform duct sealing systems FiloSeal+ & FiloSeal+HD.

Background of this requirement is that in and around waste water treatment installations the presence of H2S gas cannot be excluded. It is therefore of vital importance that the duct seals used in such environments should have sufficient resistance against H2S.

Description of test:

Firstly, 6 blocks of each of cured material were prepared to enable exposure to H2S.

After full curing, the weight and dimensions of each block were carefully determined.

Three blocks of the material were sent to Nedlab (a certified laboratory in the Netherlands with the capability to arrange exposure to H2S).

Nedlab have exposed these blocks to H2S as follows:

- Concentration of H2S: 200 ppm
- Relative humidity: 95%
- Temperature during exposure: 40°C
- Duration of exposure: 120 hours (5 days)

The exposed blocks were then returned to Filoform's laboratory for further examination, which included:

- Visual inspection
- Determination of possible change of dimensions
- Determination of possible change of weight
- Determination of possible change of compression resistance
- Determination of tightness by comparing the water absorption between exposed and non exposed blocks

Summary of test results*

Description (before/after exposure)	MD+ Sealant	
	No change	PASSED
Visual Inspection	No change	PASSED
Change of dimensions	No change	PASSED
Change of weight	No change	PASSED
Change of shore hardness	No change	PASSED
Overall result		PASSED

Before exposure
to H2S



After exposure
to H2S



From: Wim Ipenburg

Date: 19 Feb 2016

Ref.: MD+ used within FiloSeal+ HD

This report describes tests carried out at the Filoform laboratory in the Netherlands, to examine the Hydro Carbon (Fuel) resistance of the sealing compound MD+ (as used in Filoform duct sealing systems FiloSeal+ & FiloSeal+HD).

Background of this requirement is that in and around petrol installations, the presence of Gasoline, Benzin, LPG, Ethanol, and Oils and AdBlue cannot be excluded. It is therefore of vital importance that seals used in such environments should have sufficient resistance against all these Hydro Carbons

Description of test:

The vital material, Filoform's special sealing compound MD+ has fully cured and left for 4 weeks before starting the tests as described below.

Firstly a 200 gram block was prepared for the tests.

The block was cut in 10 small pieces of ca 20 grams for the different exposure tests.

Filoform have exposed / fully immersed 2 blocks for 2 years in:

- Gasoline / Diesel: 100%
- Benzin: 100%
- ASTM Oil: 100%

Filoform have exposed / fully immersed 2 blocks for 6 weeks in:

- Ethanol: 100%
- AdBlue: 100% - 32.5% Urea (Air1)
- LPG is not tested yet, but silicon products are commonly used in LPG environments.

After the immersion period, the samples are visually inspected at first.

For comparing physical values with the original: hardness, density, tensile strength and elongation at break where measured.

All measured values are presented in the table on the following page.

Test results:

Gasoline

After exposure of 2 years at 23°C of cured MD+, in 100% concentration of Gasoline, changes of the MD+ are as follows,

- Colour change - No
- Surface texture – No remarkable change.
- Volume – No swelling

Hardness, density, elongation and strength - Values have very little change compared to the original values.

AdBlue

After exposure of 3 weeks at 23°C of cured MD+, in 100% concentration of AdBlue, no changes of the MD+ are noticed.

Benzene

After exposure of 2 years at 23°C of cured MD+, in 100% concentration of Benzin, changes of the MD+ are as follows,

- Colour change - No
- Surface texture – Slightly rougher on the surface
- Volume – No Swelling
- Hardness and Tensile strength - values are slightly decreased.

Density and Elongation - At break have very little change compared to the original values.

Ethanol

After exposure of 42d at 23°C of cured MD+, in 100% concentration of Ethanol, changes of the MD+ are as follows,

- Colour change - No
- Surface texture – No change
- Volume – No Swelling
- Hardness, density, elongation and tensile strength values have not changed

ASTM Oil

After exposure of 2 years at 23°C of cured MD+, in 100% concentration of Oil, changes of the MD+ are as follows,

- Colour change - No
- Surface texture – Slightly rougher on the surface
- Volume – No swelling
- Hardness and Tensile strength - Values are slightly decreased.

Density and Elongation - At break have very little change compared to the original values.

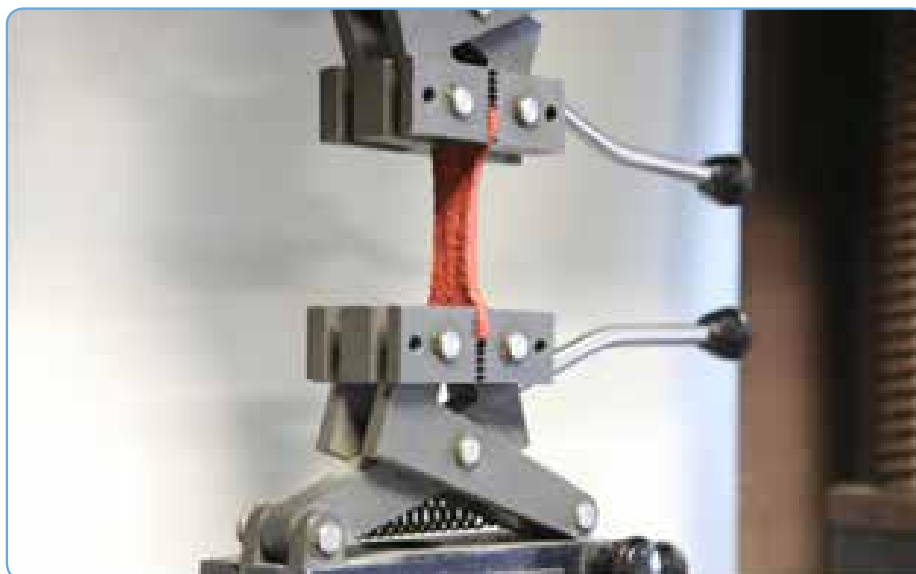
TEST REPORT

Subject: Hydro Carbon resistance on MD+

		Norm	Measure - Original	Gasoline 2 years @ 23°C	AdBlue 21 days @ 23°C	Benzin 2 years @ 23°C	Ethanol 42 days @ 23°C	ASTM Oil 2 years @ 23°C
Hardness	Shore A	30	29	30	30	22	30	26
Density	g/cm ³	1.2	1.27	1.27	1.27	1.26	1.27	1.27
Elongation	%	100	150	140	150	140	150	160
Tensile Strength	N/mm ²	0.8	0.77	0.69	0.77	0.53	0.77	0.59

Conclusions:

MD + withstands long term exposure to Hydro Carbons, such as used in petrol stations, without disintegration or loss of functionality.



From: Wim Ipenburg
 Date: 03rd March 2016
 Ref.: FiloSeal+HD

FINAL CONCLUSION

MD+ has been heavily tested against pressure, pulling forces, chemicals, gases, hydrocarbons, in conjunction with using FiloSeal+HD which uses the hexagonal backing system to support and separate the cables.

From all the tests Filoform have performed, we suggest this product can be used in every business sector where sealing cable ducts is a requirement.

Below I have summarised all the results from all the tests in this report.

Test Description	Measurement	Result	Pass or Fail
Pressure	2.0 Bar	1.0 bar long term, 2 Bar short term	PASSED
Pulling Force	100kg	100kg – 1000 newtons	PASSED
Bend Test	10xd at 45°	10xd at 45°, with 1 bar pressure	PASSED
Chlorine Gas	100% for 7 days	Slight change on colour and texture	PASSED
Methane Gas	100% for 7 days	Slight change on colour and texture	PASSED
Diesel	100% for 2 years	Hardly any change	PASSED
Petrol / Benzene	100% for 2 years	Hardly any change	PASSED
Ethanol	100% for 42 days	Hardly any change	PASSED
AD Blue	100% for 21 days	No Change	PASSED
ASTM Oil	100% for 2 years	Hardly any change	PASSED
Hydrogen Sulphide (H ₂ S)	200ppm for 5 days	Hardly any change	PASSED

The test results given in this report have been done in accordance with our installation instructions, however values achieved in field installations may vary if the instructions are not followed, and results may vary depending on cable and duct tolerances such as size, material, and volume.

Name: Wim Ipenburg

Position: R&D manager

Date: 03rd March 2016

Signature: *Wim Ipenburg*