

TEST DE LABORATORIO



AQUAFIB
Water and Air Filter Technology

Analytik Aurachtal GmbH • Wirtshöhe 6 • 91086 Aurachtal

Kuenzel awt GmbH
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95213 Münchberg

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Laboratory report: Analysis of filter materials

Lab ID:	E504968a	Date of order:	10.04.2015
Person in charge:	Christian Schad	Date of receipt:	13.04.2015
Period of investigation:	13.04.2015 – 30.04.2015	Purchase order:	Hr. Künzel

Sample description:

E504968-1: Filter material, polymer fibre from competitor
E504968-2: Filter material, PureFlow (Company Künzel)
E504968-3: Filter material, sand (filter sand)

Analysis description:

Analytik Aurachtal was ordered to investigate the filter materials and perform a storage test in chlorinated water.

Storage test conditions:

In order to test the resistance of the filter materials against chlorinated water, extreme conditions were chosen which may occur during a disinfection process of a microbial contaminated plants with increased temperature and chlorine content. Those conditions represent the exposure of filter material by chlorination of swimming water during one year.

Duration [days]	7	Active chlorine [mg/l]	100
Temperature [°C]:	70	pH area:	6,5 – 7,5

Sample	Weight of sample [g]	Chlorine test solution [g]
Fibre from competitor	19,23	996,83
PureFlow fibre	34,07	999,6
Filter sand	1058,44	481,98

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Handelsregister-Nr.: HRB 13281



Geschäftsführer:
Dr. Thomas Winkler, Dipl. Chem.
Christian Schad, Dipl.-Ing. (FH)
Dr. Thomas Furst, Dipl. Chem.

Devices and methods:

Device	Supplier / Type	Method/Standard
Digital camera	Canon SLR EOS D 20, 60mm macro lens	-
Digital microscope:	Keyence VHX 700 (with several filters, lenses and light supplies)	-
SEM:	Jeol JSM 6490 LA Analytical Scanning Electron Microscope / Low vacuum option)	a AHV790001aur, 2009-02
EDS:	EDAX (Detectible elements: boron to uranium)	-
XRF:	Shimadzu EDX-700-HS (Detectible elements: sodium to uranium)	a AHV731701aur, 2006-04
GCMS-TDS ¹ :	Agilent GC6890 ⁺ /MS 5973N; Column: optima 5 MS, 30m	a AHV770050aur, 2006-08
	MS-Detektor, Full-Scan-Mode (Masses 33-650), TDS2 / KAS4 Gerstel (direct, splitless)	

¹: Annotation: Identification of substances is done by comparison to library spectra. The plausibility rate is > 90% in most cases. Quantification is done by n-hexadecane equivalents. Thus, all quantitative values have to be understood as hexadecane equivalents.

Summary:

Documentation of fibres: The fibres of the competitor product show a diameter between 20 µm and 70 µm in the light microscope and scanning electron microscope.

At high magnification, the scanning electron microscope pictures show bright contrasting particles on the fibres (see pic. 1i). The EDS spectrum of the particles shows a significant phosphor signal besides the signals deriving from the polyester fibres (carbon and oxygen). With utmost probability the origin of the phosphor signals is an inorganic flame retardant made of red phosphor on the fibres. The elemental screening of the fibres also shows a certain phosphor content (see table 1).

The diameter of PureFlow fibres varies between 30 µm and 60 µm, most fibres show a diameter of 40 µm. Neither the scanning electron microscope pictures nor the EDS/XRF analysis show indications of a flame retardant based on inorganic substances in the PureFlow fibre material.

Table 1: Elemental screening of filter materials

	E504968 - 1 (competitor fibre)	E504968 - 2 (PureFlow fibre)
Ti (Titanium)	0,03	0,02
P (Phosphor)	0,01	-
Ca (Calcium)	< 0,01	-
Zr (Zirkonium)	< 0,01	-
Si (Silicium)	-	0,06
Matrix (plastic / polyester)	99,96	99,92

Outgassing potential of filter materials in original condition: The analysis of the original filter material by gas chromatography after thermodesorption at 90°C shows a very low amount of outgassing substances at the PureFlow fibres (see chromatogram 2).

The competitor's product evaporates tributyl acetyl citrate; this substance is commonly used as a plasticiser. In low amounts, fatty acid amides were detected (e. g. used as release and anti-seize agent). In traces, benzothiazole was detected. This substance is used as a biocide.

The outgassing potential of the PureFlow material is extremely low. In traces, plasticizers based on phthalic acid esters and some aliphatic hydrocarbons were detected.

Analysis of chlorinated solutions after storage test of filter materials :

In all water samples, trichloromethane was detected, which is formed from the chlorination solution in presence of organic material.

In the water from the PureFlow storage, traces of a terpene were detected. This substance may have intruded from the ambient air into the water during sample preparation.

The water of the sand storage contains also a brominated derivate of trichloromethane. In traces, a stabilizer and a plasticiser based on phthalic acid esters was detected. The fact, that this sample also contains a terpene and a polyamide decomposition product leads to the assumption that those substances may have intruded from a foreign source (e. g. ambient air or bottle cap of storage container).

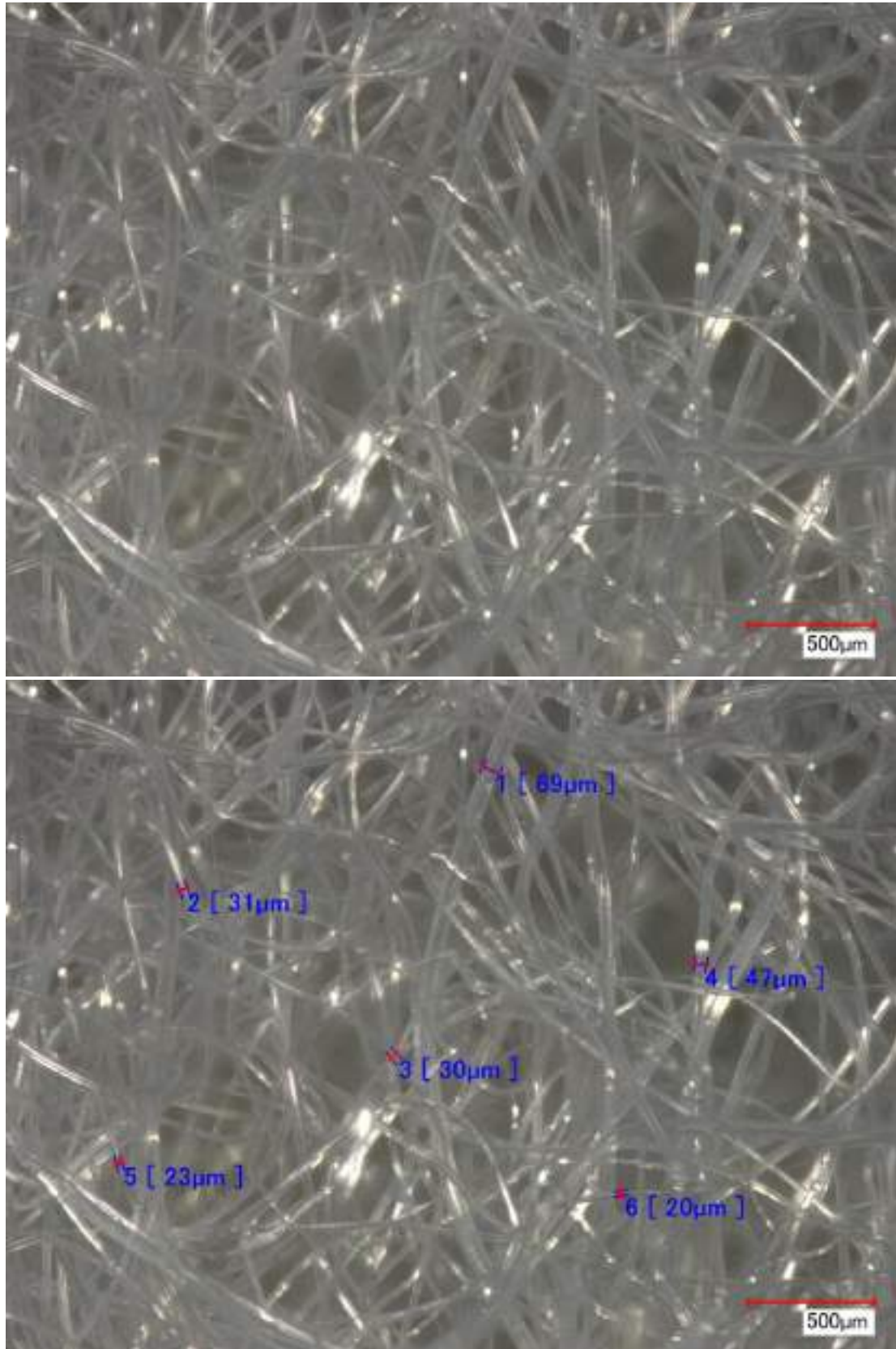
Conclusion The storage of PureFlow in chlorinated water under extreme conditions does not indicate the decomposition of the filter material. No harmful substances are eluted from the filter material. The usage in water treatment plants with disinfection by chlorination should be possible.
The PureFlow material evaporates no substances that may have negative health effects.

With best regards

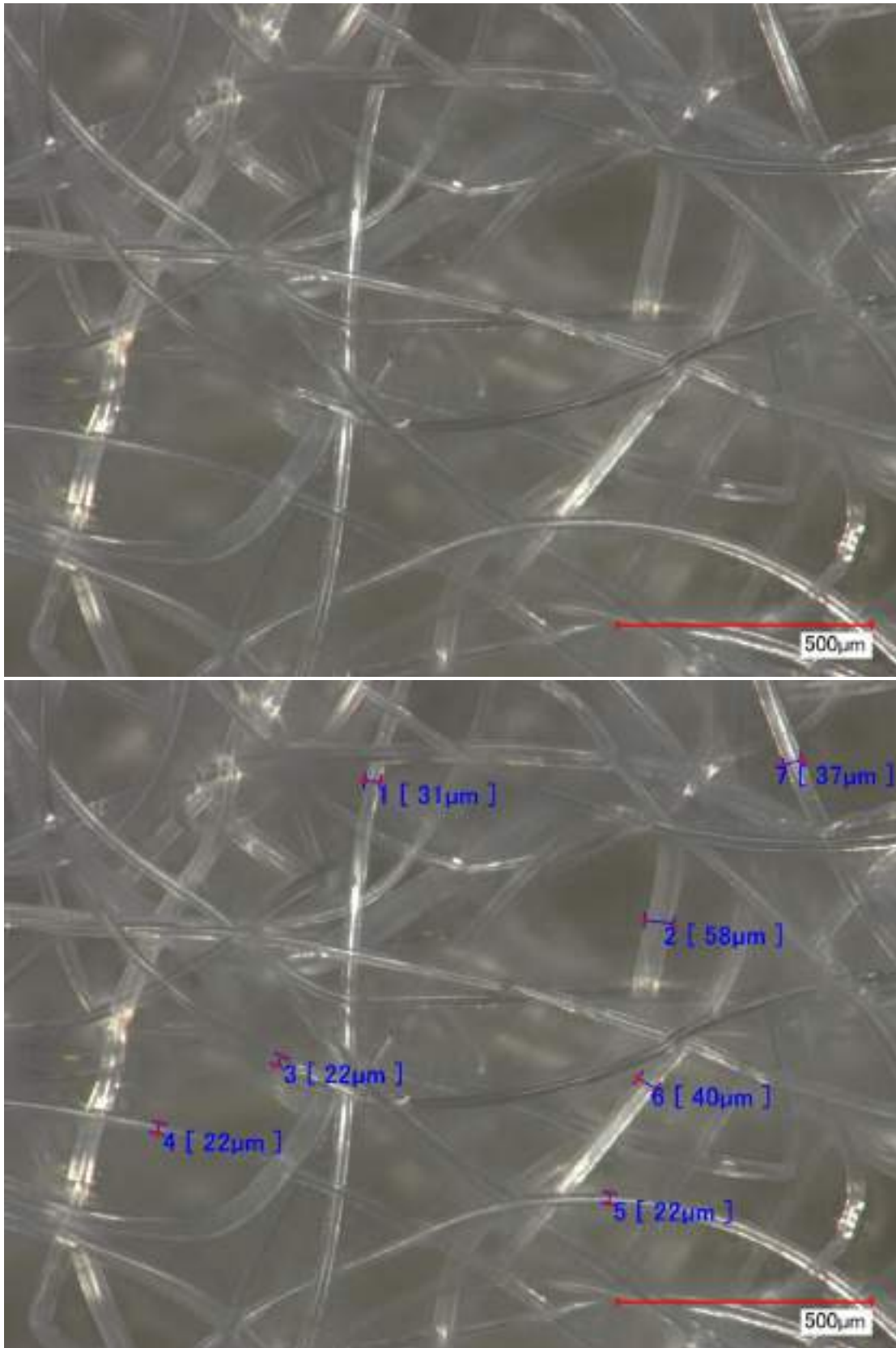


Christian Schad
(Dipl.-Ing.; FGL physikalische Chemie)

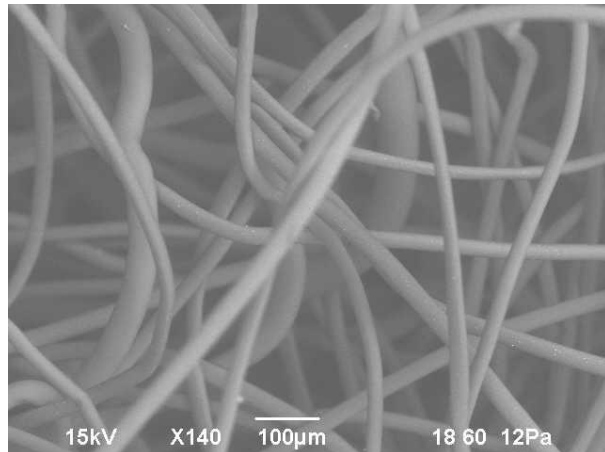
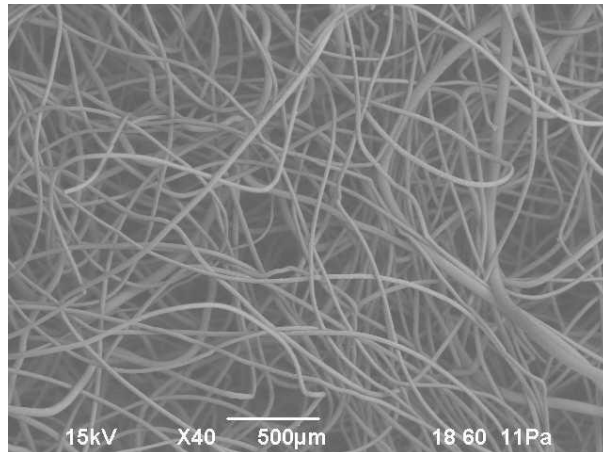
pic. 1a+b: competitor's fibre at 100x magnification in the digital microscope (3Dpicture)



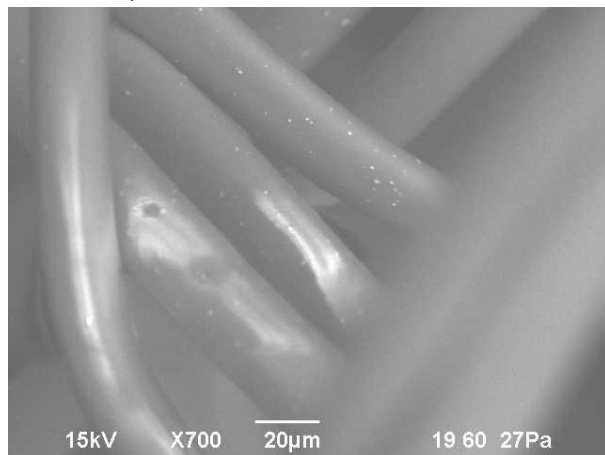
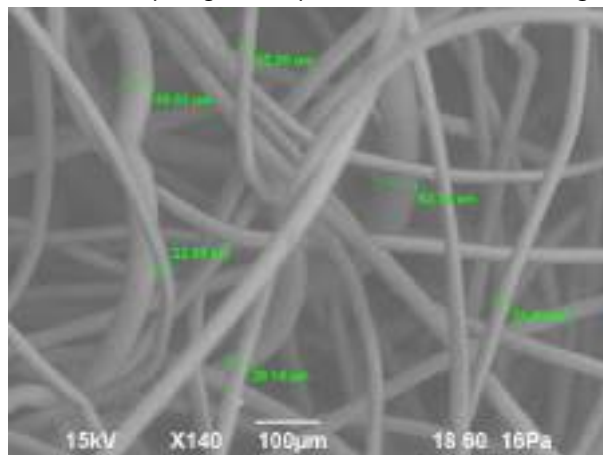
pic. 1c+d: competitor's fibre at 200x magnification in the digital microscope (3Dpicture)



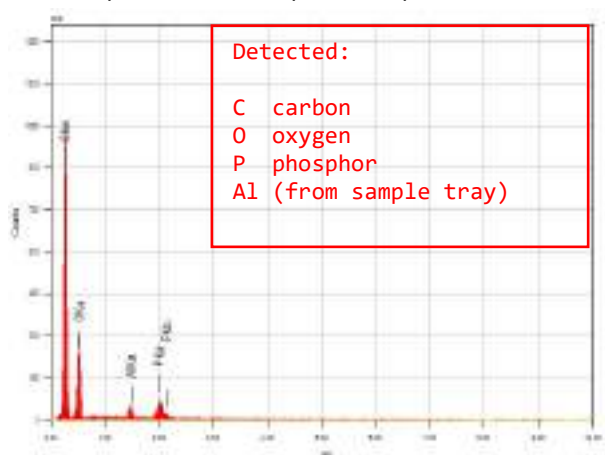
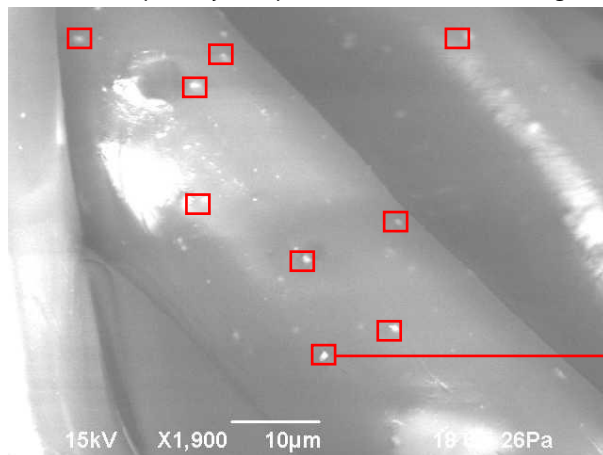
pic. 1e+f: competitor's fibre in the scanning electron microscope (40x and 140x)



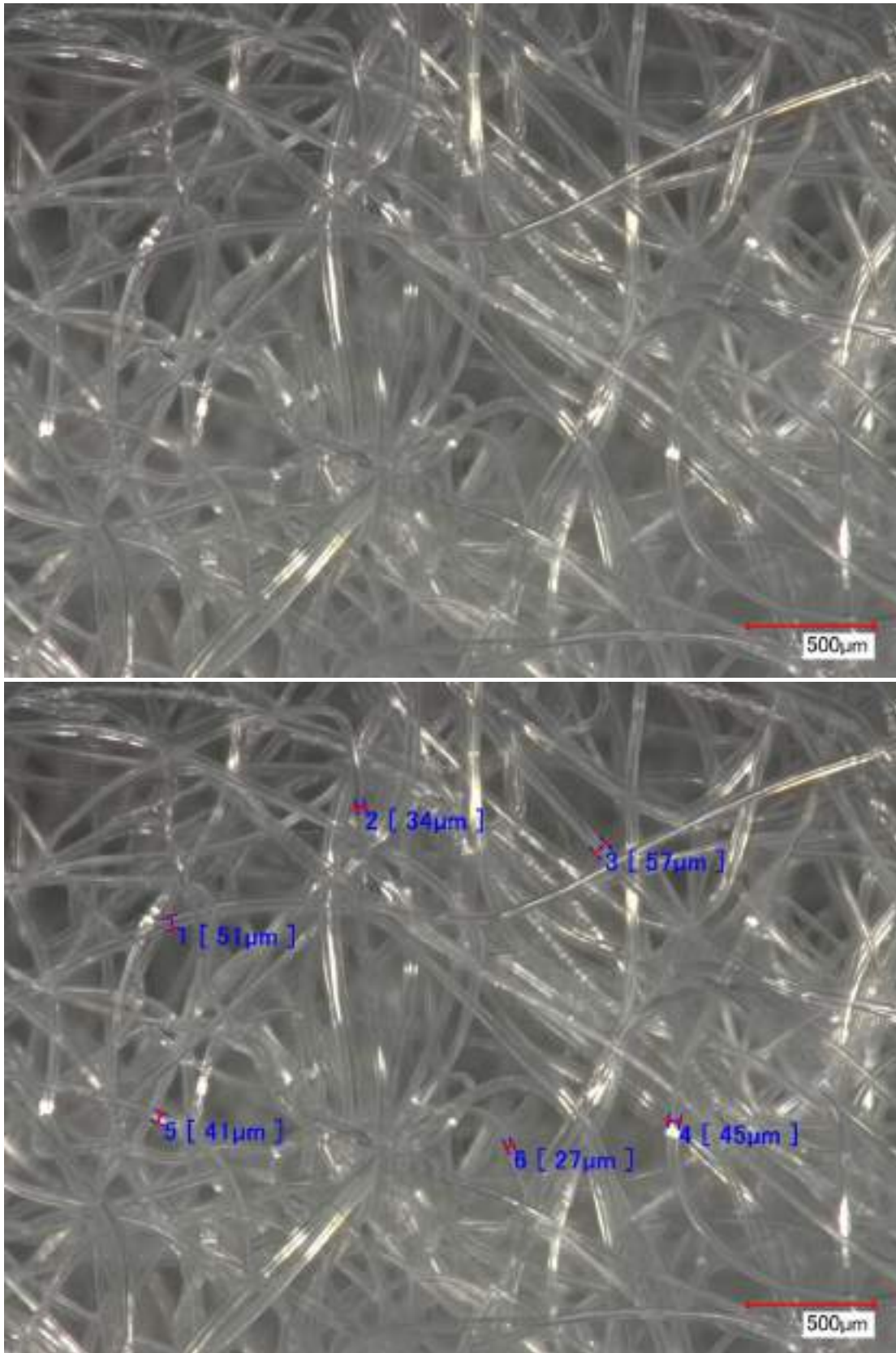
pic. 1g+h: competitor's fibre in the scanning electron microscope (140x with dimensions and 700x)



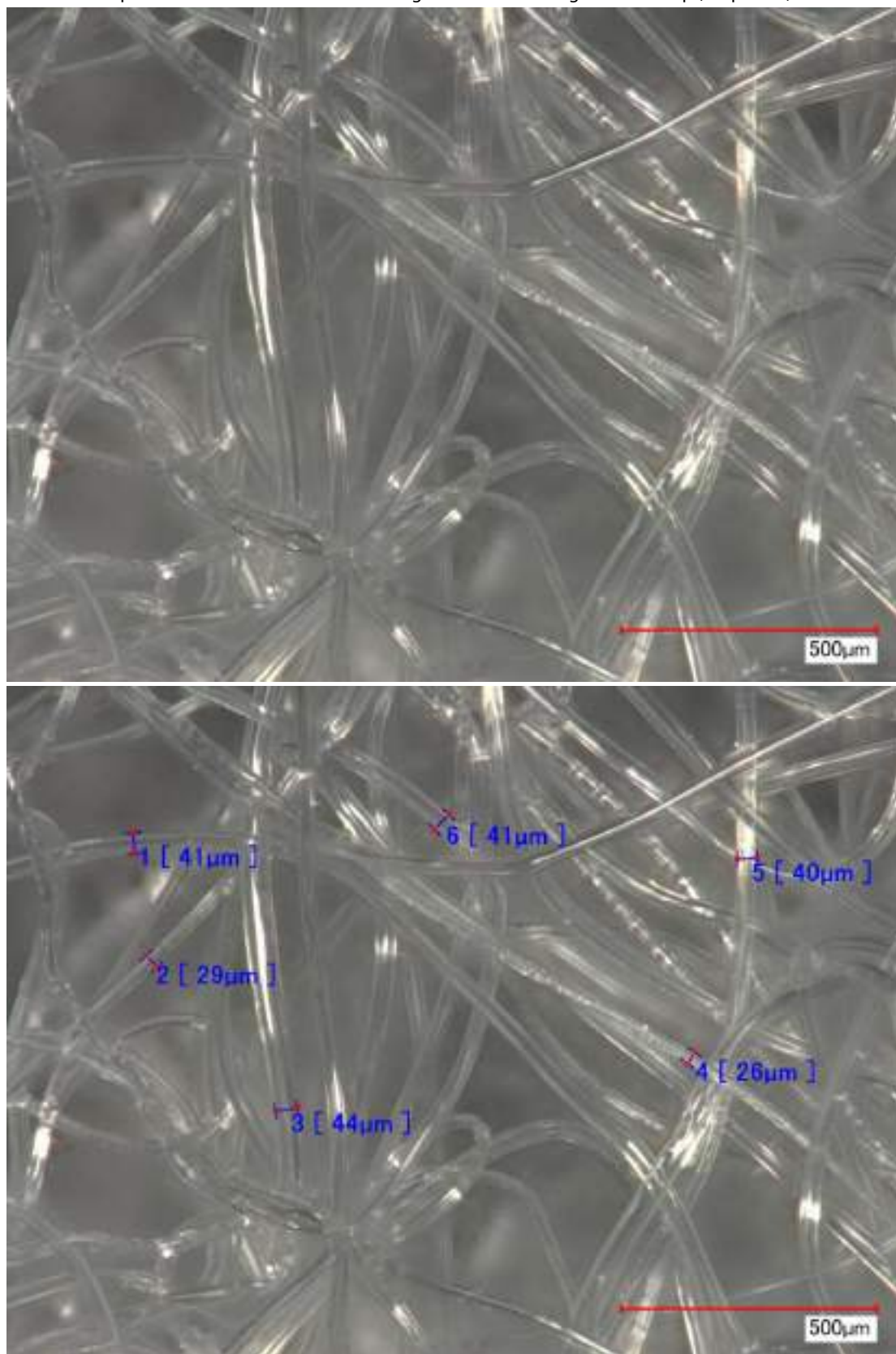
pic. 1i+j: competitor's fibre in the scanning electron microscope (1900x) and EDS spectrum of particle



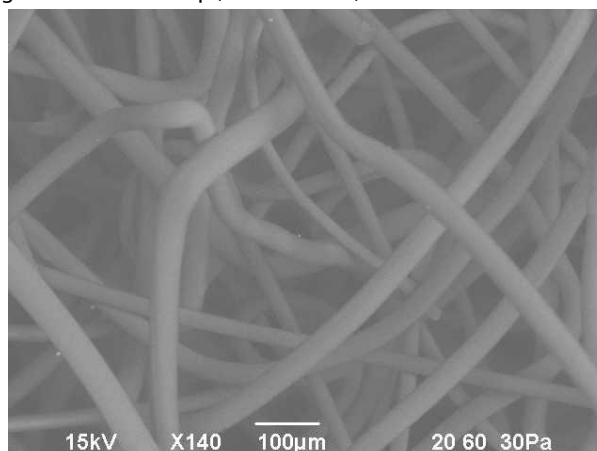
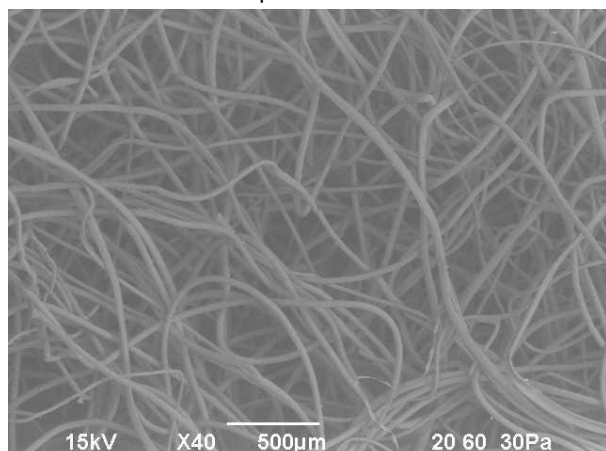
pic. 2a+b: PureFlow fibre at 100x magnification in the digital microscope(3D-picture)



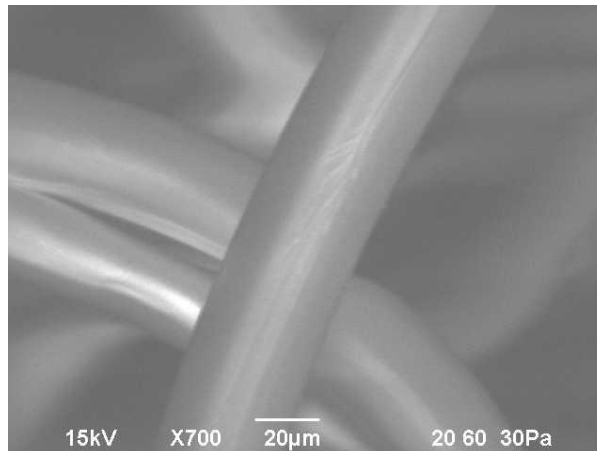
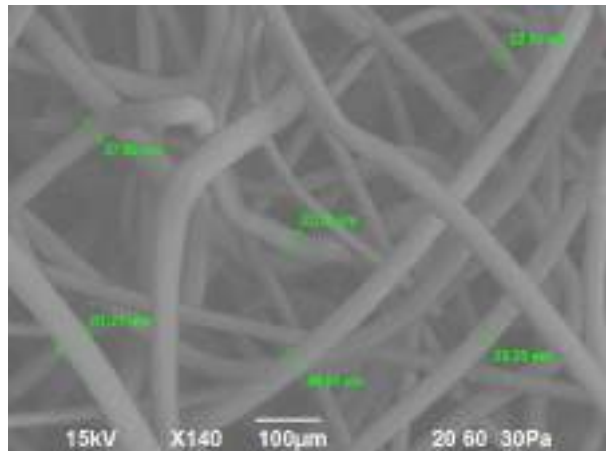
pic. 2c+d: PureFlow fibre at 200x magnification in the digital microscope (3D-picture)



pic. 2e+f: PureFlow fibre in the scanning electron microscope (40x and 140x)

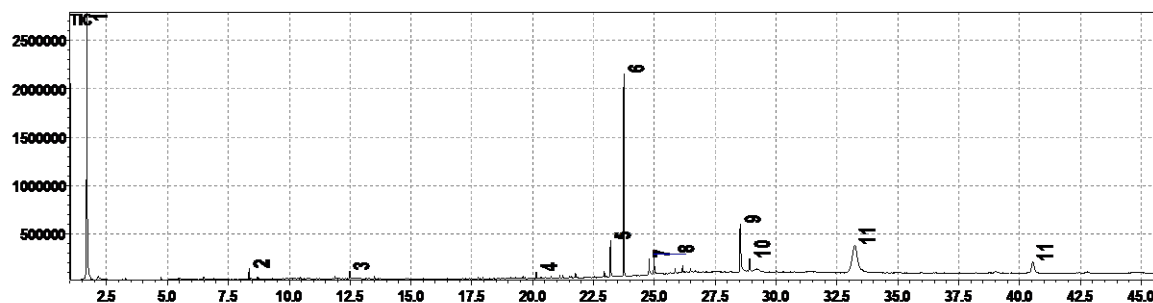


pic. 2g+h: PureFlow fibre in the scanning electron microscope (140x with dimensions and 700x)



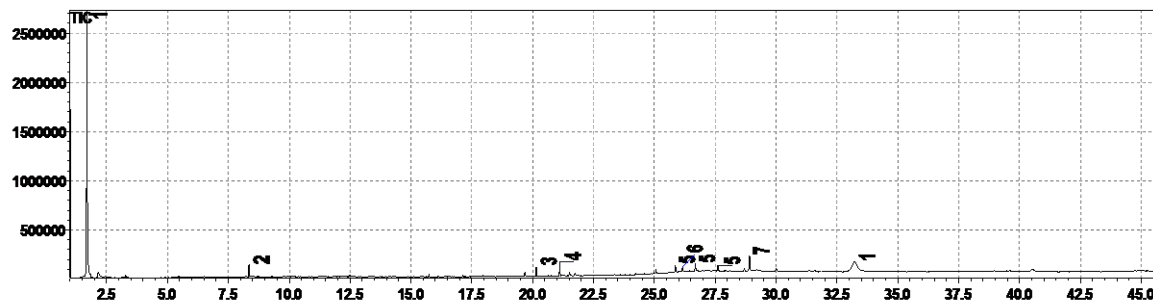
GCMS/TDS: Filter materials in original condition

Chromatogram 1:	E504968-1	Date of analysis:	26. 04. 2015
Weight:	18,1 mg	Extraction:	10 minutes at 90°C
Description:	Fibre from competitor		



Peak:	1	caused by analytical system		
	2	cyclic siloxane	1,2	mg/kg
	3	Benzothiazole (95-16-9)	1,1	mg/kg
	4	Diisobutyl phthalate (84-69-5)	0,7	mg/kg
	5	Palmitic acid amide (629-54-9)	4,3	mg/kg
	6	Tributyl acetyl citrate (77-90-7)	25,0	mg/kg
	7	Oleic acid amide (301-02-0)	1,8	mg/kg
	8	Stearic acid amide (124-26-5)	2,9	mg/kg
	9	Erucyl amide (112-84-5)	10,4	mg/kg
	10	Squalene (111-04-2)	2,3	mg/kg
		Sum of desorbed organic substances	49,8	mg/kg

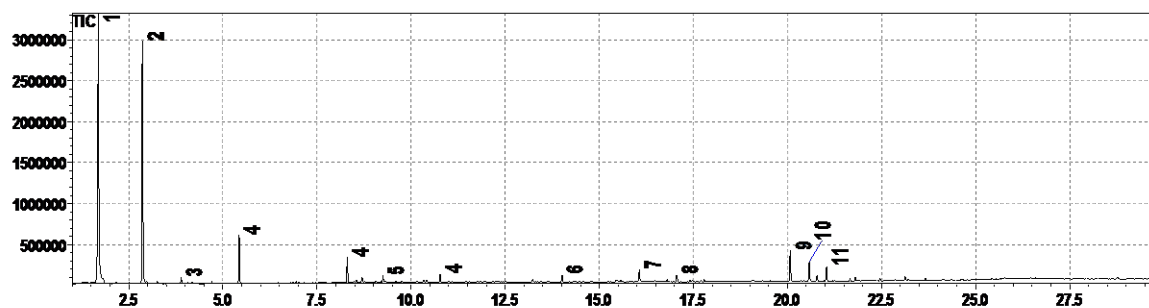
Chromatogram 2:	E504968-2	Date of analysis:	26. 04 2015
Weight:	18,1 mg	Extraction:	10 minutes at 90°C
Description:	PureFlow		



Peak:	1	caused by analytical system		
	2	cyclic siloxane	0,8	mg/kg
	3	Diisobutyl phthalate (84-69-5)	0,6	mg/kg
	4	Dibutyl phthalate (84-74-2)	1,0	mg/kg
	5	Sum n-alkanes	1,8	mg/kg
	6	Bis(2-Ethylhexyl) phthalate (117-81-7)	0,3	mg/kg
	7	Squalene (111-04-2)	1,8	mg/kg
		Sum of desorbed organic substances	6,4	mg/kg

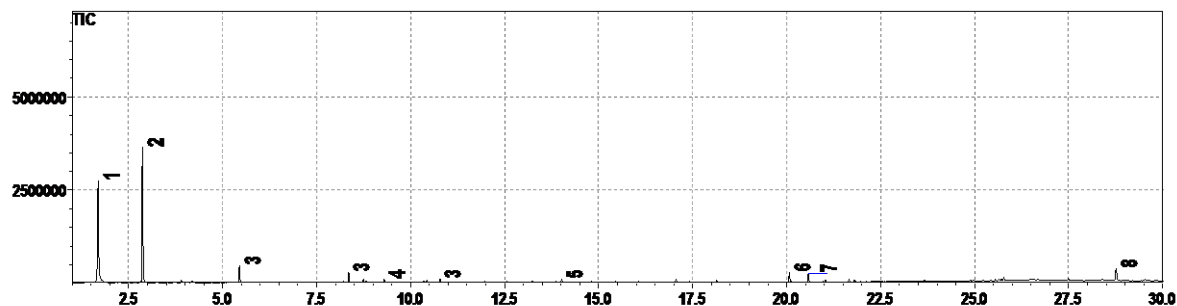
GCMS/TDS: water samples from storage test under extreme conditions

Chromatogram 1a:	E504968-1a	Date of analysis:	29. 04. 2015
Weight:	10 mL extract	Extraction:	10 minutes at 250°C
Description:	Water from storage test with competitor's fibre		



Peak:	1	caused by analytical system
	2	Trichloromethane (67-66-3)
	3	caused by analytical system (Sum cyclic siloxanes)
	4	caused by analytical system (Alkane, also present in blank water sample)
	5	caused by analytical system (Limonene (5989-27-5) from ambient air)
	6	caused by analytical system (TXIB (6848-50-0), also present in blank water sample)
	7	caused by analytical system (Diisobutyl phthalate (84-69-5), also present in blank water sample)

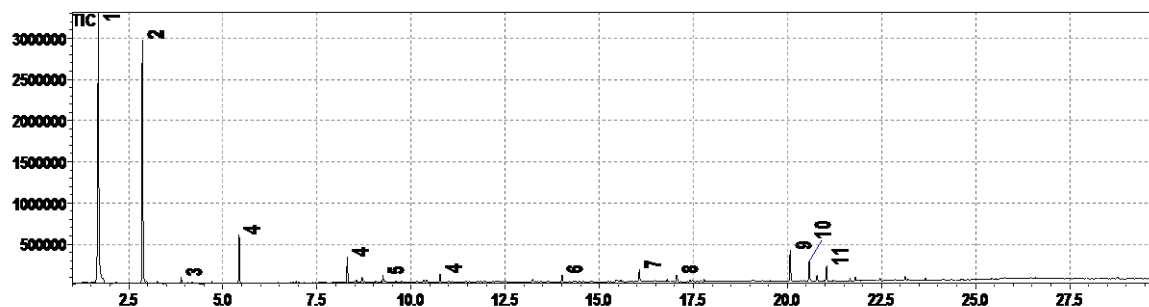
Chromatogram 2a:	E504968-2a	Date of analysis:	29. 04. 2015
Weight:	10 mL extract	Extraction:	10 minutes at 250°C
Description:	Water from storage test with PureFlow		



- Peak:
- 1 caused by analytical system
 - 2 Trichloromethane (67-66-3)
 - 3 caused by analytical system (Sum cyclic siloxanes)
 - 4 caused by analytical system (D-Limonene (5989-27-5) from ambient air)
 - 5 nicht näher identifizierbares Terpen (maybe from ambient air)
 - 6 caused by analytical system (Diisobutyl phthalate (84-69-5), also present in blank water sample)
 - 7 caused by analytical system (also present in blank water sample)
 - 8* Squalene (111-04-2)

* typical part of human hand sweat, contamination by packaging or sample preparation possible

Chromatogram 3a:	E504968-3a	Date of analysis:	29. 04. 2015
Weight:	10 mL extract	Extraction:	10 minutes at 250°C
Description:	Water from storage test with filter sand		



Peak:	1	caused by analytical system
	2	Trichloromethane (67-66-3)
	3	Dichlorobromomethane (75-27-4)
	4	caused by analytical system (cyclic siloxanes from SBSE medium)
	5	caused by analytical system (D-Limonene (5989-27-5) from ambient air)
	6	not identifiable terpene
	7	2,4-Di-tert-butylphenole (96-76-4)
	8	caused by analytical system (TXIB (6846-50-0), also present in blank water sample)
	9	caused by analytical system (Diisobutyl phthalate (84-69-5), also present in blank water sample)
	10	7,9-Di-tert-butyl-1-oxaspiro[4.5]deca-6,9-diene-2,8-dione (82304-66-3)
	11	Dibutyl phthalate (84-74-2)



Contacto

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