

# **LS RESEARCH**

## ***REACH Chemical Analysis***

### ***TiWi-BLE & TiWi-R2***



Last updated  
February 11, 2016

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## 1 General Information

### 1.1 Summary

The test results below show that the TiWi-R2 and TiWi-BLE do not contain any of the 151 chemicals that are classified by REACH as Substances of Very High Concern (SVHC).

### 1.2 Date of Test

December 5<sup>th</sup>, 2013.

### 1.3 Test Laboratory

The chemical testing was completed by Integrated Service Technology (IST), an independent accredited laboratory.

### 1.4 Description of Sample

This testing was performed on LSR part number 450-0064, TiWi-BLE Module. This testing also applies to the 450-0037 TiWi-R2 module as the *only difference* between the two devices is the software on the core radio IC.

### 1.5 Definitions

MDL = Method Detection Limit.

mg/kg = ppm.

N.D. = Not Detected. (The result is below the MDL.)

Negative = Undetectable.

GC-MS = Gas Chromatograph-Mass Spectrometer.

GC-MS/MS = Gas Chromatograph-tandem mass spectrometer.

GC-FID = Gas Chromatograph-flame ionization detector.

LC-MS/MS = Liquid Chromatograph-tandem mass spectrometer.

OM = Optical Microscope .

XRF = X-ray Fluorescence Spectrometer

FTIR = Fourier-Transform Infrared Spectrometer

ICP-OES = Inductively Coupled Plasma-Optical Emission Spectrometer.

UV-VIS = Ultraviolet-Visible Spectrophotometer.

## 1.6 Revision History

Date	ECN	Change Description	Revision
10/29/2013	117-2013	Initial Release	1.0
12/06/2013	124-2013	Updated to 151 chemicals	2.0

Table 1 Revision History

## 1.7 Measurement Flow Chart

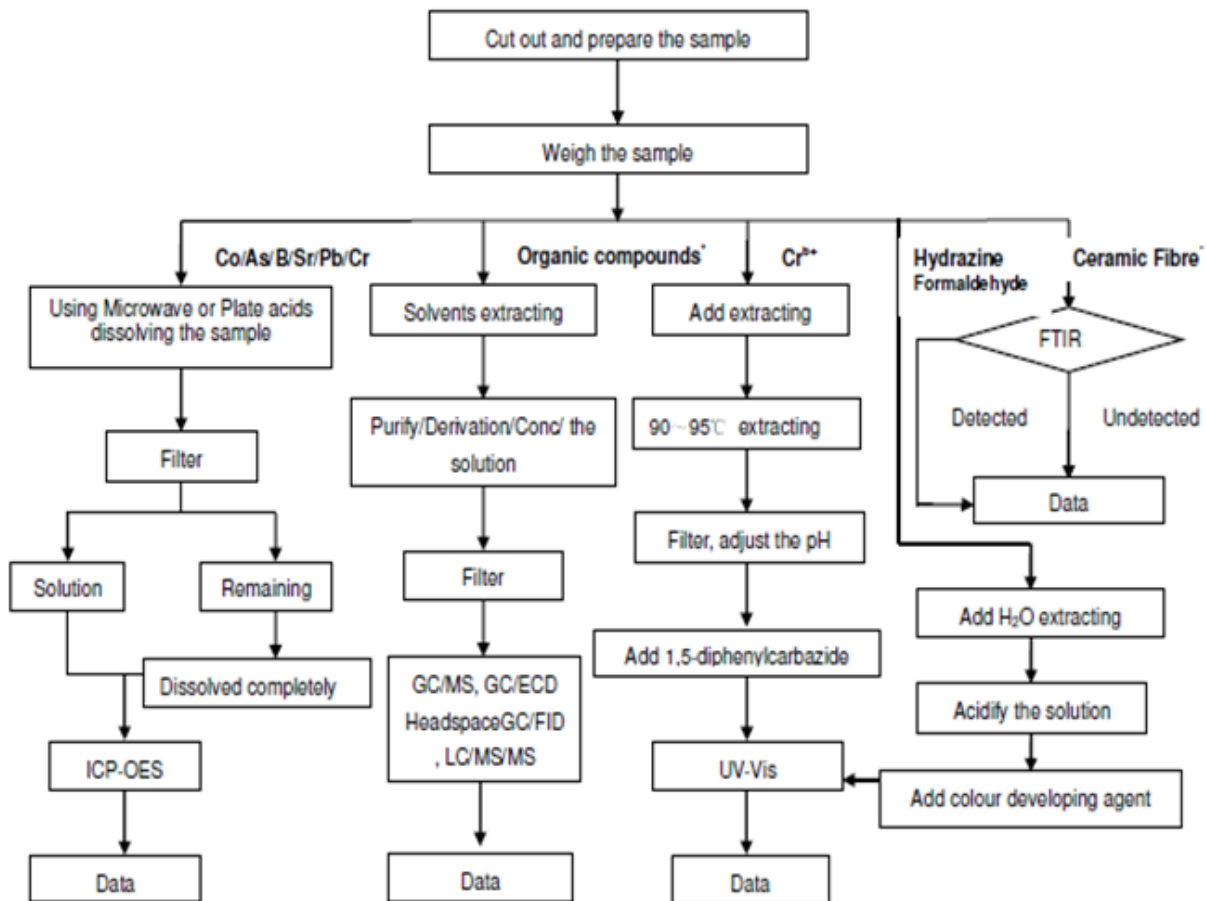


Figure 1

## 2 Chemical Analysis Results

Test Item(s)	Method	Instrument	Unit	MDL	Result
Dibutyl phthalate (DBP) (CAS NO. : 84-74-2)	Reference : US EPA 3550C:2007	GC-MS-MS	mg/kg	8	N.D.
Benzyl butyl phthalate (BBP) (CAS NO. : 85-68-7)				4	N.D.
Bis (2-ethylhexyl) phthalate (DEHP) (CAS NO. : 117-81-7)				10	N.D.
5-tert-butyl-2,4,6-trinitro- m- Xylene (Musk xylene) (CAS NO. : 000081-15-2) (CAS NO. : 81-15-2)				6	N.D.
Anthracene (CAS NO. : 120-12-7)				2	N.D.
4,4'-Diaminodiphenylmethane (MDA) (CAS NO. : 101-77-9)				5	N.D.
Hexabromocyclododecane (HBCDD)and all major diastereoisomers identified(-HBCDD,-HBCDD and -HBCDD) (CAS NO. : 25637-99-4 and 3194-55-6 (134237-50-6, 134237-51-7 and 134237-52-9))	Reference : US EPA 3550C:2007	LC-MS-MS	mg/kg	5	N.D.
Alkanes, C <sub>10-13</sub> , chloro (Short chain chlorinated paraffins) (CAS NO. : 85535-84-8)	Reference : US EPA 3550C:2007	GC-MS-MS	mg/kg	10	N.D.
Bis(tributyltin)oxide (TBTO) (CAS NO.: 56-35-9)				8	N.D.
Cobalt dichloride (CAS NO. : 7646-79-9)	Reference : US EPA 3052:1996	ICP-OES	mg/kg	3	N.D.
Diarsenicpentaoxide (CAS NO. : 1303-28-2)				8	N.D.
Diarsenic trioxide (CAS NO. : 1327-53-3)				8	N.D.
Triethyl arsenate (CAS NO. : 15606-95-8)				8	N.D.
Lead hydrogen arsenate (CAS NO. : 7784-40-9)				8	N.D.
Sodium dichromate (CAS NO. : 10588-01-9)	Reference: US EPA 3052:1996/ IEC 62321	ICP-OES UV-VIS	mg/kg	2	N.D.

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Test Item(s)	Method	Instrument	Unit	MDL	Result
2,4-Dinitrotoluene (2,4-DNT) (CAS NO. : 121-14-2)	Reference: US EPA 3550C:2007	GC-MS-MS	mg/kg	6	N.D.
Diisobutylphthalate (DIBP) (CAS NO. : 84-69-5)				8	N.D.
Tris(2-chloroethyl)phosphate (TCEP) (CAS NO. : 115-96-8)				4	N.D.
Acrylamide (CAS NO. : 79-06-1)	Reference: US EPA 3550C:2007	LC-MS-MS	mg/kg	10	N.D.
Anthracene oil (CAS NO. : 90640-80-5)	Reference: US EPA 3550C:2007	GC-MS-MS	mg/kg	3	N.D.
Anthracene oil, anthracene paste, distn. lights (CAS NO. : 91995-17-4)				3	N.D.
Anthracene oil, anthracene paste, anthracene fraction (CAS NO. : 91995-15-2)				3	N.D.
Anthracene oil, anthracene-low (CAS NO. : 90640-82-7)				3	N.D.
Anthracene oil, anthracene paste (CAS NO.: 90640-81-6)				3	N.D.
Coal tar pitch, high temperature (CAS NO. : 65996-93-2)				3	N.D.
Aluminosilicate, Refractory Ceramic Fibres (CAS NO. : -- )				-	OM,XRF
Zirconia Aluminosilicate, Refractory Ceramic Fibres (CAS NO. : --)	-	-	Negative		
Lead chromate (CAS NO. : 7758-97-6)	Reference: US EPA 3052:1996/ IEC 62321	ICP-OES UV- VIS	mg/kg	2	N.D.
Lead sulfochromate yellow (C.I. Pigment Yellow 34) (CAS NO. : 1344-37-2)				2	N.D.
Lead chromate molybdate sulfate red (C.I. Pigment Red 104) (CAS NO. : 12656-85-8)				2	N.D.

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Test Item(s)	Method	Instrument	Unit	MDL	Result
Trichloroethylene (CAS No.: 79-01-6)	-	XRF FTIR	-	-	Negative
Boric acid (CAS No.: 10043-35-3, 11113-50-1)	Reference: US EPA 3052	ICP-OES	%	0.0008	N.D
Disodium tetraborate, anhydrous (CAS No.: 1330-43-4, 12179-04-3, 1303-96-4)				0.0008	N.D
Tetraboron disodium heptaoxide, hydrate (CAS No.: 12267-73-1)				0.0008	N.D
Sodium chromate (CAS No.: 7775-11-3)	Reference: US EPA 3052:1996/ IEC 62321	ICP-OES UV-VIS	mg/kg	2	N.D.
Potassium chromate (CAS No.: 7789-00-6)				2	N.D.
Ammonium dichromate (CAS No.: 7789-09-5)				2	N.D.
Potassium dichromate (CAS No.: 7778-50-9)				2	N.D.

Test Item(s)	Method	Instrument	Unit	MDL	Result
2-Methoxyethanol (CAS No.: 109-86-4)	Reference: US EPA 3550C:2007	GC-FID	mg/kg	3	N.D.
2-Ethoxyethanol (CAS No.: 110-80-5)				3	N.D.
Cobalt(II) dinitrate (CAS No.: 10141-05-6)	Reference: US EPA 3052:1996	ICP-OES	mg/kg	3	N.D.
Cobalt(II) sulphate (CAS No.: 10124-43-3)				3	N.D.
Cobalt(II) carbonate (CAS No.: 513-79-1)				3	N.D.
Cobalt(II) diacetate (CAS No.: 71-48-7)				3	N.D.
Chromium trioxide (CAS No.: 1333-82-0)	Reference: US EPA 3052:1996/ IEC 62321	ICP-OES UV-Vis	mg/kg	2	N.D.
Acids generate from Chromium trioxide and their oligomers; Group contains: Chromic acid, Dichromic acid, Oligomers of chromic acid and dichromic acid (CAS No.: 7738-94-5 and 13530-68-2)				2	N.D.



Test Item(s)	Method	Instrument	Unit	MDL	Result
1,2-Benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich (CAS NO. : 71888-89-6)	Reference: US EPA 3550C:2007	GC-MS-MS	mg/kg	5	N.D.
Hydrazine (CAS NO. : 7803-57-8 302-01-2)	Reference: US EPA 3550C:2007	GC-FID	mg/kg	3	N.D.
2-ethoxyethyl acetate (CAS NO. :111-15-9)				5	N.D.
1,2,3-trichloropropane (CAS NO. : 96-18-4)				7	N.D.
1-methyl-2-pyrrolidone (CAS NO. : 872-50-4)				7	N.D.
strontium chromate (CAS NO. : 7789-06-2)	Reference: US EPA 3052:1996/ IEC 62321	ICP-OES UV-Vis	mg/kg	2	N.D.
1,2-Benzenedicarboxylic acid, di-C7-11-branched and linear alkyl esters (CAS NO. :68515-42-4)	Reference: US EPA 3540C	GC-MS	mg/kg	5	N.D.

Test Item(s)	Method	Instrument	Unit	MDL	Result
Lead dipicrate (CAS NO. :6477-64-1)	Reference: US EPA 3052:1996	ICP-OES	mg/kg	5	N.D.
Lead styphnate (CAS NO. :15245-44-0)				5	N.D.
Lead azide Lead diazide (CAS NO. : 13424-46-9)				5	N.D.
Phenolphthalein (CAS NO. :77-09-8)	Reference: US EPA 3550C:2007	LC-MS/MS	mg/kg	10	N.D.
2,2'-dichloro-4,4'-methylene dianiline (CAS NO. :101-14-4)				10	N.D.
N,N-dimethylacetamide (DMAC) (CAS NO. :127-19-5)	Reference: US EPA 3550C:2007	GC/FID	mg/kg	5	N.D.
Trileaddiarsenate (CAS NO. :3687-31-8)	Reference: US EPA 3052:1996	ICP-OES	mg/kg	8	N.D.
Calcium arsenate (CAS NO. : 7778-44-1)				8	N.D.
Arsenic acid (CAS NO. : 7778-39-4)				8	N.D.
Bis(2-methoxyethyl) ether (CAS NO. : 111-96-6)	Reference: US EPA 3550C:2007	GC-FID	mg/kg	3	N.D.
1,2-Dichloroethane (CAS NO. : 107-06-2)				5	N.D.
4-(1,1,3,3-tetramethylbutyl)p henol, (4-tert-Octylphenol) (CAS NO. : 140-66-9)	Reference: US EPA 3550C:2007	GC-MS/MS	mg/kg	5	N.D.
2-Methoxyaniline; o-Anisidine (CAS NO. : 90-04-0)	Reference: US EPA 3550C:2007	GC-FID	mg/kg	5	N.D.
Bis(2-methoxyethyl) phthalate (CAS NO. : 117-82-8)	Reference: US EPA 3550C:2007	LC-MS/MS	mg/kg	10	N.D.
Formaldehyde, oligomeric reaction products with aniline (technical MDA) (CAS NO. : 25214-70-4)	Reference: GB/T 2912.1-2009	UV-VIS	mg/kg	20	N.D.

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Test Item(s)	Method	Instrument	Unit	MDL	Result
ZirconiaAluminosilicate Refractory Ceramic Fibres (CAS NO. : --)	-	OM,XRF	-	-	Negative
Aluminosilicate Refractory Ceramic Fibres (CAS NO. : --)				-	Negative
Pentazinc chromate octahydroxide (CAS NO. : 49663-84-5)	Reference: US EPA 3052:1996/ IEC 62321	ICP-OES UV- VIS	mg/kg	2	N.D.
Potassium hydroxyoctaoxodizincatedi-c hromate (CAS NO. :11103-86-9)				2	N.D.
Dichromiumtris(chromate) (CAS NO. :24613-89-6)				2	N.D.

Test Item(s)	Method	Instrument	Unit	MDL	Result
1,2-Bis(2-methoxyethoxy) ethane;TEGDME;Triglyme (CAS No.:112-49-2)	Reference: US EPA 3550C:2007	GC/FID	mg/kg	5	N.D.
1,2-Dimethoxyethane ; Ethylene glycol dimethyl ether ; EGDME (CAS No.:110-71-4)				10	N.D.
Formamide (CAS No.:75-12-7)				5	N.D.
(1,3,5-tris(oxiranylmethyl)-1,3,5-triazine-2,4,6-(1H,3H,5H)-trione) ; TGIC (CAS No.:2451-62-9)		LC-MS/MS	mg/kg	10	N.D.
4,4'-bis(dimethylamino)benzophenone ; Michler's ketone (CAS No.:90-94-8)				10	N.D.
N,N,N',N'-tetramethyl-4,4'-methylenedianiline ; Michler's base (CAS No.:101-61-1)			GC-MS/MS	mg/kg	5
[4-[4,4'-bis(dimethylamino)benzhydrylidene]cyclohexa-2,5-dien-1-ylidene]dimethylammonium chloride (C.I. Basic Violet 3) (CAS No.:548-62-9)				-	Negative
[4-[[4-anilino-1-naphthyl][4-(dimethylamino)phenyl]methylene]cyclohexa-2,5-dien-1-ylidene] dimethylammonium chloride (C.I. Basic Blue 26) (CAS No.:2580-56-5)	-	FT-IR.	-	-	Negative
$\alpha,\alpha$ -Bis[(dimethylamino)phenyl]-4(phenylamino)naphthalene-1-methanol (C.I. Solvent Blue 4) (CAS No.:6786-83-0)				-	Negative
Diboron trioxide (CAS No.:1303-86-2)	Reference: US EPA 3052:1996.	ICP-OES	%	0.0008	N.D.
Lead(II) bis(methanesulfonate) (CAS No.:17570-76-2)			mg/kg	8	N.D.
$\beta$ -TGIC (1,3,5-tris[(2S and 2R)-2,3-epoxypropyl]-1,3,5-triazine-2,4,6-(1H,3H,5H)-trione) (CAS No.:59653-74-6)	Reference: US EPA 3550C:2007	GC-MS	mg/kg	5	N.D.
4,4'-bis(dimethylamino)-4''-(methylamino)trityl alcohol (CAS No.: 561-41-1)		LC-MS/MS	mg/kg	5	N.D.

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Test Item(s)	Method	Instrument	Unit	MDL	Result
Bis(pentabromophenyl) ether(decabromodiphenylether; DecaBDE) (CAS No.: 1163-19-5)	-	FT-IR.	-	-	Negative
Pentacosafuorotridecanoic acid (CAS No.: 72629-94-8)				-	Negative
Tricosafuorododecanoic acid (CAS No.: 307-55-1)				-	Negative
Henicosafuorododecanoic acid (CAS No.: 2058-94-8)				-	Negative
Heptacosafuorotetradecanoic acid (CAS No.: 376-06-7)				-	Negative
4-(1,1,3,3-tetramethylbutyl) phenol, ethoxylated (CAS No.: -)	Reference: US EPA 3550C:2007	GC/MS/MS	mg/kg	5	N.D.
3-ethyl-2-methyl-2-(3-methylbutyl)-1,3-oxazolidine (CAS No.: 143860-04-2)	Reference: US EPA 3550C:2007	GC/FID	-	-	Negative
4-Nonylphenol, branched and linear (CAS No.: -)	-	FT-IR	-	-	Negative
Cyclohexane-1,2-dicarboxylic anhydride (Hexahydrophthalic anhydride - HHPA) (CAS No.: 85-42-7, 13149-00-3, 14166-21-3)	-	FT-IR	-	-	Negative
Hexahydro-4-methylphthalic anhydride, Hexahydromethylphthalic anhydride, Hexahydro-1-methylphthalic anhydride, Hexahydro-3-methylphthalic anhydride (CAS No.: 25550-51-0, 19438-60-9, 48122-14-1)	Reference: US EPA 3550C:2007	LC/MS/MS	mg/kg	6	N.D.
Methoxy acetic acid (CAS No.: 625-45-6)	-	FTIR	-	-	Negative
1,2-Benzenedicarboxylic acid, dipentylester, branched and linear (CAS No.: 84777-06-0)	Reference: US EPA 3550C:2007	LC/MS/MS	-	-	Negative
Diisopentylphthalate (DIPP) (CAS No.: 605-50-5)				-	Negative
N-pentyl-isopentylphthalate (CAS No.: 776297-69-9)				-	Negative

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Test Item(s)	Method	Instrument	Unit	MDL	Result
1,2-diethoxyethane (CAS No.: 629-14-1)	Reference: US EPA 3550C:2007	GC-FID	mg/kg	10	N.D.
N,N-dimethylformamide (CAS No.: 68-12-2)			mg/kg	10	N.D.
Dibutyltin dichloride(DBTC) (CAS No.: 683-18-1)		GC/MS/MS	mg/kg	8	N.D.
Furan (CAS No.: 110-00-9)	-	FTIR	-	-	Negative
Methyloxirane(Propylene oxide) (CAS No.: 75-56-9)			-	-	Negative
4,4'-methylenedi-o-toluidine (CAS No.: 838-88-0)	Reference: US EPA 3550C:2007	LC/MS/MS	mg/kg	10	N.D.
4,4-oxydianiline and its salts (CAS No.: 101-80-4)			mg/kg	6	N.D.
4-aminoazobenzene (CAS No.: 60-09-3)	-	FTIR	-	-	Negative
6-methoxy-m-toluidine (p- cresidine) (CAS No.: 120-71-8)	Reference: US EPA 3550C:2007	LC/MS/MS	mg/kg	6	N.D.
o-aminoazotoluene [(4-o- tolylazo-o-toluidine)] (CAS No.: 97-56-3)	-	FTIR	-	-	Negative
N-methylacetamide (CAS No.: 79-16-3)	Reference: US EPA 3550C:2007	GC-FID	mg/kg	4	N.D.
1- bromopropane (n- propyl bromide) (CAS No.: 106-94-5)	-	FTIR	-	-	Negative
Diazeno-1,2-dicarboxamide (C,C'- azodi(formamide)) (CAS No.: 123-77-3)	-	FTIR	-	-	Negative
Dimethyl sulphate (CAS No.: 77-78-1)	-	FTIR	-	-	Negative
Dinoseb (6-sec-butyl-2,4-dinitrophenol) (CAS No.: 88-85-7)	-	FTIR	-	-	Negative
4-methyl-m-phenylenediamine (toluene-2,4-diamine) (CAS No.: 95-80-7)	-	FTIR	-	-	Negative
o-toluidine (CAS No.: 95-53-4)	Reference: US EPA 3550C:2007	GC/FID	mg/kg	6	N.D.
Acetic acid, leadsalt, basic (CAS No.: 51404-69-4)	Reference: US EPA 3052:1996	ICP-OES	mg/kg	5	N.D.
Trilead bis(carbonate)dihydroxide (CAS No.: 1319-46-6)				5	N.D.
Lead oxide sulfate (CAS No.: 12036-76-9)				5	N.D.

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Test Item(s)	Method	Instrument	Unit	MDL	Result
[Phthalato(2-)]dioxotrilead (CAS No.: 69011-06-9)	Reference: US EPA 3052:1996	ICP-OES	mg/kg	5	N.D.
Dioxobis(stearato)trilead (CAS No.: 12578-12-0)				5	N.D.
Fatty acids,C16-18,lead salts (CAS No.: 91031-62-8)				5	N.D.
Lead bis(tetrafluoroborate) (CAS No.: 13814-96-5)				5	N.D.
Lead cynamidate (CAS No.: 20837-86-9)				5	N.D.
Lead dinitrate (CAS No.: 10099-74-8)				5	N.D.
Lead monoxide(Lead oxide) (CAS No.: 1317-36-8)				5	N.D.
Orange lead(Lead tetroxide) (CAS No.: 1314-41-6)				5	N.D.
Lead titanium trioxide (CAS No.: 12060-00-3)				5	N.D.
Lead titanium zirconium oxide (CAS No.: 12626-81-2)				5	N.D.
Pentaleadtetraoxidesulphate (CAS No.: 12065-90-6)				5	N.D.
Pyrochlore,antimony lead yellow (CAS No.: 8012-00-8)				5	N.D.
Silicic acid(H <sub>2</sub> Si <sub>2</sub> O <sub>5</sub> ), barium salt(1:1),lead-doped (CAS No.: 68784-75-8)				5	N.D.
Silicic acid, lead salt (CAS No.: 11120-22-2)				5	N.D.
Sulfurous acid,leadsalt,dibasic (CAS No.: 62229-08-7)				5	N.D.
Tetraethyllead (CAS No.: 78-00-2)				Reference: US EPA 3540C	GC-MS
Tetralead trioxide sulphate (CAS No.: 12202-17-4)	5	N.D.			
Trilead dioxide phosphonate (CAS No.: 12141-20-7)	5	N.D.			
Diethyl sulphate (CAS No.: 64-67-5)	5	N.D.			
Biphenyl-4-ylamine (CAS No.: 92-67-1)				5	N.D.

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Test Item(s)	Method	Instrument	Unit	MDL	Result
Dipentyl phthalate (DnPP) (CAS No.: 131-18-0)	Reference: US EPA 3550C:2007	GC/MS/MS	-	-	Negative
4-Nonylphenol, branched and linear, ethoxylated [substances with a linear and/or branched alkyl chain with a carbon number of 9 covalently bound in position 4 to phenol, ethoxylated covering UVCB- and well-defined substances, polymers and homologues, which include any of the individual isomers and/or combinations thereof] (CAS No.: --)	Reference: Journal of Water Reaource and Protection , 2010,2,818-829	LC/MS/MS	mg/kg	1	N.D.
Ammoniumpentadecafluorooctanoate (APFO) (CAS No.: 3825-26-1)	-	FT-IR	-	-	Negative
Pentadecafluorooctanoic acid (PFOA) (CAS No.: 335-67-1)	-	FT-IR	-	-	Negative
Cadmium (CAS No.: 7440-43-9)	Reference: US EPA 3052:1996	ICP-OES	mg/kg	8	N.D.
Cadmium oxide (CAS No.: 1306-19-0)			mg/kg	8	N.D.

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Test Item(s)	Method	Instrument	Unit	MDL	Result
Cadmium sulphide (CAS No. 1306-23-6)	Reference: US EPA 3052:1996	ICP-OES	mg/kg	8	N.D.
Lead di(acetate) (CAS No. 301-04-2)			mg/kg	5	N.D.
Dihexyl phthalate (CAS No.84-75-3)	Reference: US EPA 3550C:2007	GC/MS/ MS	-	-	Negative
Disodium 3,3'-[[1,1'-biphenyl]-4,4'- diyl]bis		LC/MS/M S.	-	-	Negative
Trixylyl phosphate (CAS No. 25155-23-1)		GC/FID.	-	-	Negative
Disodium 4-amino-3- [[4'-[[2,4-diaminophenyl]azo] [1,1'-biphenyl]-4-yl]azo]	-	FT-IR	-	-	Negative
Imidazolidine-2-thione; 2-imidazoline-2-thiol (CAS No. 96-45-7)			-	-	Negative