iFLUX

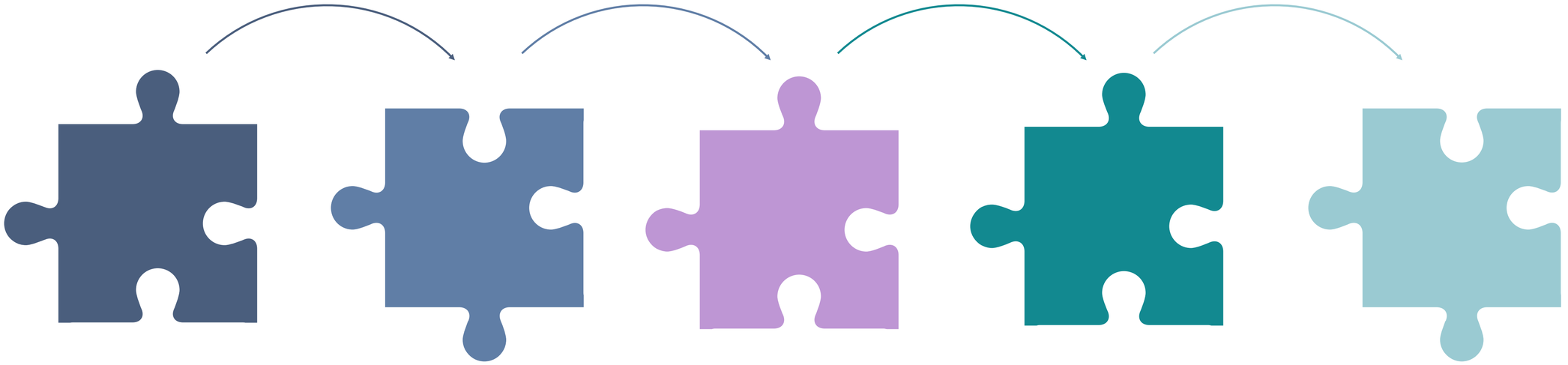
Isodetect
Umweltmonitoring GmbH

new tool for precise quantification of pesticide degradation in contaminated aquifers

IsoFLUX

Marjan Joris

14 OCTOBER 2025



1. Preferential pathways

Are there preferential pathways?
If so, where are they located?

2. Contaminant mass

How much contamination is migrating? Is this a relevant mass to be considered a migration risk?

3. Migration rate

How fast is groundwater or contaminant migrating? Will this be impacted by other effects?

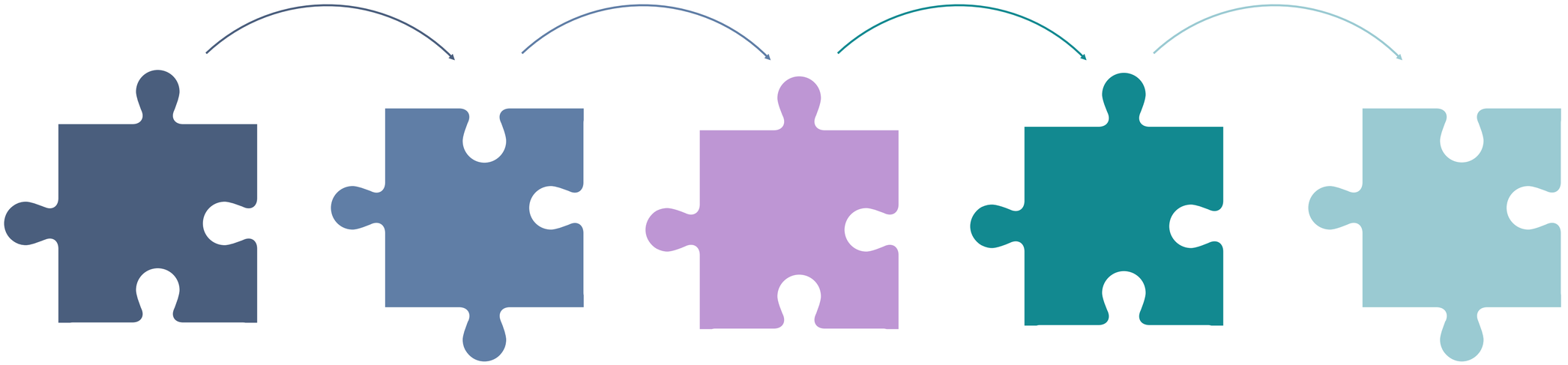
4. Optimized Mitigation

If remedial actions are required, how can they be optimized and become highly effective?

5. Proof and quantification of biodegradation

Determine natural degradation rate.

iFLUX



1. Preferential pathways

Are there preferential pathways? If so, where are they located?

2. Contaminant mass

How much contamination is migrating? Is this a relevant mass to be considered a migration risk?

3. Migration rate

How fast is groundwater or contaminant migrating? Will this be impacted by other events?

4. Optimized Mitigation

If remedial actions are required, how can they be optimized and become highly effective?

5. Proof and quantification of biodegradation

Determine natural degradation rate.

Isodetect Umweltmonitoring GmbH

iFLUX

CORNET & RENARD ECOLOGISTICS & ENVIRONMENTAL FORENSICS Belgium

iFLUX

Steps in Remediation Measures

01 Conditions

02 Proof of degradation

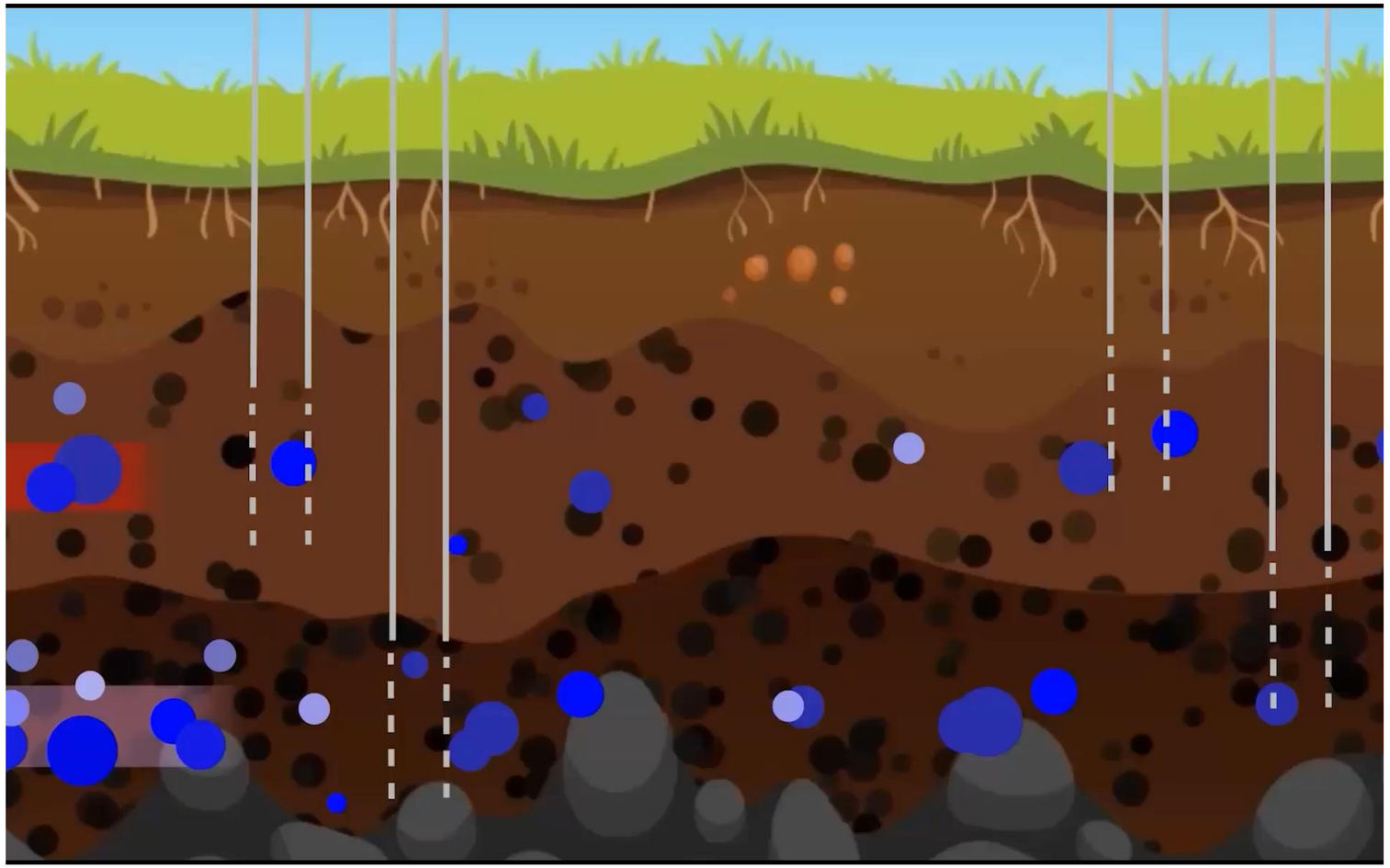
03 Quantification of degradation

INCREASING COMPLEXITY OF THE INVESTIGATION

iFLUX

The dynamics of contamination

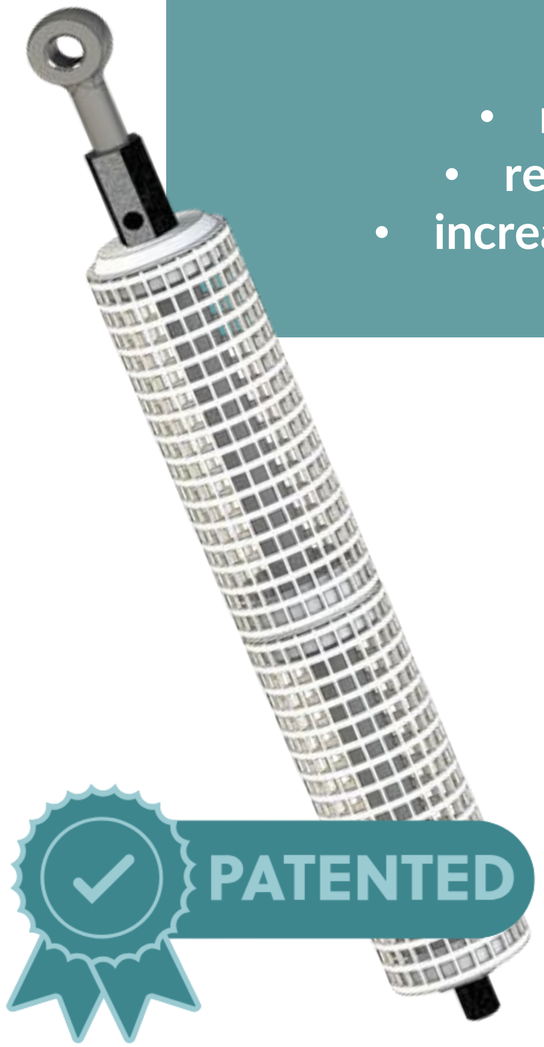
iFLUX Samplers - Contamination & Remediation



iFLUX Samplers

Measuring contamination dynamics for more effective remediation

- reduce remediation costs by up to 40%
- reduce remediation duration by up to 20%
- increase success rates (avoid remediation failure)



network for industrially co-ordinated sustainable land management in europe

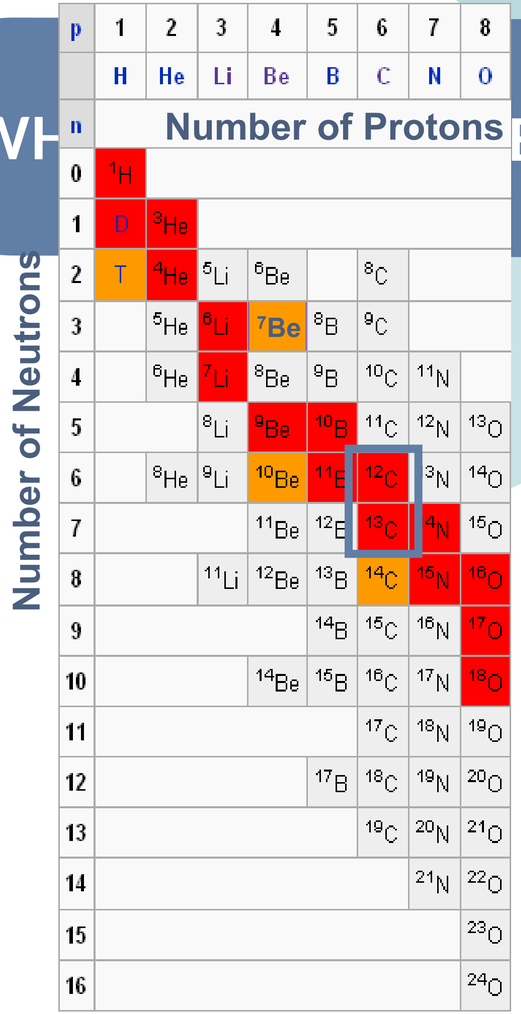
Winner of the NICOLE Innovation Award 2017

"Remediation is extremely costly, so it's best that our customers do it in a targeted way and get it right the first time."

Erik Bosmans, project manager iFLUX

Compound-specific Stable Isotope Analysis (CSIA)

WH ES?



stable isotopes
radioactive isotope
synthetic

…Isotopes are atoms of an element with the same number of protons but different numbers of neutrons

For example Carbon:

^{13}C = 0.96% to 1.16%

^{12}C = 98.84% to 99.04%

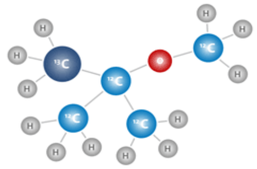
$$\frac{^{13}C}{^{12}C}$$ **Isotope ratio**

measured via isotope ratio mass spectrometry (IRMS)

$$\delta^{13}C = \frac{\left(^{13}C/^{12}C\right)_{Sample}}{\left(^{13}C/^{12}C\right)_{Standard}} - 1 \quad \text{in } ‰$$

iFLUX

FINGERPRINT – Source Identification



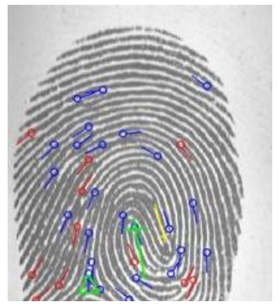
$\delta^{13}C$ = X ‰ VPDB

$\delta^{37}Cl$ = X ‰ SMOC

$\delta\ ^{2}H$ = X ‰ SMOW

$\delta^{18}O$ = X ‰ SMOW

$\delta^{15}N$ = X ‰ AIR

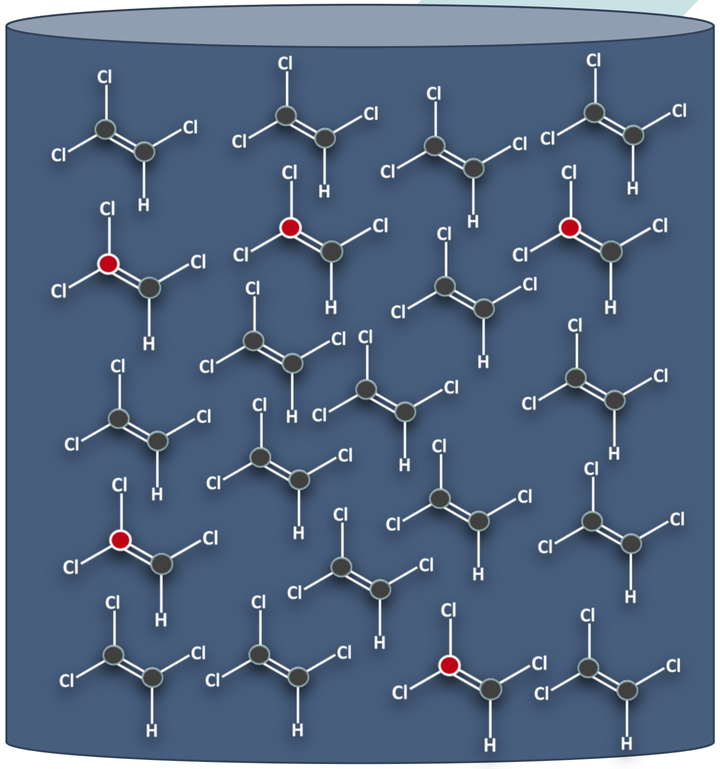


Isotope signature of the primary

WHY DO I NEED TO ANALYZE THEM?

Pol… …otopes …ly …ning

pollutant pool.

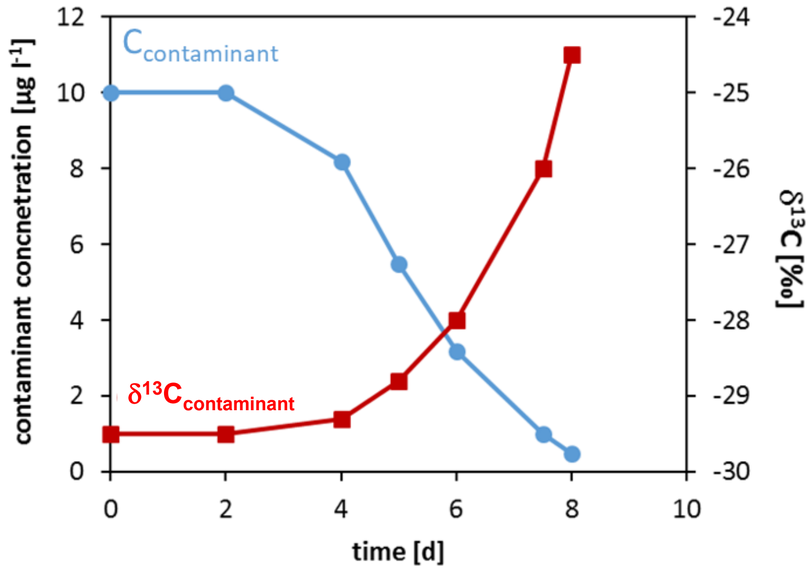


^{13}C

^{12}C

DEGRADATION

$\frac{^{13}C}{^{12}C}$



In case of degradation, isotope values are getting more positive

iFLUX

Validated components

iFLUX Samplers - Contamination & Remediation

WATERFLUX

Traceralcohols

BTEX-N-S-MTBE

Benzene
Toluene
Ethylbenzene
O-Xylene
M-,p-Xylenes
Naphtalene
Styrene
MTBE

MINERAL OILS

Fraction C-10 – C-12
Fraction C-12 – C-20
Fraction C-20 – C-30
Fraction C-30 – C-40
Mineral oils (GC)

CHLORINATED SOLVENTS

Dichloromethane
1,1-Dichloroethane
1,2-Dichloroethane
Cis-1,2-dichloroethene
Trans-1,2-dichloroethene
Trichloromethane
Trichloroethene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Tetrachloromethane
Tetrachloroethene
Vinylchloride

CHLOROBENZENES

Monochlorobenzene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene
1,3,5-Trichlorobenzene

CHLOROTOLUENES

2-Chlorotoluene
4-Chlorotoluene

TRIMETHYBENZENES

1,2,3-trimethylbenzene
1,2,4-trimethylbenzene
1,3,5-trimethylbenzene

POLYAROMATIC HYDROCARBONS

Napthalene
Acenapthylene
Acenaphtene
Fluorene
Fenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Dibenzo(ah)anthracene
Benzo(ghi)perylene
Indeno(123cd)pyrene

POLYCHLORINATED BIPHENYLS

PCB 28
PCB 52
PCB 101
PCB 118
PCB 138
PCB 153
PCB 180

CHLOROTOLUENES

2-Chlorotoluene
4-Chlorotoluene

Pesticides

VOLATILE ORGANIC COMPOUNDS SPECIFIC

1,1,1,2-Tetrachloroethane
1,1,2-Trichloro-1,2,2-trifluorethane
1,1-Dichloroethene
1,1-Dichloropropane
1,1-Dichloropropene
1,2,3-Trichloropropane
1,2-Dibromoethane
1,2-Dichloropropane
1,3-Dichloropropane
2,2-Dichloropropane
2,3-Dichloropropene
2-Chloro-1,3-butadiene
2-Ethyltoluene
3-Chloro-1-propene (allylchloride)
3-Ethyltoluene
4-Ethyltoluene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromomethane
Chloroethane
cis-1,3-Dichloropropene
Cumene
Dibromochloromethane
Dibromomethane
Diisopropylether
ETBE (Ethyl tert-butyl ether)
Ethylether
Hexachlorobutadiene
Iodomethane
TAME (Tert-Amyl Methyl Ether)
trans-1,3-Dichloro-propene
Tribromomethane (Bromoform)
Trichloromonofluor-

HEAVY METALS

Cadmium
Chromium
Copper
Lead
Nickel
Zinc

METAL SPECIFIC

Calcium
Iron
Potassium
Magnesium
Manganese
Sodium

NUTRIENT CATIONIC

Ammonium - N

HEAVY METAL SPECIFIC

Mercury
Arsenic

NUTRIENT ANIONIC

Nitrate-N
Sulfate

DIOXANE

1,4-Dioxane

PFAS

Perfluorobutanoic acid (PFBA)
Perfluorohexanoic acid (PFHxA)
Perfluoroheptanoic acid (PFHpA)
Perfluorooctanoic acid (PFOA) (linear)
Perfluorooctanoic acid - sum (PFOATotal)
Perfluorononoic acid (PFNA)
Perfluorodecanoic acid (PFDA)
Perfluoroundecanoic acid (PFUnDA)
Perfluorododecanoic acid (PFDoDA)
Perfluorohexadecanoic acid (PFTeDA)
Perfluorohexadecanoic acid (PFHxDA)
Perfluorobutane acid (PFBS)
Perfluorohexane sulfonic acid (PFHxS) (linear)
Perfluorohexane sulfonic acid (PFHxSTotal)
Perfluoroheptane sulfonic acid (PFHpS)
Perfluorooctane sulfonic acid (PFOS) (linear)
Perfluorooctane sulfonic acid - sum (PFOSTotal)
Perfluorononane sulfonic acid (PFNS)
Perfluorodecane sulfonic acid (PFDS)
4:2 Fluorotelomersulfonic acid (4:2 FTS)
6:2 Fluorotelomersulfonic acid (6:2 FTS)
8:2 Fluorotelomersulfonic acid (8:2 FTS)
10:2 Fluorotelomersulfonic acid (10:2 FTS)
Perfluorooctane sulfonamide (PFOSA) (linear)
Perfluorooctane sulfonamide - sum (PFOSA) (linear)
N-ethylperfluorooctane sulfonamide (EtPFOSA) (linear)
N-ethylperfluorooctane sulfonamide (EtPFOSATotal)
N-methylperfluorooctane-sulfonamidoacetic acid (MePFOSAA)
N-ethylperfluorooctanesulfonamidoacetic acid (EtPFOSAA)
8:2 Fluorotelomerphosphate diester (8:2 DiPAP)
2,3,3,3-tetrafluor-2-(heptafluorpropoxy)propanoic acid (HFPO-DA)
Perfluorohexanesulfonamide (PFHXSA)
Perfluorotridecanoic acid (PFTrDA)
Perfluorooctadecanoic acid (PFODA)
Perfluoroundecane sulfonic acid (PFUnDS)
Perfluorododecane sulfonic acid (PFDoDS)
Perfluorotridecane sulfonic acid (PFTrDS)
6:2 Fluorotelomerphosphate diester (6:2 DiPAP)
6:2/8:2 Fluorotelomerphosphatediester (6:2/8:2 DiPAP)
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonate (11Cl-PF3OuDS) (F-53B Minor)
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonate (9Cl-PF3ONS) (F-53B Major)
Perfluoropentanoic acid (PFPeA)*
Perfluoropentane sulfonic acid (PFPeS)*
N-methylperfluorooctanesulfonamide (MePFOSA) (linear)*
N-methylperfluorooctanesulfonamide (MePFOSATotal)*
4,8-Dioxa-3H-perfluorononoicacid (DONA)*
Perfluoro-4-ethylcyclohexanesulfonic acid (PFECHS)*
Perfluorobutanesulfonamide (PFBSA)*
N-methylperfluorobutanesulfonamide (MePFBSA)*
N-Methyl-perfluorobutane-sulfonylamidoacetate (MePFBSAA)*
2H-Perfluoro-2-decenoic acid (FOUEA / 8:2 FTUCA)*

Indicative list

For more details, please visit
www.iFLUX.be

Collaborative third-party lab
SGS

iFLUX SGS

+160 validated components, including 51 types of PFAS

NEW
isoFLUX ($\delta C^{13}/C^{12}$)
BTEX, chlorethenes

Isodetect Umweltmonitoring GmbH

4-CPP
2-(4-Chlorphenoxy)-
Propionic acid

Dichloroprop
2-(2,4-dichlorophenoxy)-
propionic acid

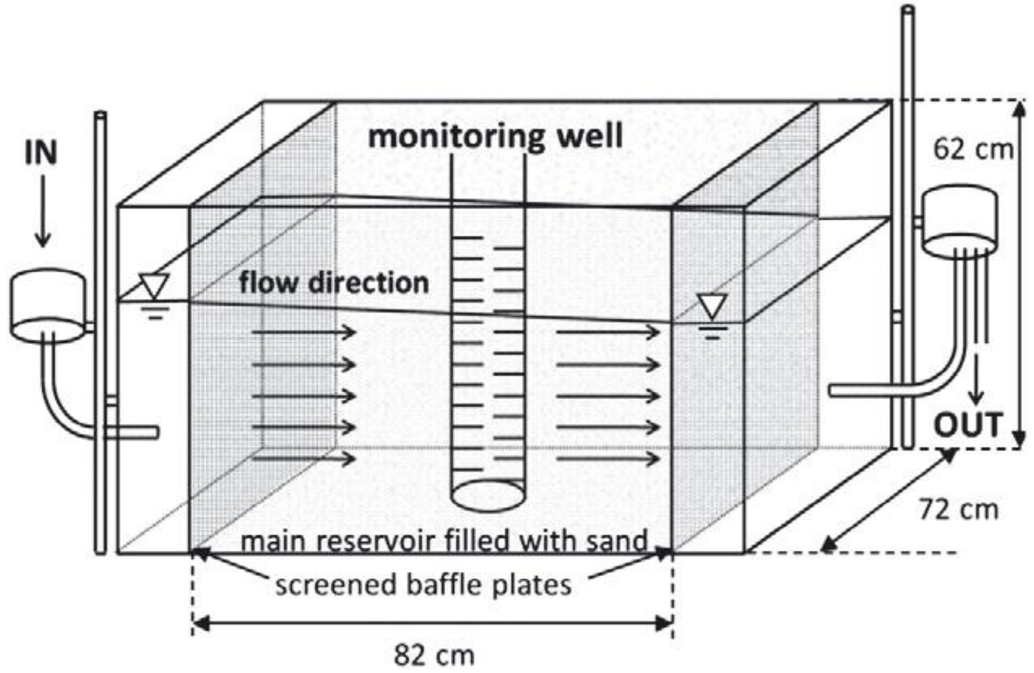
- **Flux measurements**
- **CSIA**

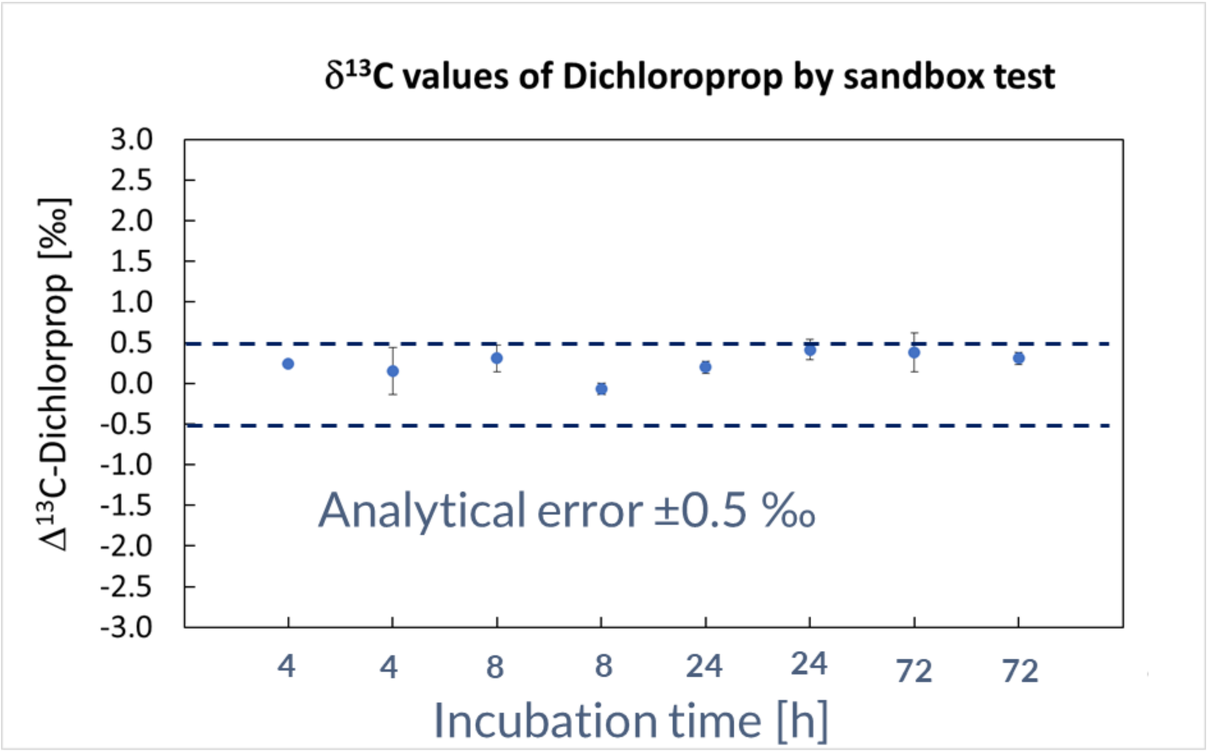
Isodetect
Umweltmonitoring GmbH

iFLUX

eurostars™

Perfomance Test in the Lab





Isodetect Umweltmonitoring GmbH iFLUX eurostars™

Field testing

Groundwater flow direction

Well B1 primary source	4-CPP	Dichloro-prop	Well B2 secondary source	4-CPP	Dichloro-prop	Well B3 downgradient	4-CPP	Dichloro-prop
Concentration [µg/L]	5.8	5.2	Concentration [µg/L]	22	69	Concentration [µg/L]	0.5	0.12
$\delta^{13}C$ [‰]	-28.2	-27.3	$\delta^{13}C$ [‰]	-28.3	**-28.9**	$\delta^{13}C$ [‰]	**-27.0**	-28.2

Secondary source

Proof of degradation of 4-CPP

Isodetect Umweltmonitoring GmbH

iFLUX

eurostars™

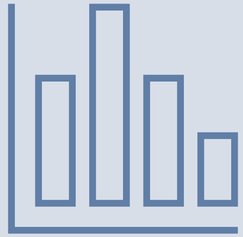
Isotopes meet mass flux –
new evaluation tool for degradation and sources of groundwater pollutants

Improve quantification of contaminant flux reduction

Comprehensive insights of site conditions over a clearly defined timeframe including water and contaminant flux (& flow direction)

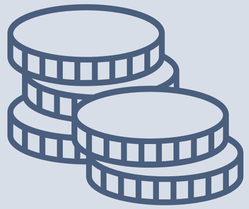
Easy to sample

with a small and fixed volume sampler



Level out temporary peaks

Sampling passively over a longer period of time avoids temporary peak concentrations



Lower costs

Passive collection of analytes in comparison to direct sampling lowers sampling efforts and costs.

Isodetect Umweltmonitoring GmbH

iFLUX

eurostars™

kuntze@isodetect.de

+32 486 41 39 25

Marjan@iflux.be

+32 498 90 27 42

Isodetect
Umweltmonitoring GmbH

iFLUX

www.iFLUX.be

iFLUX