

SGS Belgium – Industries & Environment

Environmental and Industrial Hygiene testing

# Environmental Forensics

An analytical Challenge



Eurachem - AOAC Webinar | Luc De Ren | 15/11/2022

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## Luc De Ren

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### SGS Belgium NV :

- We can provide range of expertise on :
  - Soil
  - Water
  - Gas
  - Asbestos risk
  - High End analysis
  - Environmental Forensics
  
- We have a global solution and local expertise.



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  - What - How
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  - Environmental Forensics
  - PPCP's
- Summary



## INTRODUCTION - BeNe



**950** employees



**6** laboratories & **10** offices



**€ 106** mio revenue 2021

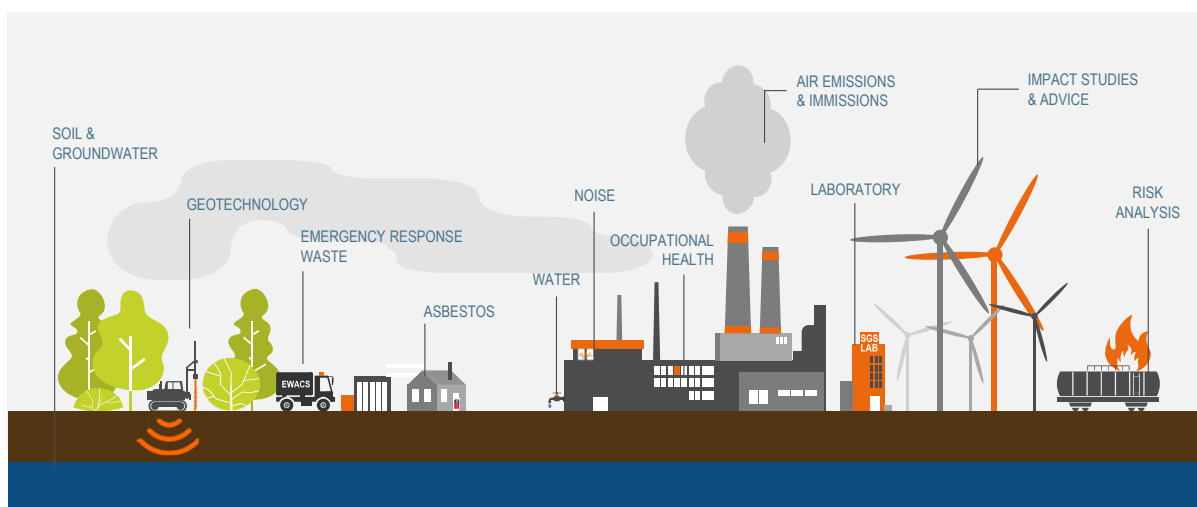


ca. **5.000** customers annually

## COMPLEMENTARY - SCOPE OF SERVICES

FIELD & MONITORING	LABORATORY	REAL ESTATE	SOIL & SUBSOIL	STUDIES & ASSESSMENTS	TRAINING	WASTE & CHEMICALS
air emissions & immissions	high-end testing	circularity & demolition management	drilling & sampling	environmental compliance & impact	asbestos recognition & expertise	calamity interventions
asbestos & restricted substances	on-site sampling	energy performance	geohydrology	HSE management	BHV & EHBO	collection
CEMS calibration & validation	research & method development	environmental & technical due diligence	geotechnical & geophysical assessment	noise & vibrations	DHV & DTA & mentorship	emergency response
marine inspections: IHM & ballast water	routine testing	fire safety & protection	pollution investigation	process safety	e-learnings	handling & management
occupational health	sample collection	property & transition management	settlement calculations & stability	product compliance & REACH & CLP	on demand & inhouse	repacks & conditioning
SGS airsense & smartsense	troubleshooting & customer support	technical inspections	traceability verification	sustainability & verification	safety (VCA)	storage

## INTRODUCTION - BeNe



## Global vs Local issues (1)

- Terminology
  - POP – Emerging Contaminants
  - Water Frame Directive
- PFAS
  - Environment
  - AFFF – 3F transition
- Future ones
  - PPCP
  - SCCP - MCCP
  - Brominated Flame Retardants
  - Others to come?

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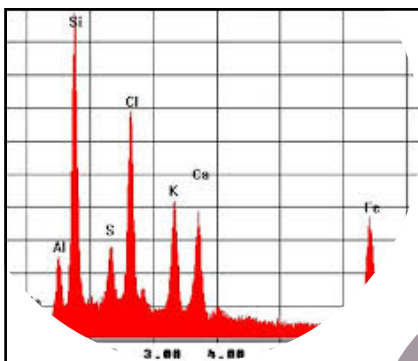
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## Principles

- Allocation of sources – provide scientific evidence to link the source to a contaminant in order to help for compensation for economic losses and environmental damage
- Pollutor pays the bill principle Directive 2004/35/EC
- Financial impact is substantial e.g. Exxon Valdez, Gulf of Mexico
- A need for a well-defined analytical strategy
- State of the art techniques in order to identify unknown compounds in a large variety of matrices: pure products (liquid, solid), environmental samples
- Results must give scientific evidence which can be used in court

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## Analytics

- Target analysis
  - Specific
  - Low concentrations
  - Cost
- Screening approach
  - Non-Specific – uncertainty?
  - Semi-quantitative
  - Low cost



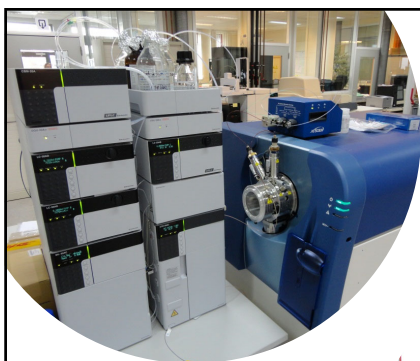
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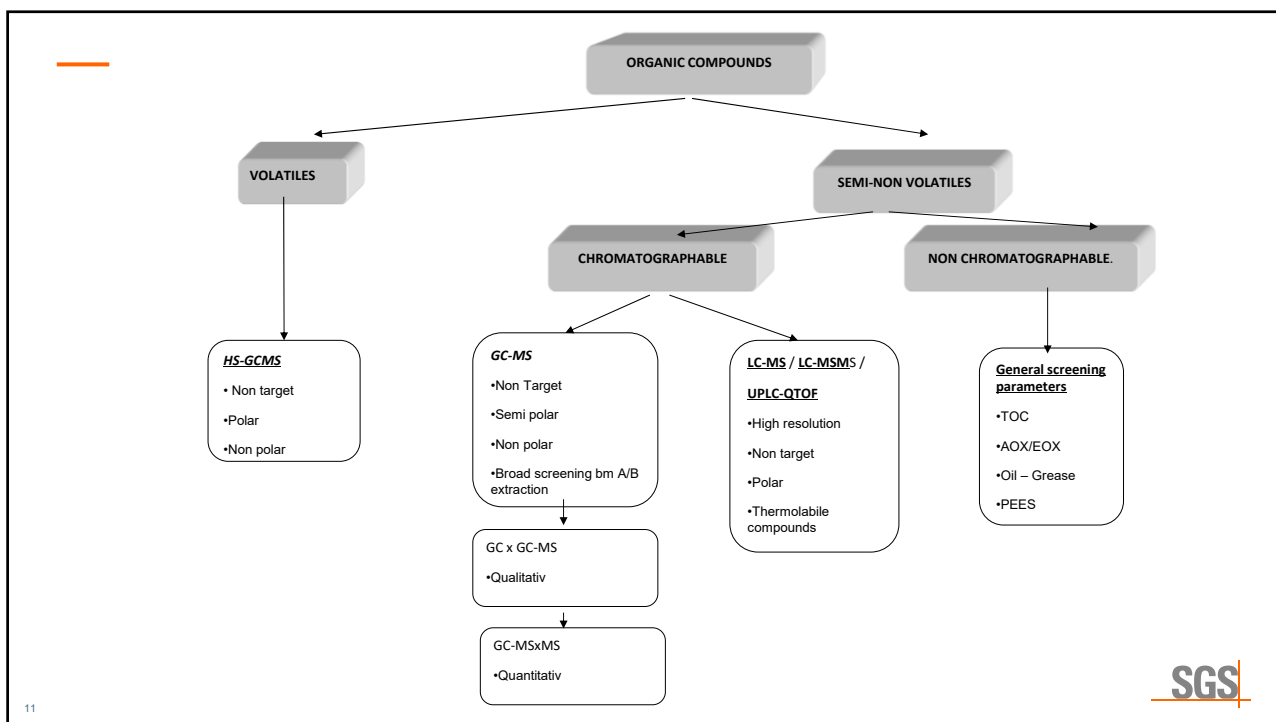


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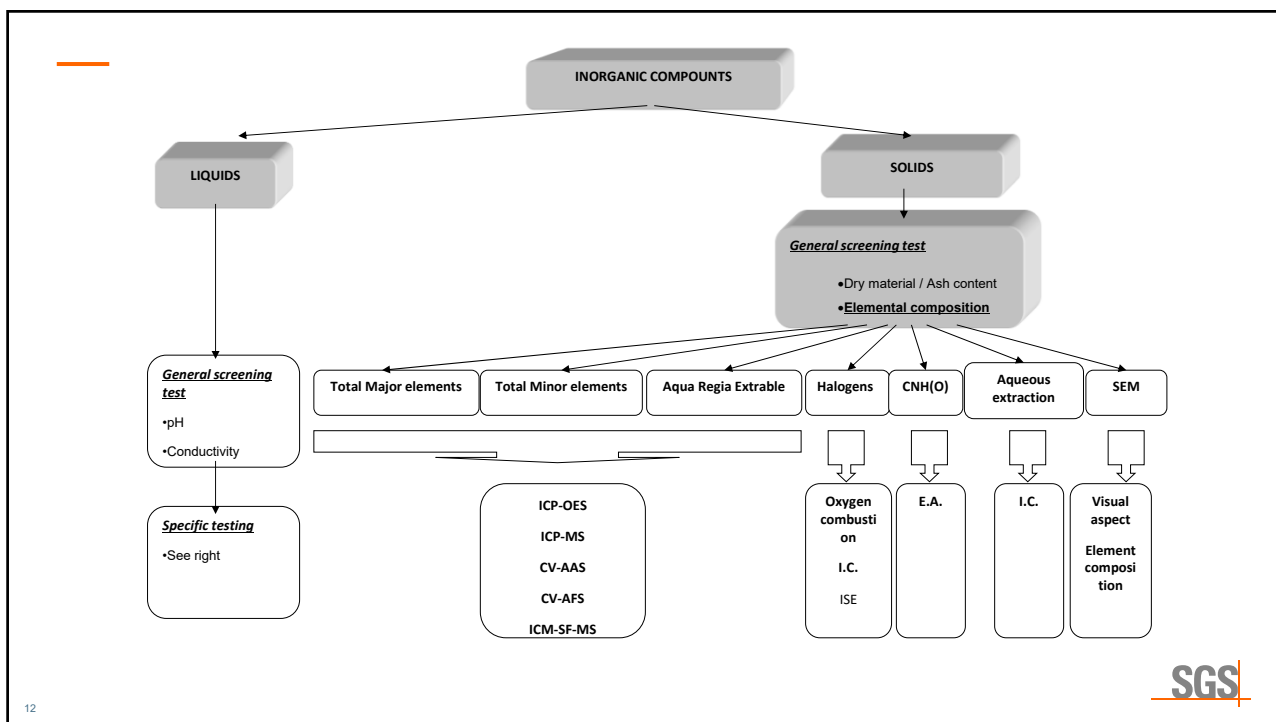
## WHAT - HOW

- State of the Art techniques must be used
  - Organic analysis – molecular composition
  - Inorganic analysis – elemental composition
- Molecular composition
  - GC/MS screening (HS or LLE)
  - GC x GC/MS
  - GC-MS x MS
  - LC/MS (High Resolution)
- Elemental composition
  - Major/Minor elements (ICP-OES / ICP-MS / ICP-SF-MS / CV-AAS / CV-AFS)
  - Halogens (Oxygen combustion with IC or ISE)
  - C/N/H (O) composition: Element Analyser
  - Ions
  - SEM/EDX





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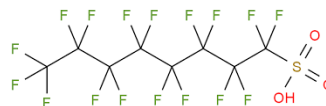
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## Challenges : What are PFAS substances?

- **PFAS** = **P**oly & **P**er **F**luorinated **A**lky **S**ubstance
- PFAS substances are
  - synthetize “Man Made”
  - “For ever chemicals”
  - There are about (estimated) 4000 – 6000 different comp.
- They have in common the C-F bond. This the strongest bond in the organic chemistry.
- PFAS have **surfactant-related properties** : water and oil repellent , surface tension reducing capacity.

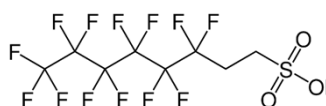
- PFOS : **P**er **F**luoro **O**ctane **S**ulfonic acid



- PFOA : **P**er **F**luoro **O**ctanoic **A**cid



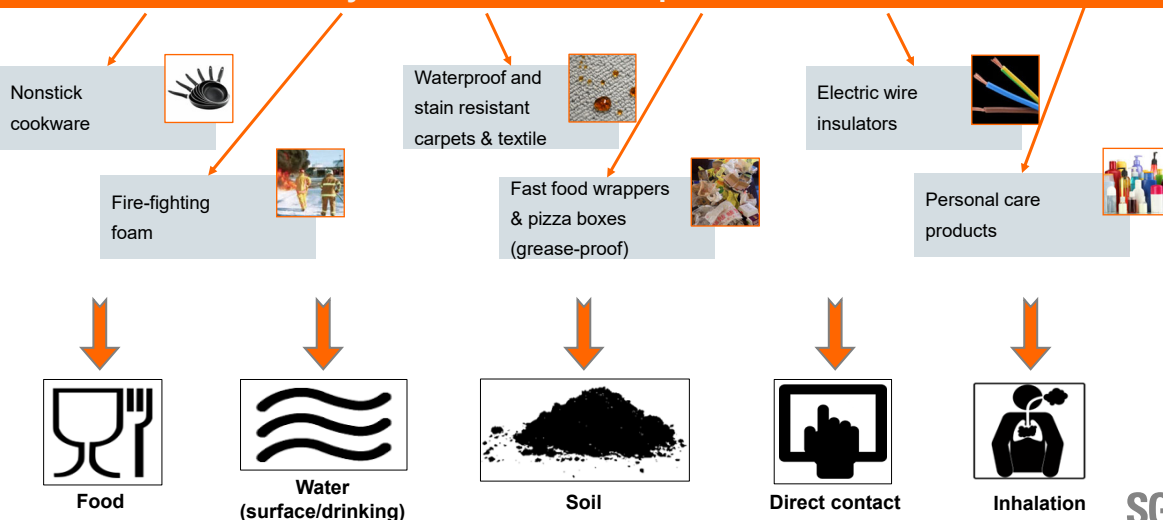
- PFAS: **P**oly **F**luorinated **A**lky **S**ubstances



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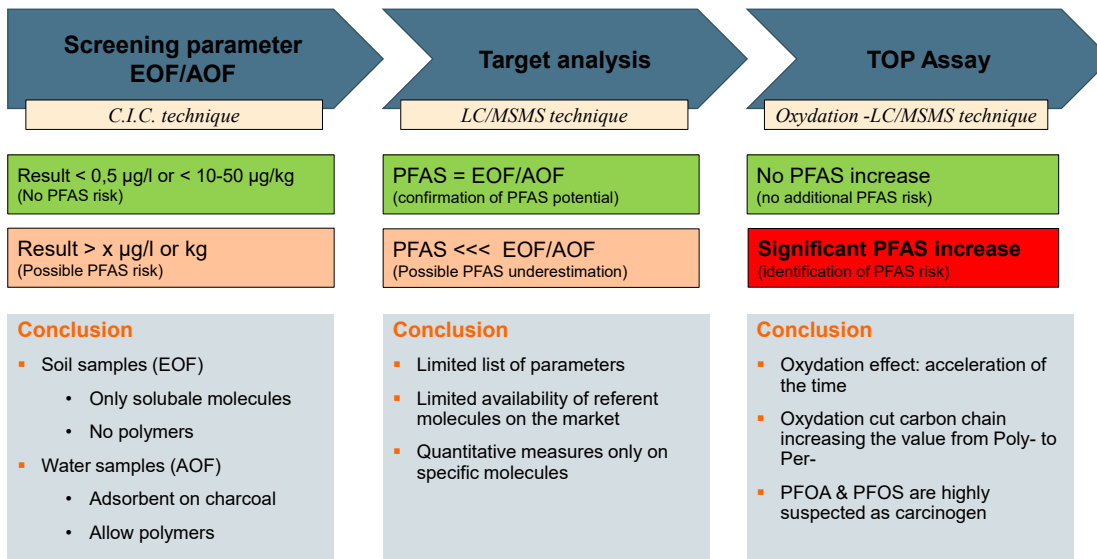
## Problem?

### Poly - Perfluorinated compounds - PFAS



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## PFASafe Next Level analysis

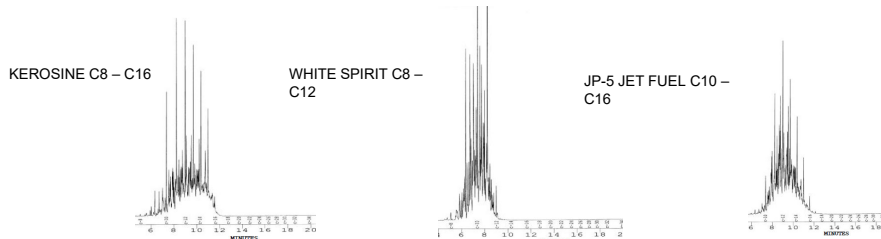


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## Hydrocarbons - Complex matter

- The number of individual hydrocarbons in materials varies (e.g. petroleum hydrocarbons > 5000)
- Hydrocarbon pattern varies due to:
  - Production proces
  - Weathering proces
  - Mixing
  - ...
- Identification is not always evident → Expert Judgement

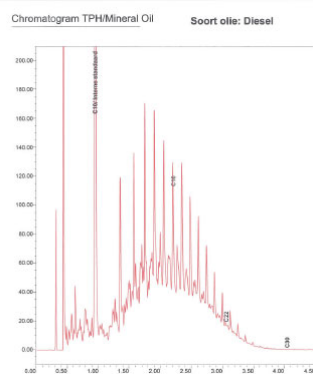
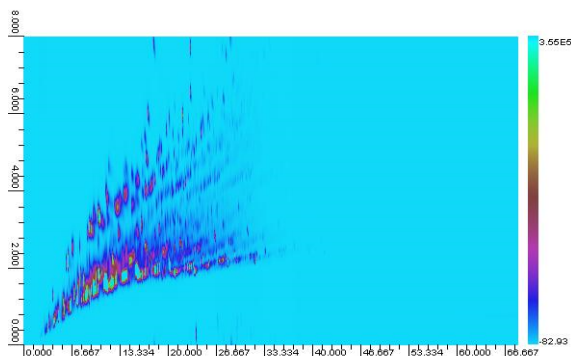


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## Fingerprinting technique vs GC-FID



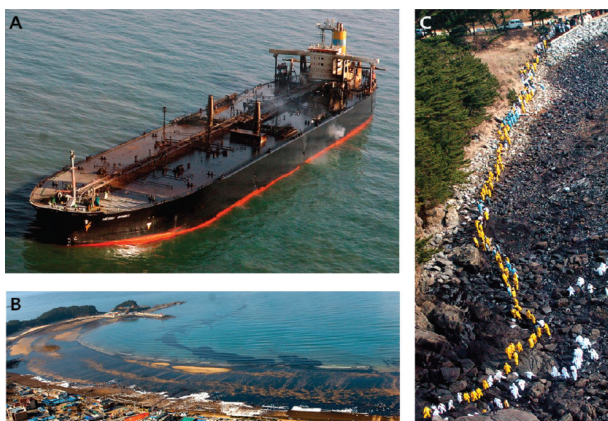
C-nr	Carbon number	Di-Na	Di-naphthenics
Par	Normal paraffins	Mo-Ar	Mono-aromatics
Me-Br	Methyl branched paraffins	Na-Mo-Ar	Naphthenic-mono-aromatics
Et-Br	Ethyl branched paraffins	Di-Ar	Di-aromatics
H-Br	Heavily branched paraffins	Na-Di-Ar	Naphthenic-di-aromatics
M-Na	Mono-Naphthenics	Tri-Ar	Tri-aromatics

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## ENVIRONMENTAL FORENSICS

### ■ Petroleum Isotopes and biomarkers

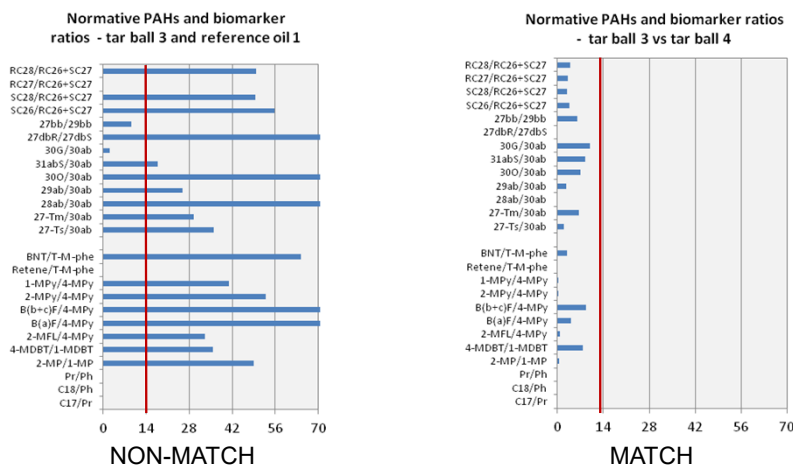


- Carbon isotopic ratio can provide useful information with regard to oil spill and oil field fingerprinting
- Combined approach with biomarker methodology (EN 15522) leads to increased confidence in the results
- Depending on the samples, GC-C-IRMS may be the only reliable technique for fingerprinting in case of the lack of biomarkers.

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## ENVIRONMENTAL FORENSICS – OIL SPILLS



**Conclusions:** tar balls originated from the same source, none of the oils was the source of this oil spill

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## Pharmaceuticals and personal care products as pollutants (PPCPs)

PPCPs are a highly diverse group of chemicals

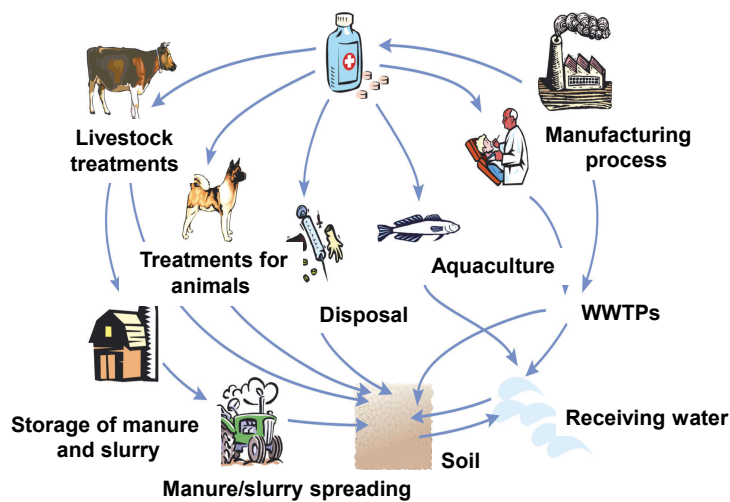
- Basically, all prescription and over-the-counter drugs
- Illicit drugs
- Diagnostic agents
- Dietary supplements
- Fragrances, soaps, conditioners..
- Sunscreens, cosmetics...
- Caffeine, Nicotine



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## Challenges



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## Challenges

- Type of compound
- Reporting levels in relation to legislation
- Matrices
  - Environment
  - Food Feed
  - Emission - immision

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Please remember...

...analytical results are  
interpreted under the conditions  
of the test/method

...pragmatism



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# Thank you!

Do you have any questions?

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