

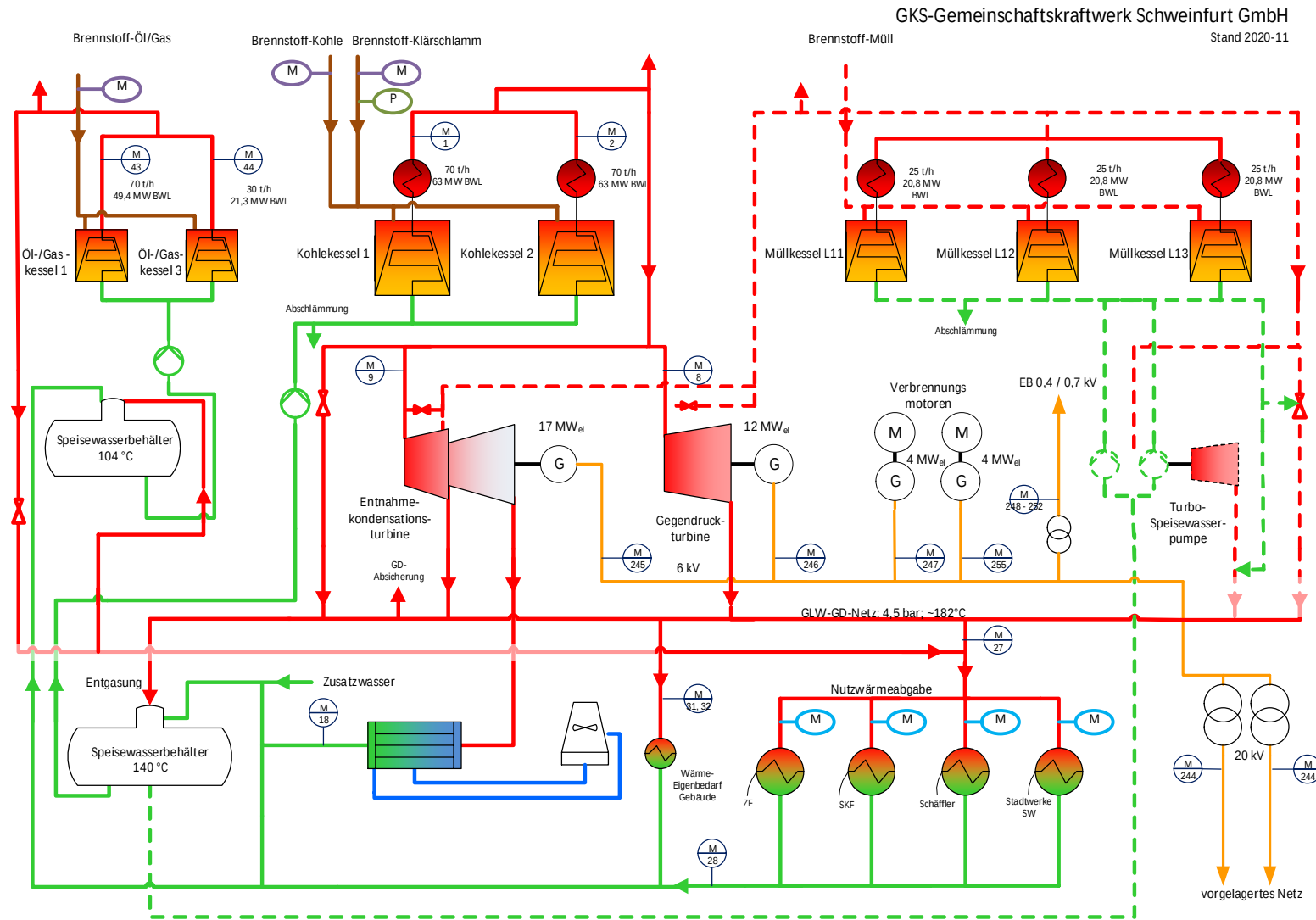
PFAS campaign at GKS plant

Dr. Ragnar Warnecke, GKS Schweinfurt

Daniel Wohter, RWTH Aachen  

Anna Holfelder, KIT Karlsruhe  

Flow Sheet GKS GmbH



Objectives and overall approach



■ Objectives of the campaign

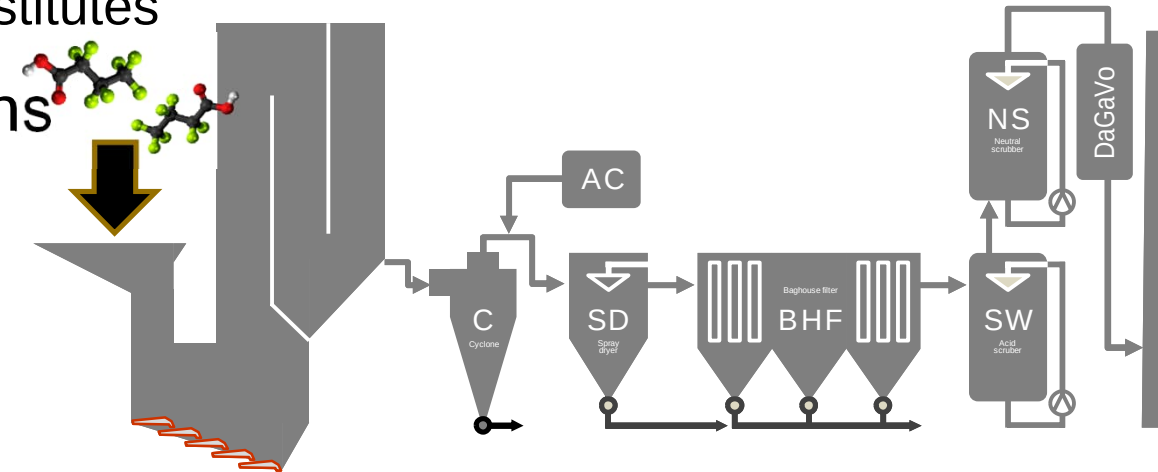
- ❑ Establishment of measurement and analysis methods for PFAS in flue gas and residues of MSWI
- ❑ Investigation of the decomposition behavior of PFAS in MSWI full-scale facilities
- ❑ Assessment of the separation efficiency in the flue gas cleaning system

■ Successful completion of a 2-week campaign in February 25

- ❑ More than 1 year of organization work
- ❑ Active participation of > 15 labs and research institutes

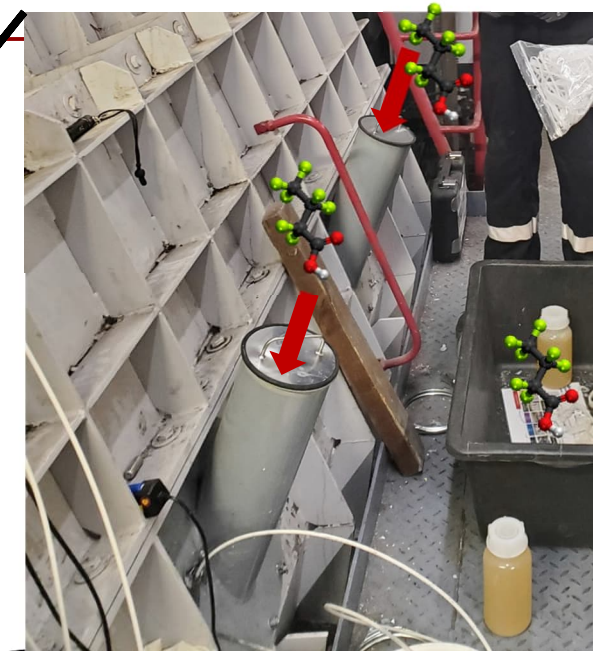
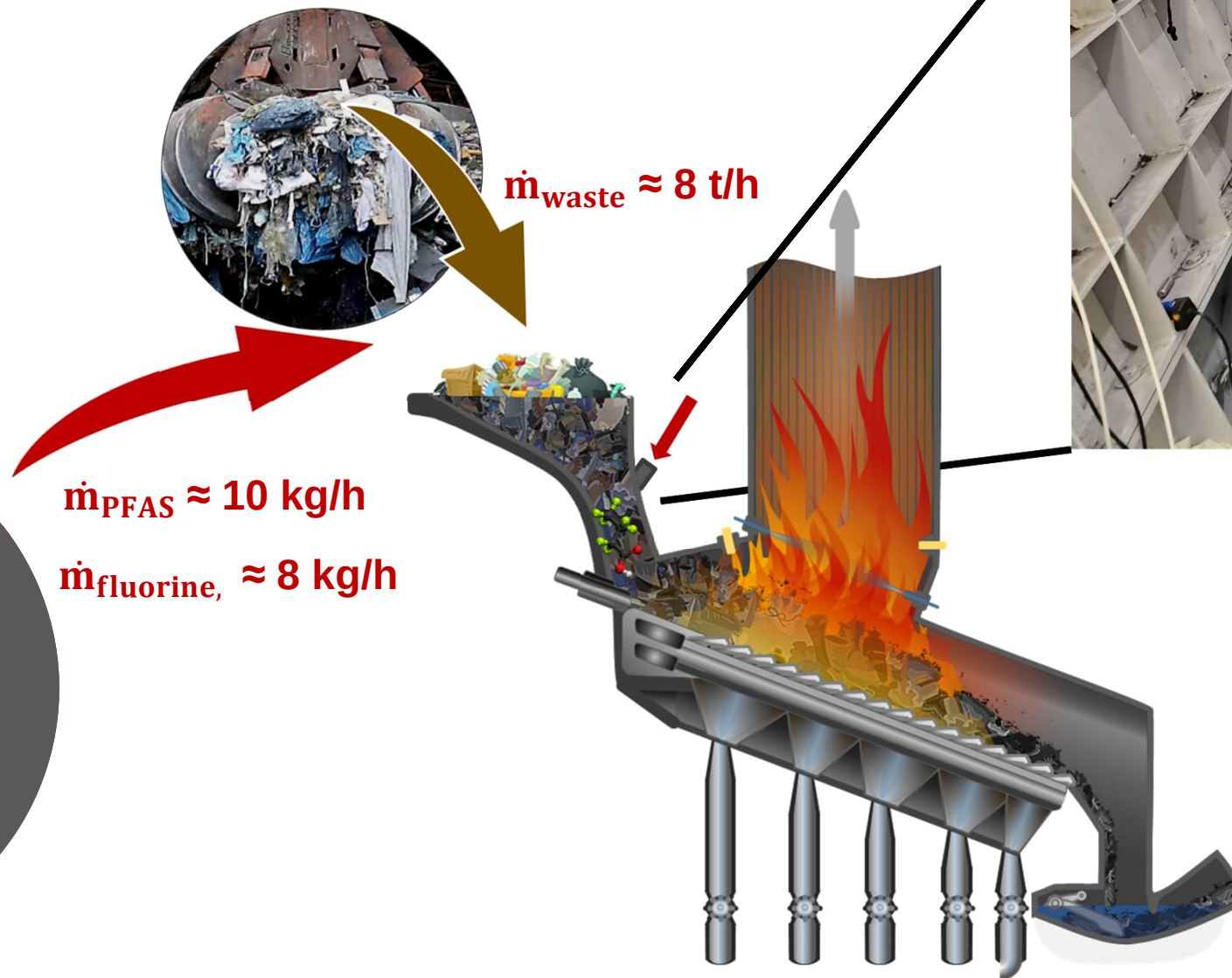
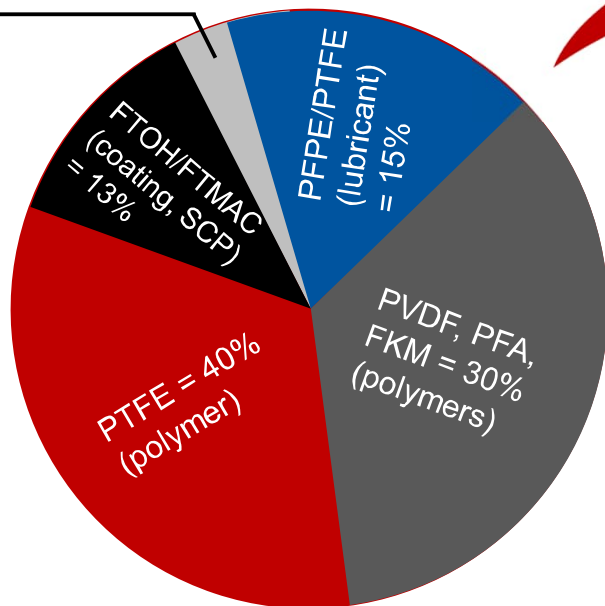
■ Measurements under 3 operating conditions

- I. Reference/baseline values (household waste)
- II. Addition of 70 t of PFAS contaminated soil
- III. **Dosing of 4 t PFAS containing material**



PFAS dosing

PFAS in AFFF = 2 %
Capstone A/B, 6:2 FTS, other PFAA



PFAA = perfluorinated alkyl acids (sulfonic and carboxylic)
SCP = side-chain fluorinated polymers

PFAS materials

PTFE



Foils, rolled,
500 g each batch



Bags of scraps of
300 g each

Coating
suspension



Continuously pumped

AFFF



2000 x 1 l bottles

72 h manual dosing



PVDF



Cut plates,
500 g each batch

FKM



Bags of sealings of
300 g each

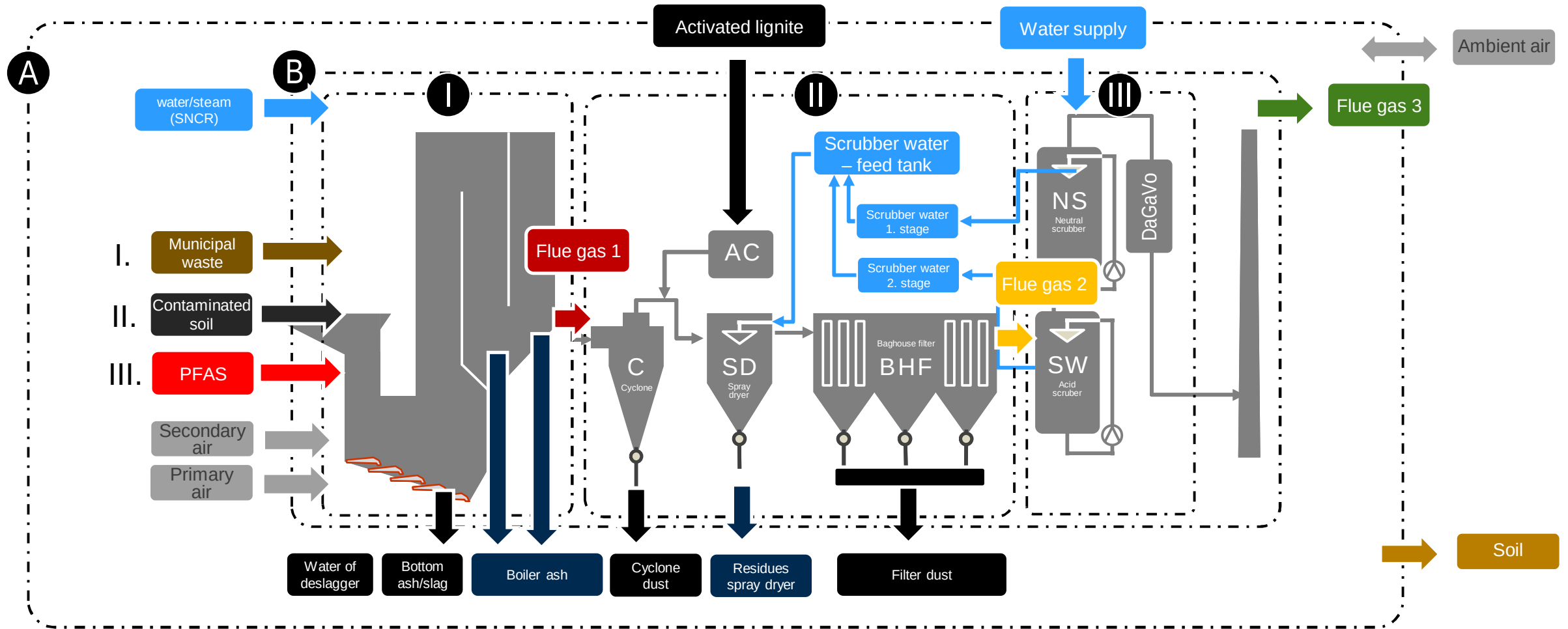
lubricant



Small cans of
400 g each

AFFF = Aqueous Film Forming Foam

PFAS and fluorine balance



Gas measurement

variation of OTM 45



OTM 50



FTIR, TDL



particles (gravimetric)



variation of OTM 45

cooled probe, XAD

heated filter, no impinger

Long term sampling: 20 h

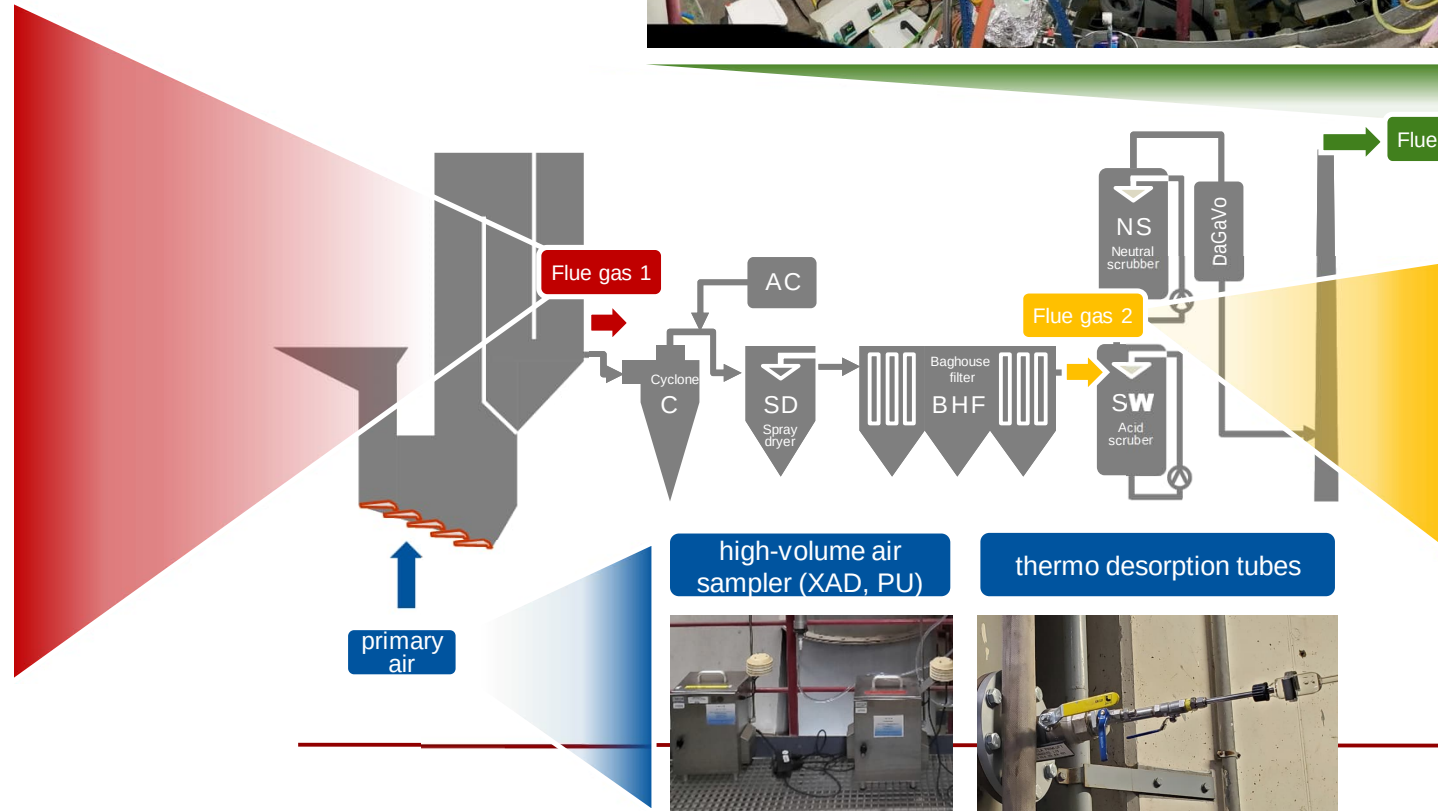
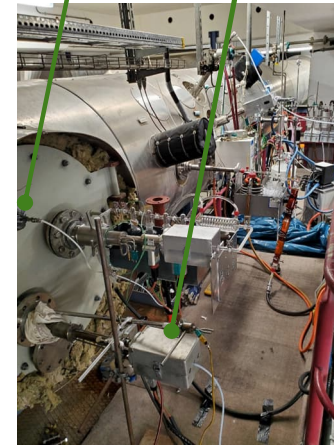
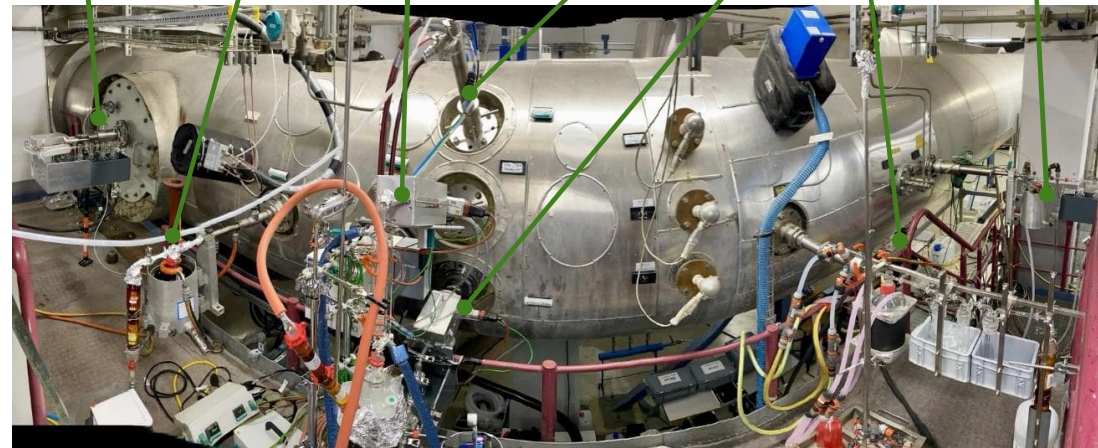
OTM 50

cooled probe, XAD

cooled probe, XAW

FTIR

OTM 45 + 50



Cooled probe, XAD



OTM 50



high-volume air sampler (XAD, PU)



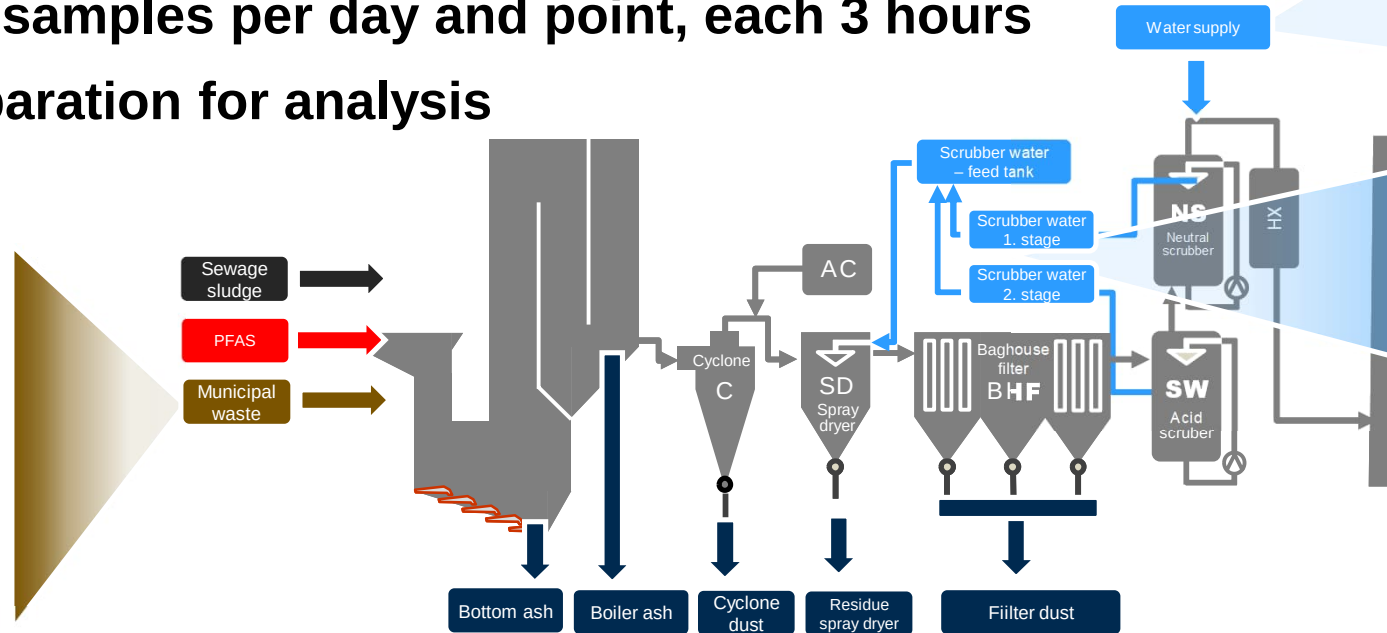
thermo desorption tubes



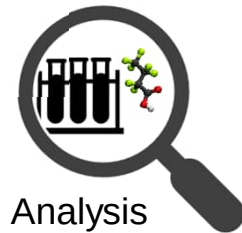
Input material and residues

At site: 6 individual samples per day and point, each 3 hours

In lab: Pooling, preparation for analysis



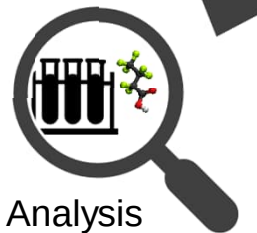
Processing in lab



Analysis



Processing in lab



Analysis

PFAS and fluorine balances – analysis methods

Analysis of air and flue gas

- Polar, semi-volatile PFAS + volatile PFAS
 - Short-term sampling: **target analysis of 40 individual PFAS**
 - Long-term sampling: **target and non-target analysis**
- Non-polar, volatile PFAS (PICs/fragments: $C_xF_yH_z$)
 - Sampling in canisters + GC analysis (OTM 50)
 - **Target and non-target analysis**
(supported by Markes International)
 - FTIR: CF_4 , C_2F_6 , C_3F_8 , COF_2 , LOD = 50-100 ppb
- HF
 - Laser-diode-measurement (TDL) + FTIR + wash solution/IC
- Particle bound inorganic fluorine (fluorides)
 - Gravimetric particle sampling
 - Analysis: **pyrohydrolysis/CIC or HR-CS-GFMAS**

Analysis of solid and liquid input-material and residues

- Analysis of PFAS
 - Target analysis **of 40 individual PFAS (incl. TFA)**
- Analysis of organic fluorine
 - Sumparameter analysis (EOF, AOF)
 - Comparison of different analysis techniques
 - CIC
 - HR-CS-GFMAS
- Analysis of inorganic fluorine
 - Comparison of different analysis techniques
 - Pyrohydrolysis/CIC
 - HR-CS-GFMAS
 - IC ISE (liquids)
- Analysis of fluorine containing species
 - X-ray diffraction (XRD)

and additional investigations about toxicology

Project Involvement

- Involvement of 8 different measurement institutes from 3 EU countries
 - ❑ Germany: Müller BBM, aneco, TÜV Süd, TÜV Rheinland, SGS Fresenius, envea
 - ❑ Belgium: SGS Fresenius, Vito
 - ❑ Austria: Kalb Analytik
- Involvement of 4 further labs
 - ❑ Eurofins, TZW Karlsruhe, SGS Fresenius, münster analytical solutions
- Involvement of 3 renowned research institutes/universities
 - ❑ TEER/RWTH Aachen
 - ❑ ITC/KIT
 - ❑ BAM

Project Involvement and Funding

Funding:



Project-
Involvement:

