Business from technology

Gas Analysis Workshop
Berlin September 7th – 8th 2017

VTT's gasification gas analysis activities

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Bioruukki Pilot Centre

Bioruukki piloting ecosystem - efficiency, speed and lower risks to development with piloting and demonstrations

- **A new piloting ecosystem** for process industry scale-up and demonstrations.
- A former printing plant transformed to world scale R&D centre.
- Located close to Otaniemi campus.

Bioruukki is the largest open pilot facility in bioeconomy in Northern Europe

Bioruukki Pilot Centre - Value from integration

THERMOCHEMICAL CONVERSION PLATFORM

Gasification and pyrolysis technologies for biofuels and biochemicals. Recycling concepts.

Full operation started Q3/2015

ENERGY STORAGE PLATFORM

Storage concepts for solar and wind energy through mono carbon gases to chemicals and materials

Starts at Bioruukki 2016

BIOMASS PROCESSING PLATFORM

Innovative biomass processing and cellulose fibres for new biobased value chains

Starts at Bioruukki 2017

GREEN CHEMISTRY PLATFORM

Sustainable process chemistry and bioprocesses for biochemicals and tailored biobased hybrid materials

Starts at Bioruukki 2018

Bioruukki thermochemical platform started 2015

Gasification pilot plant

- Dual Fluidized-Bed steam gasification pilot
- Bench-scale CFB gasifier

Opening ceremony 13.3.2015

Biofuels, biochemicals, recycling concepts

Pyrolysis pilot plant

- Fast Pyrolysis CFB Pilot
- Fast Pyrolysis BFB Bench-Scale
- Slow Pyrolysis batch unit

On-line / off-line measurement campaign with dilution sampling

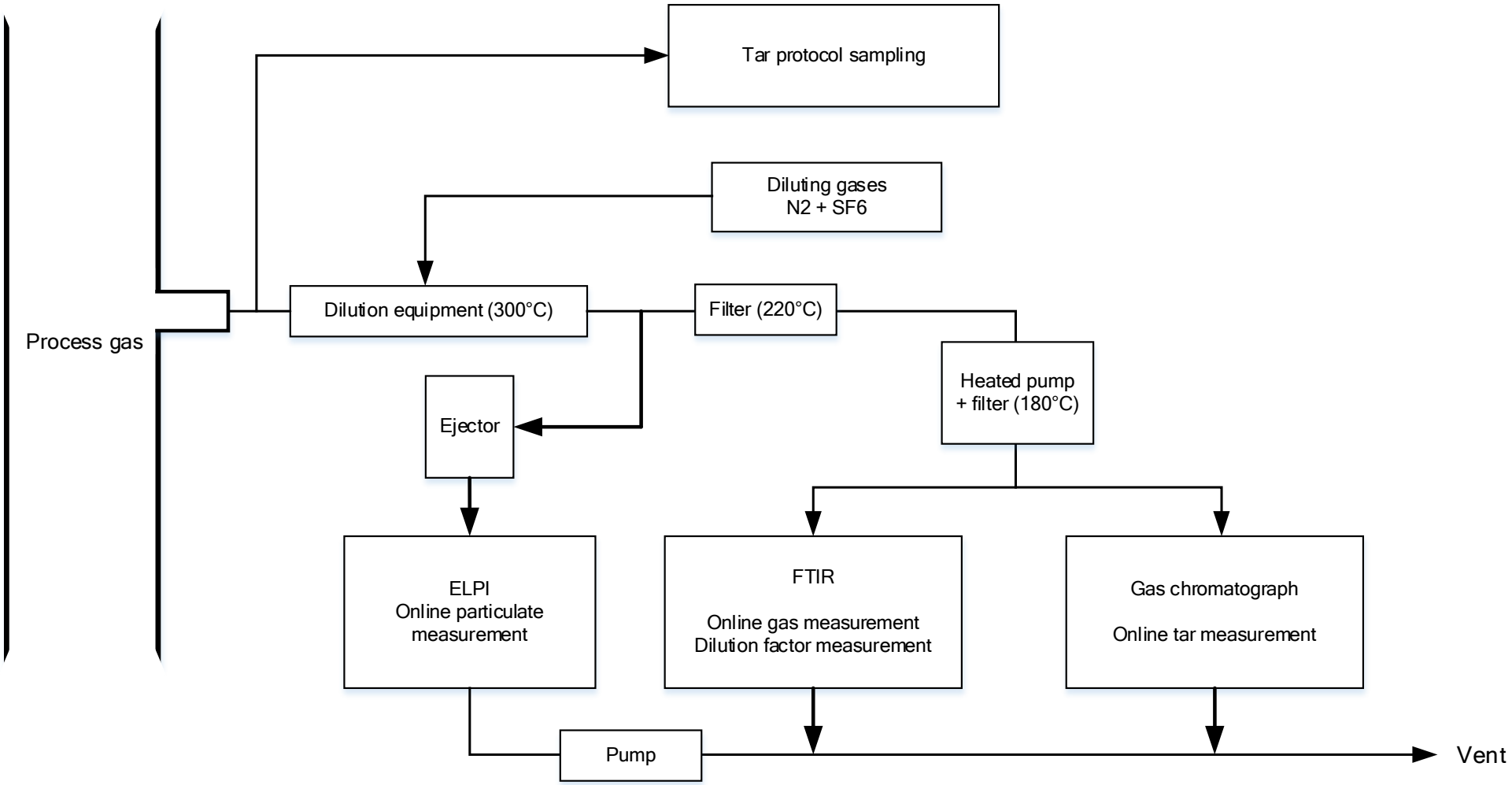
Dilution sampling measurement campaign

- DFB and BFB gasification processes

- 2 sample gathering locations
  - Before reformer
  - After reformer

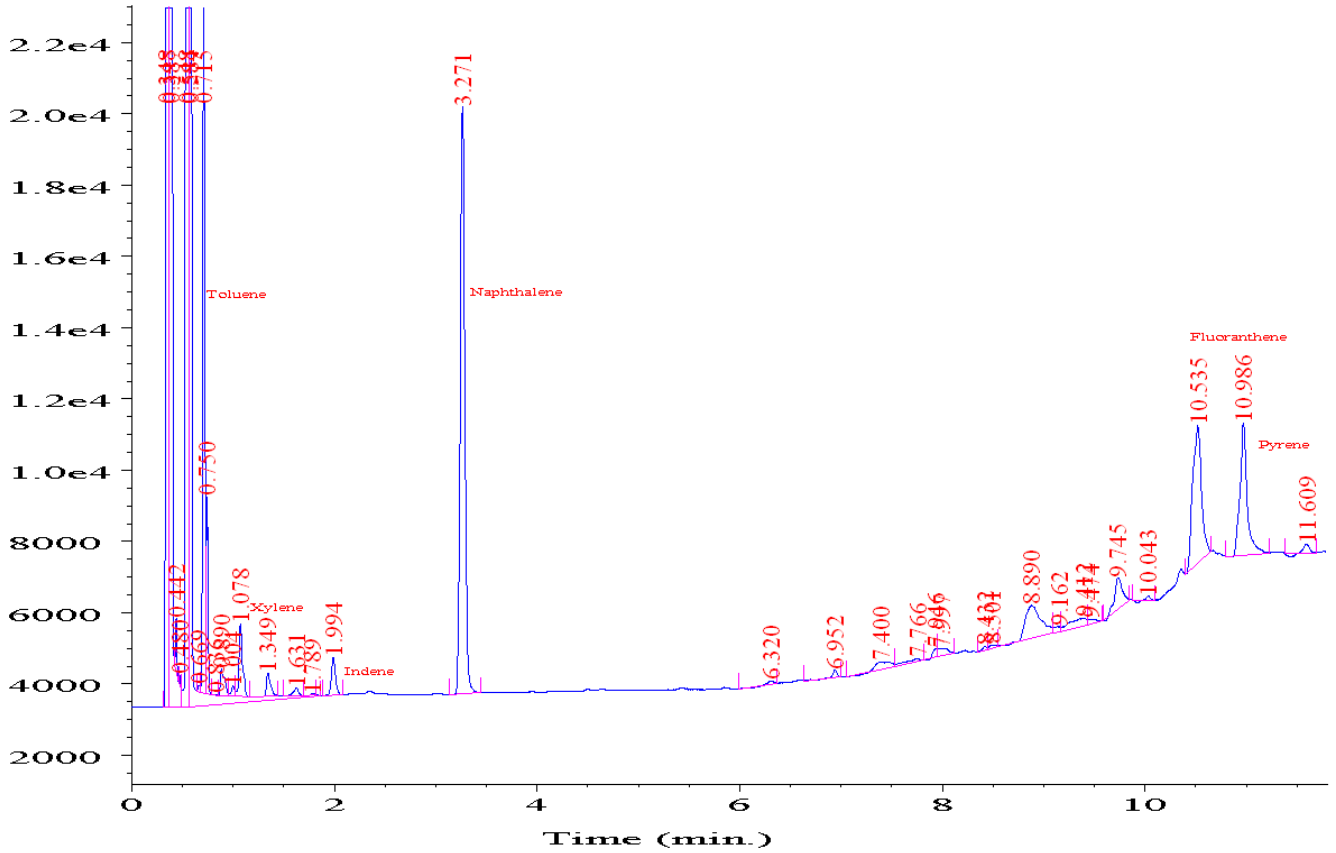
- 3 different on-line analysis methods for:
  - Light tar compounds (GC-FID)
  - Particulates (ELPI)
  - Ammonia (FTIR)

Dilution sampling equipment



'Rapid' on-line tar analysis

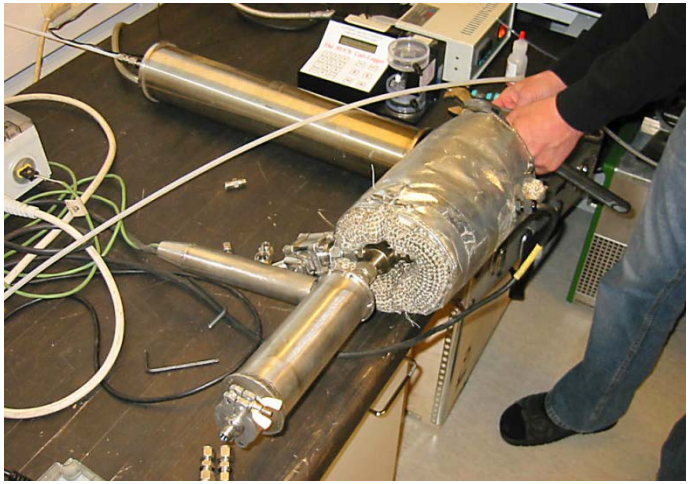
- Analysis time 20 min
- Calibrated compounds:
  - Benzene
  - Toluene
  - Naphthalene
  - Phenanthrene
  - Anthracene
  - Fluoranthene
  - Pyrene
  - (if desired, 20 additional compounds)
- HP-1 (10 m x 0.53 mm x 0.26 µm) or HP Ultra 2 –column (25 m x 0.32 mm x 0.52 µm)



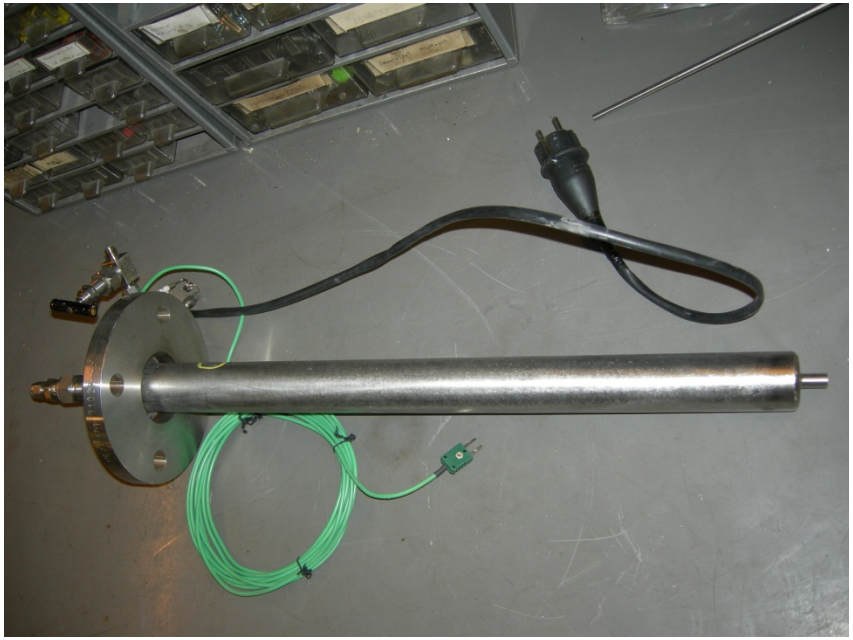
Dilution sampling

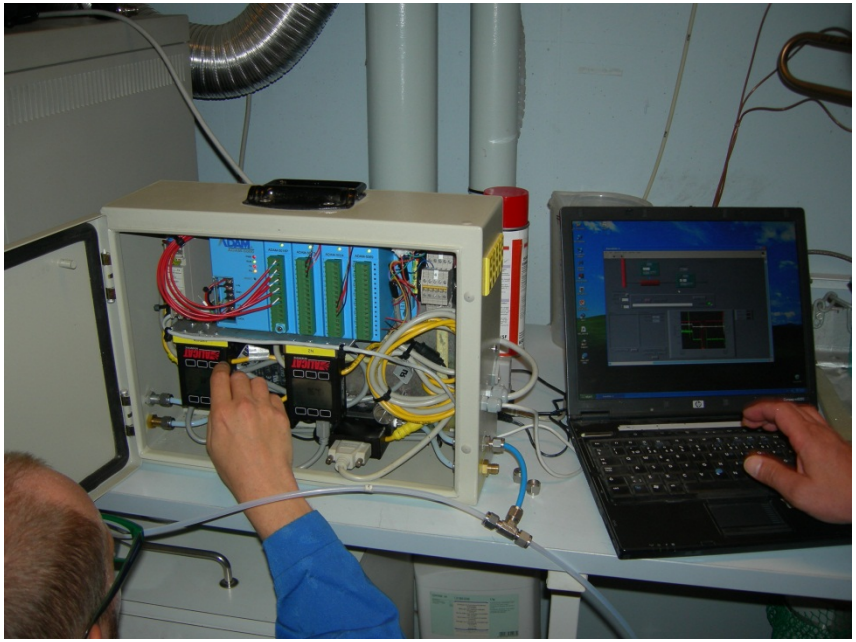
- Based on technology patented by VTT (e.g. US 8302495, FI 119450, WO/2007/080221)
- Can be applied to both atmospheric and pressurised systems
- Temperature range 280-800°C
- Dilution ratio typically 0-100

- Preliminary results with very tarry raw gas have been promising
  - Results consistent with controlled off-line sampling
  - No problem with condensation of tars in the sampling lines
  - Good repeatability

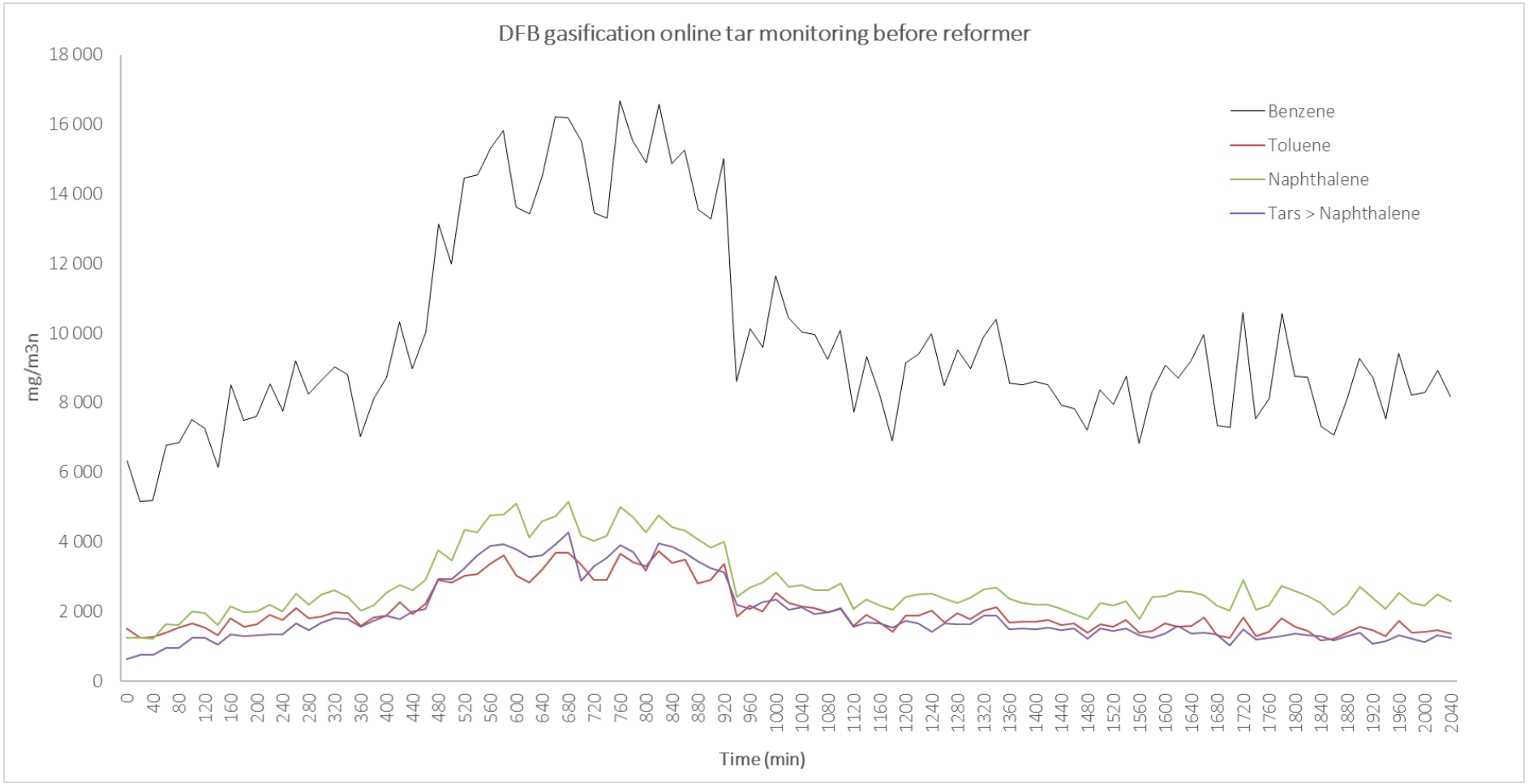


Dilution sampling probe with control unit





Example of rapid tar measurement by on-line-GC



Results from project: 2G2020 Gasification based BTL R&D

Comparison of tar analyses by on-line (dilution) and off-line methods

	Benzene (mg/m3n)		Toluene (mg/m3n)		Naphthalene (mg/m3n)		Tars > Naphthalene (mg/m3n)	
Sample no.	Offline	Online	Offline	Online	Offline	Online	Offline	Online
1	7732	8900	36	80	1297	2553	266	294
2	7926	8225	630	57	1546	2169	395	173
3	7948	7572	49	56	1251	1854	224	173
4	8892	7270	870	73	1869	2047	400	288
5	8573	6877	859	46	1776	1811	342	264
6	7633	6303	35	40	1107	1563	199	191
7	10797	11416	4568	2001	2708	3352	3004	5586
8	9953	10743	4194	1861	2469	3066	2751	4738
9	12204	11182	3040	1843	3339	3176	3168	4908
10	11569	11088	2799	1778	3037	3078	2766	4035
11	11411	10982	2904	1880	3146	3267	2905	3575

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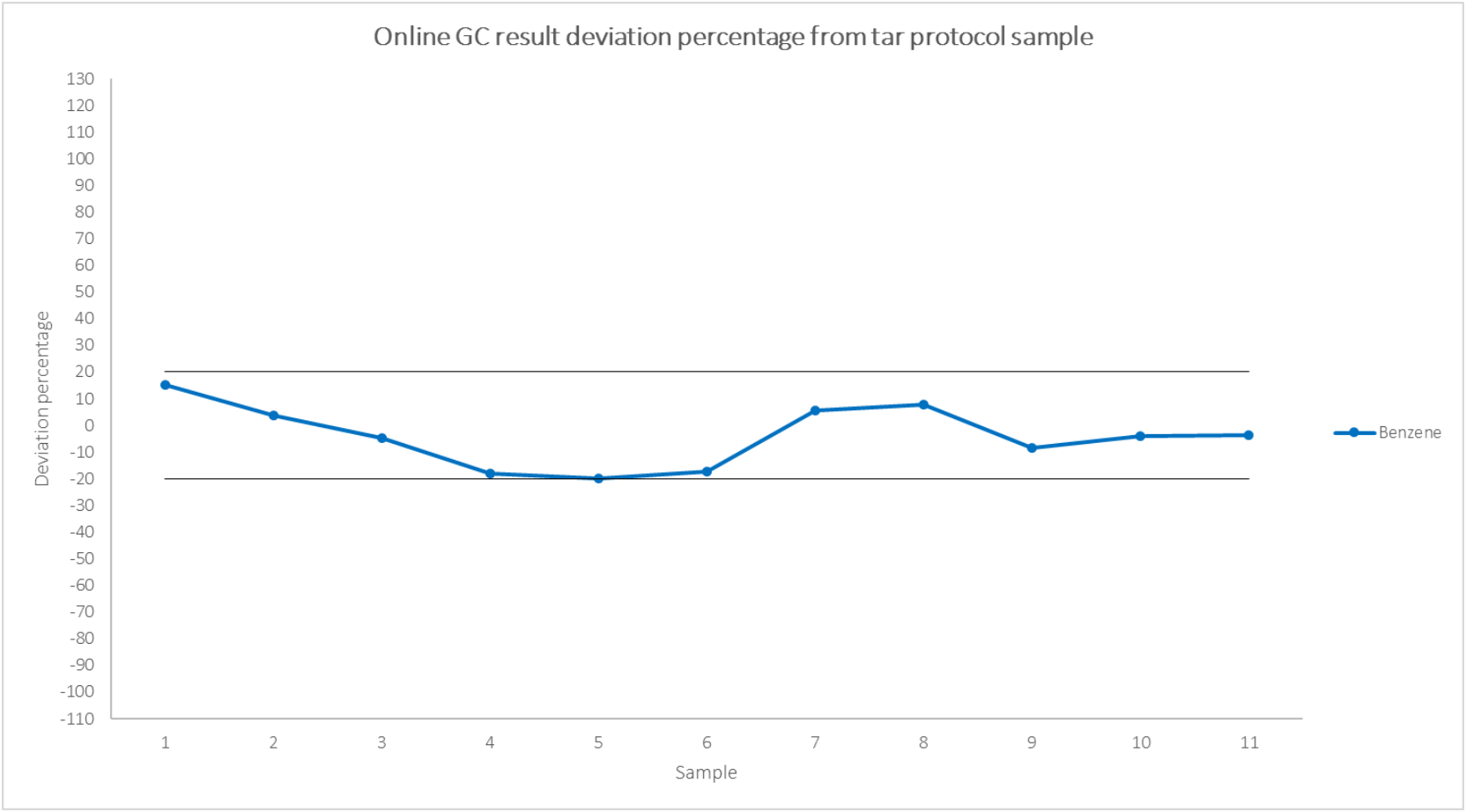

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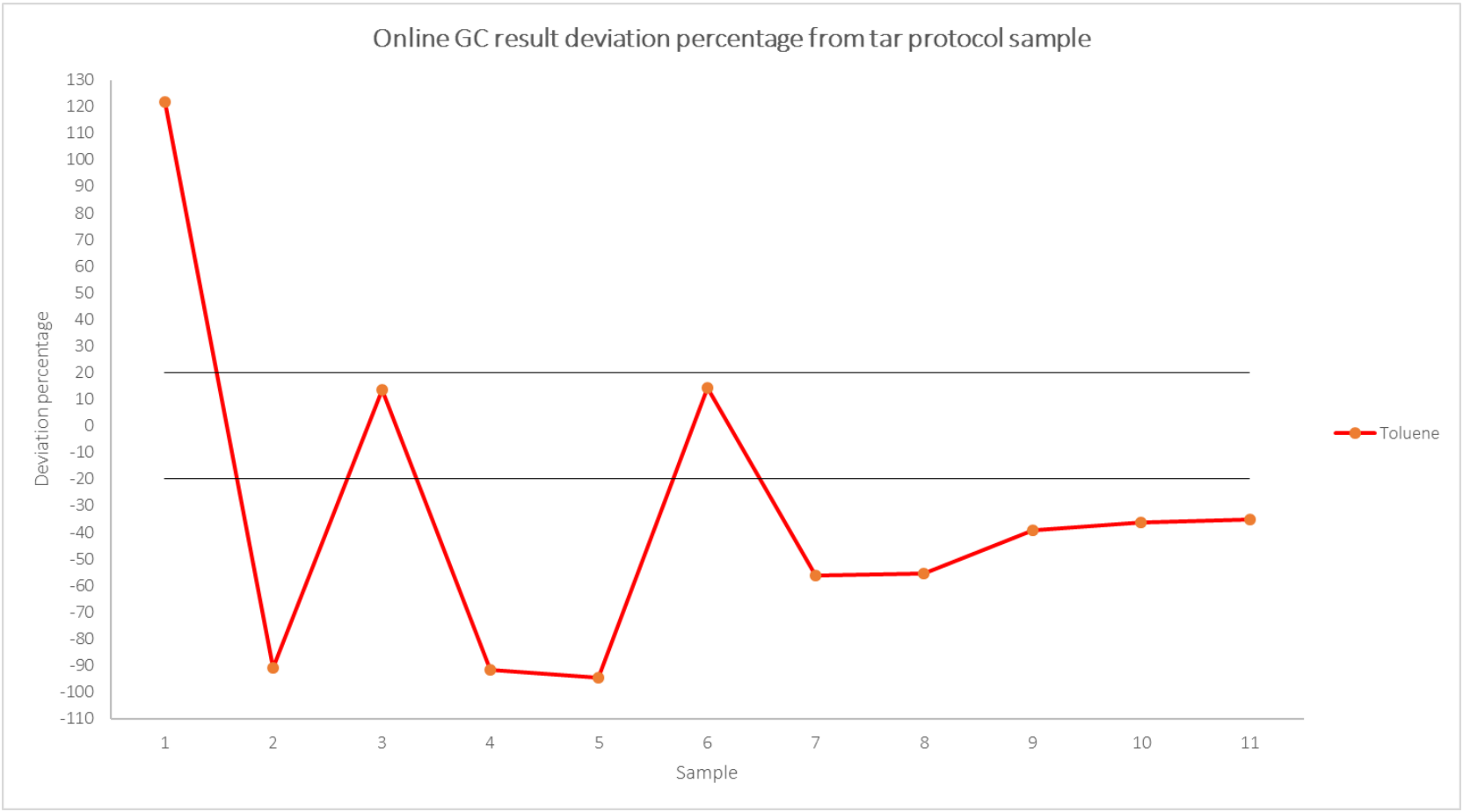

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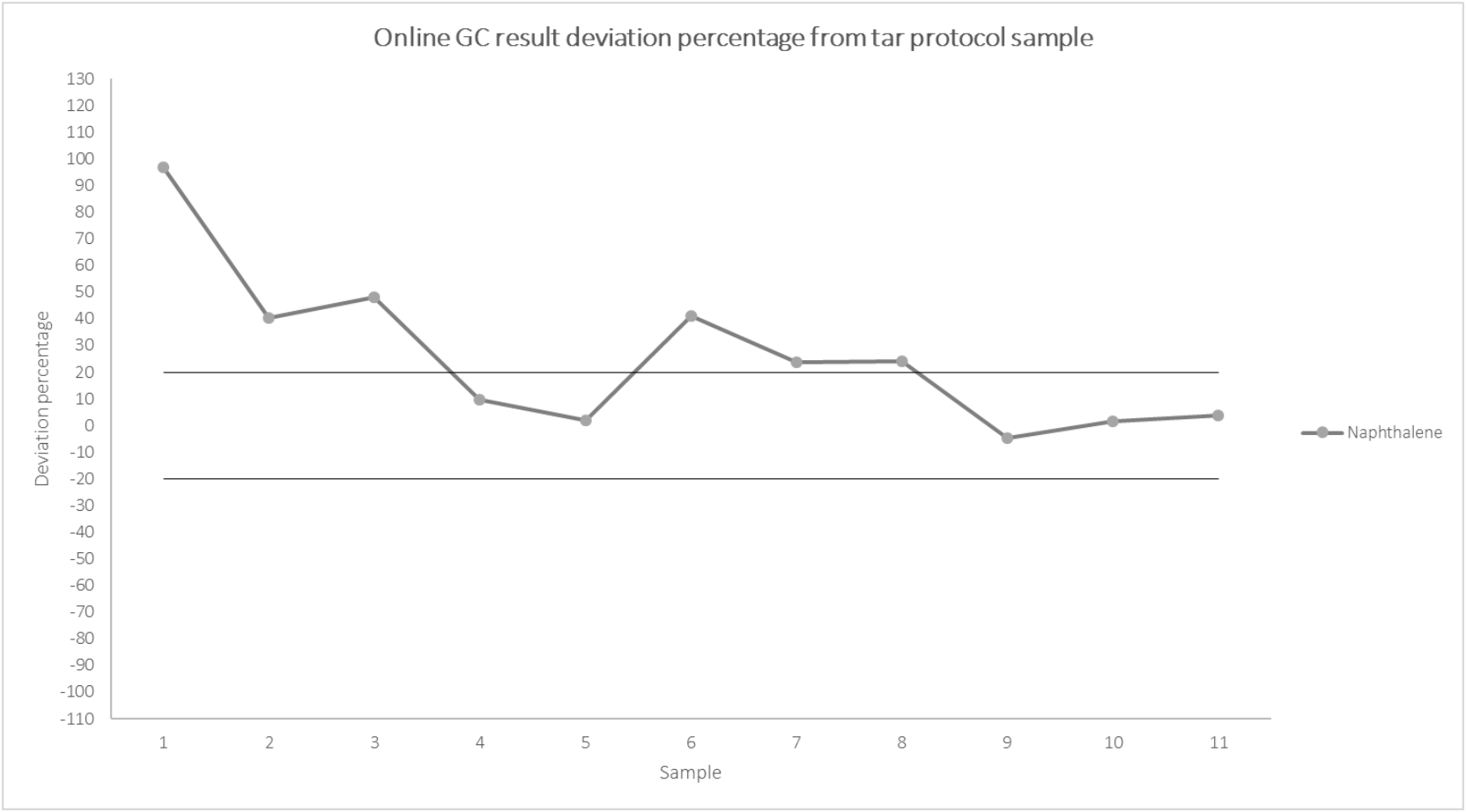

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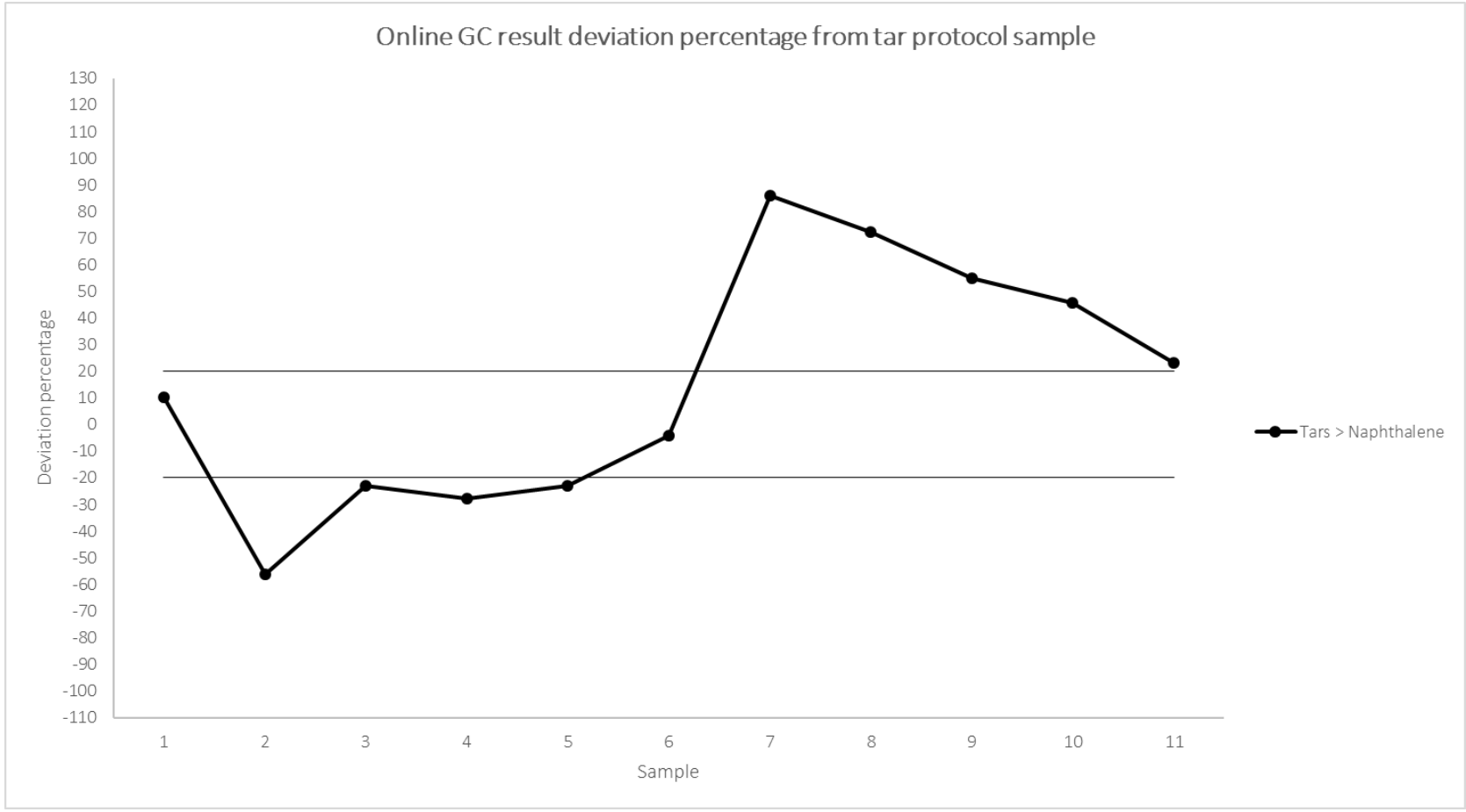

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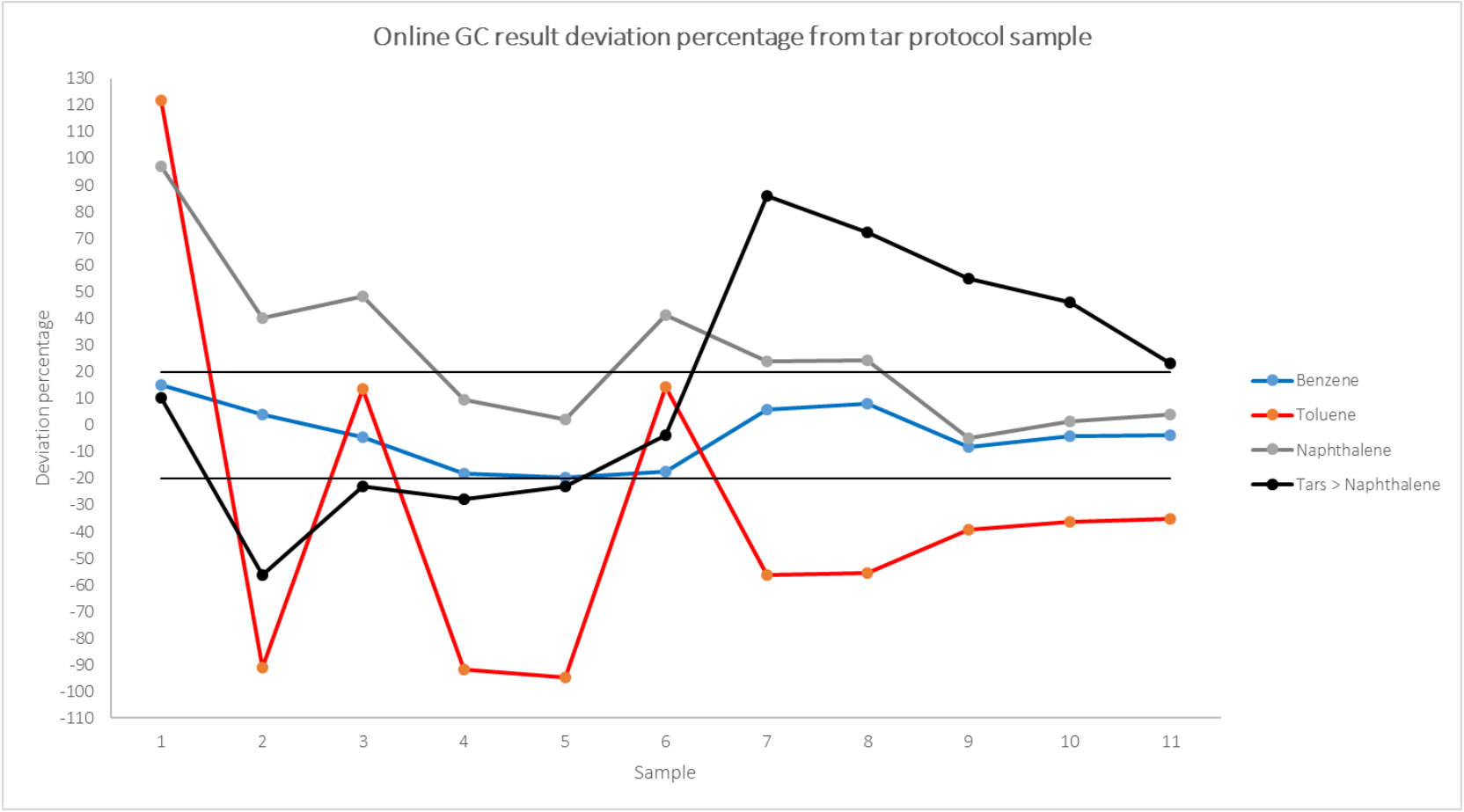
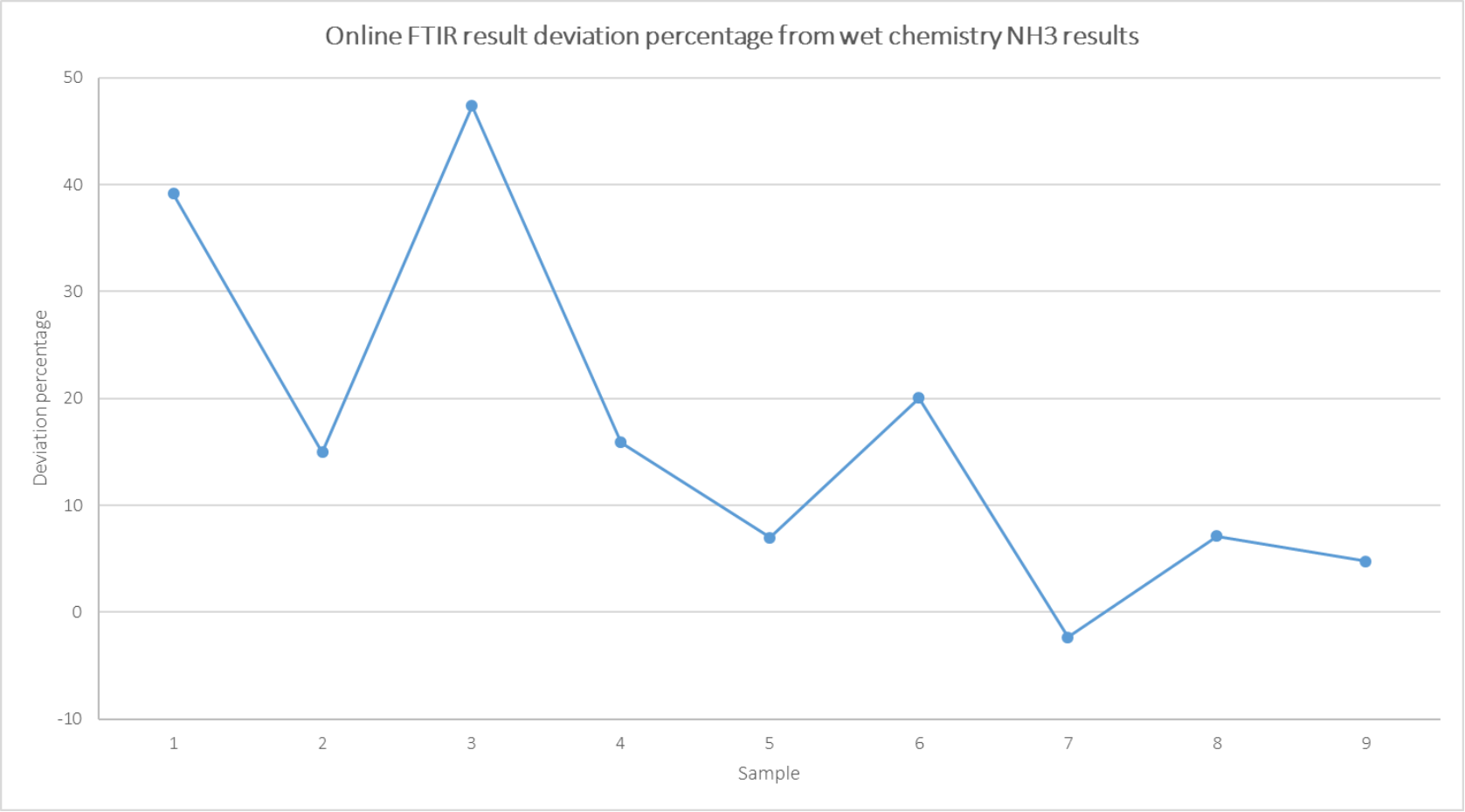
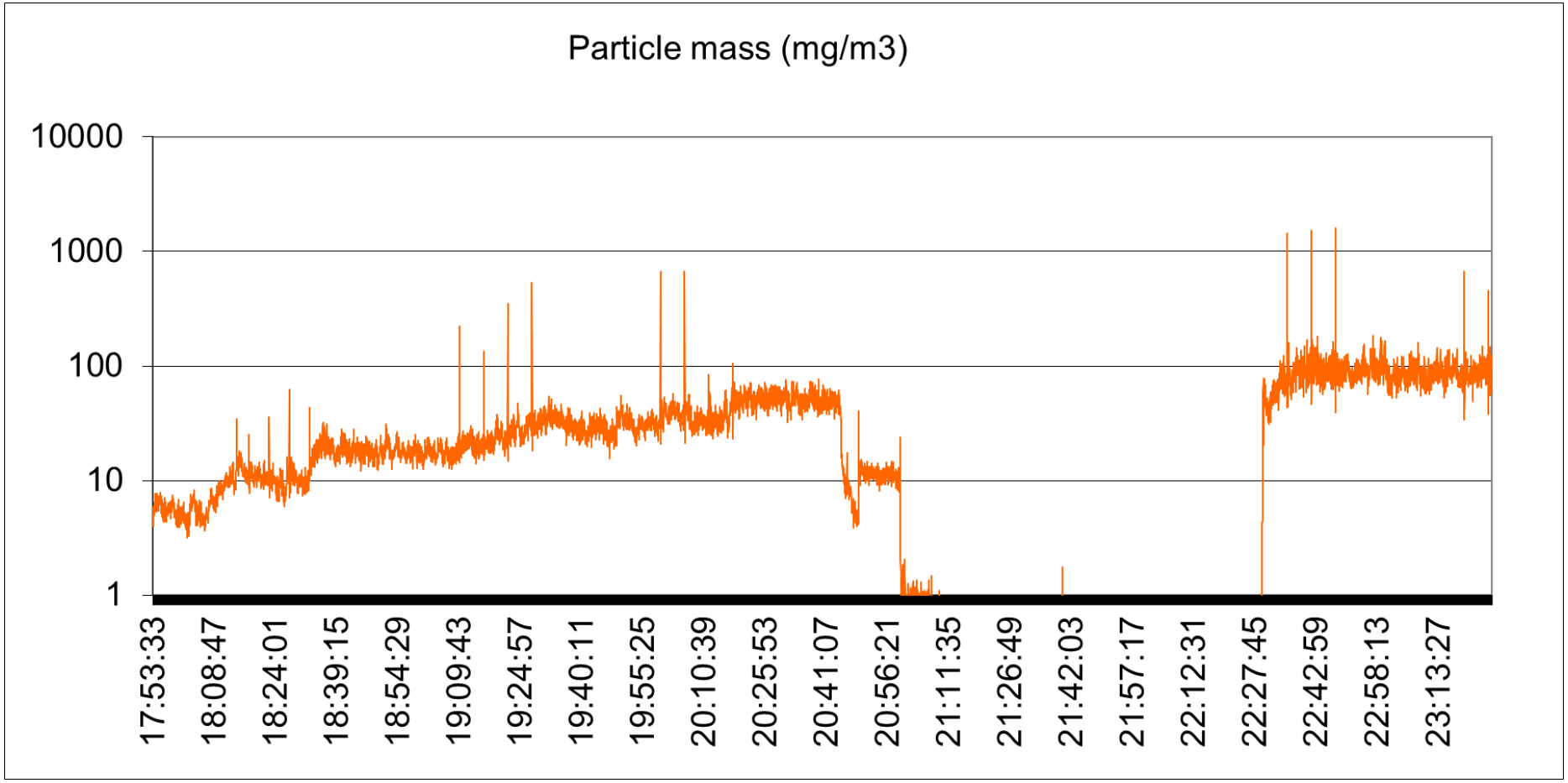


Comparison of on-line ammonia FTIR (diluted) and off-line method



Particle measurement with ELPI (Electrical Low Pressure Impactor) equipment



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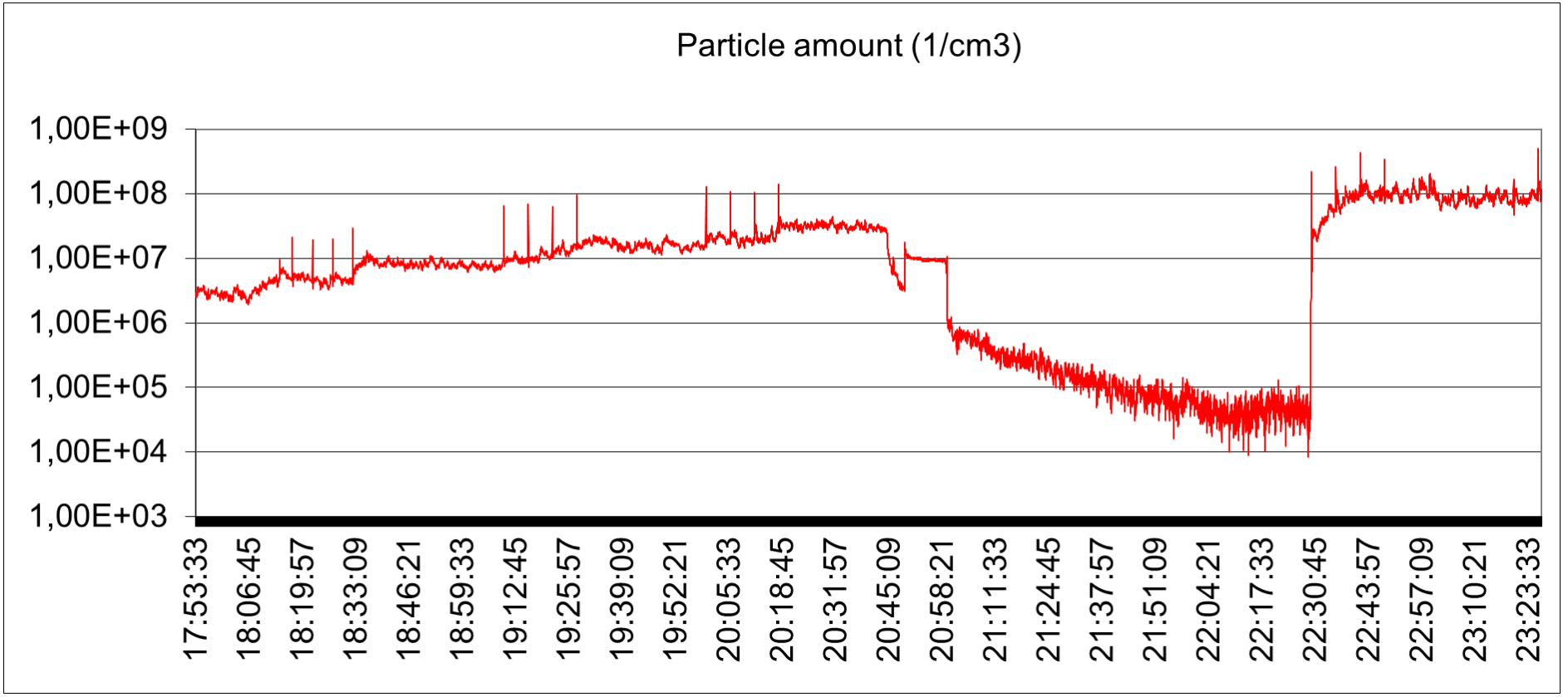

VTT’s current measurement capabilities related to thermochemical conversion processes

Sustainable syngas R&D and analytics

- Tar analysis (tar protocol)
- On-site measurement campaigns
- On-line gas sampling and analysis
- Special impurity analytics
  - Hydrogen impurities
  - Sulphur, ammonium nitrogen and cyanide compounds
- Gas analytics related to catalyst development

http://www.vttresearch.com/services/business-essentials/pilot-plants-and-r-d-infra/sustainable-syngas-r-d-and-analytics