

3rd Sampling Campaign in HyCoRA

HyCoRA OEM workshop

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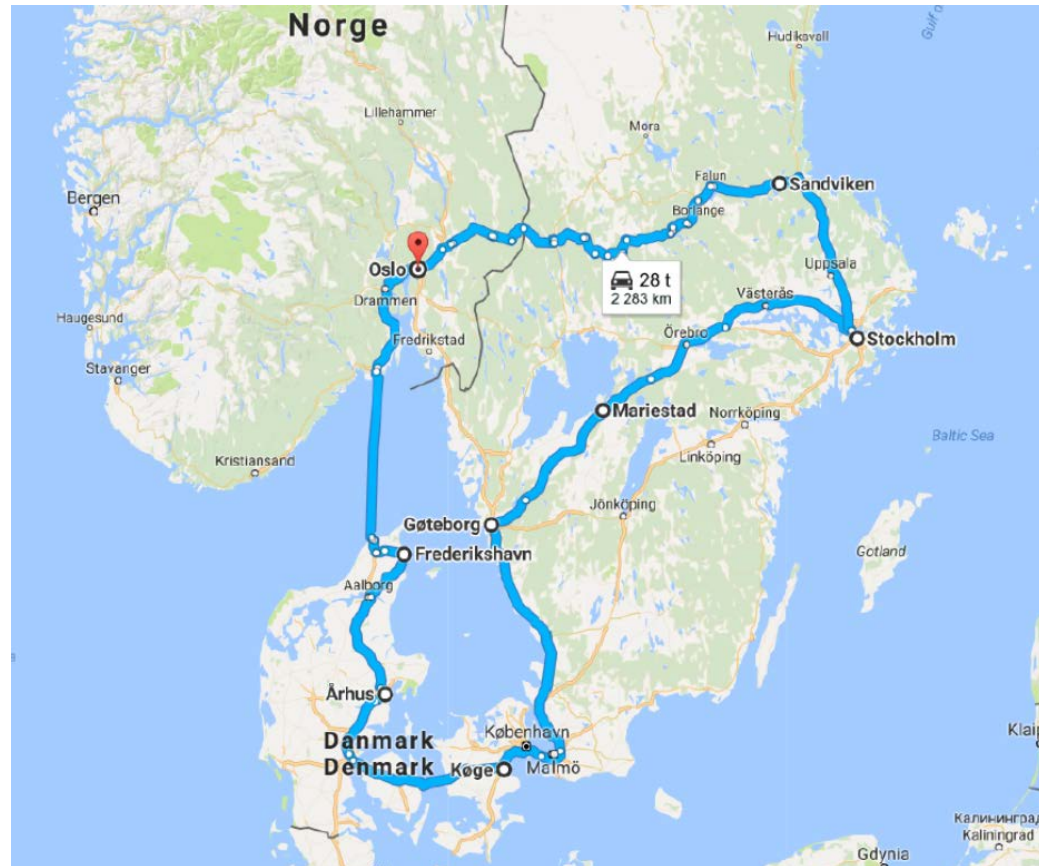
Outline

- Sampling plan
- Driving route
- Sampling setup and experiences
- Analytical results
- Particulate samples

Plan and preparations

- 10 samples
- Cover scandinavian stations
- All samples were sent to Smart Chemistry in US for analysis
- Gas cylinders evacuated to <2 mbar
 - If still with pure H_2 from last campaign only vacuum
 - If vented with air (due to shipment), filled 2x with H_2 6.0 to 10 bar and evacuated between

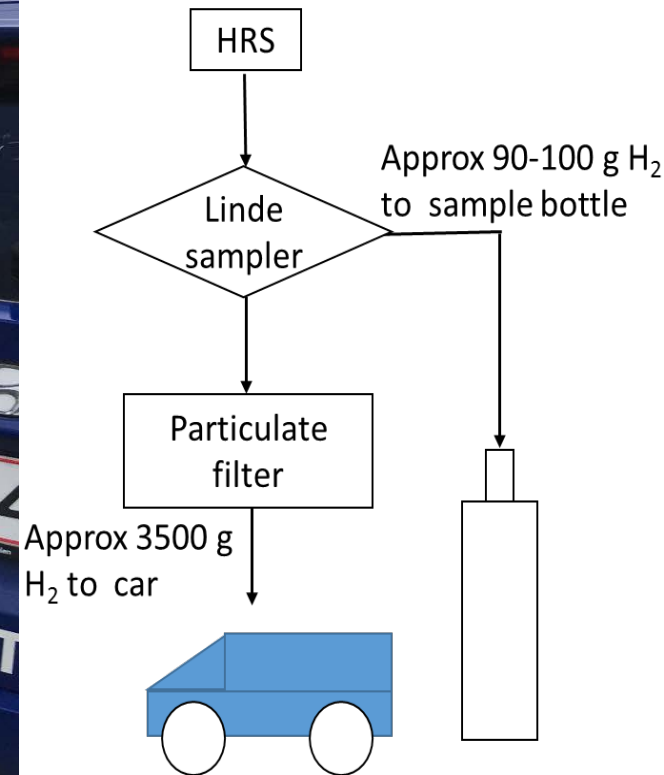
Driving route



HRS overview

HRS	Date	Feedstock	Storage	Sample ID
Gaustad (NO)	30.03.2017	Water electrolysis	Compressed	HY-1
Lillestrøm (NO)	30.03.2017	Water electrolysis	Compressed	HY-2
Gardermoen (NO)	30.03.2017	Water electrolysis	Compressed	HY-3
Porsgrunn (NO)	31.03.2017	Chlor-alkaline	Compressed (350bar) and booster	HY-4
Århus (DK)	05.04.2017	Water electrolysis (trucked-in)	Compressed	HY-5
Køge (DK)	05.04.2017	Water electrolysis	Trucked in	HY-6
Gothenburg (SE)	06.04.2017	Water electrolysis	Trucked in from Finland)	HY-7
Mariestad (SE)	06.04.2017	Water electrolysis	Trucked	HY-8
Sandviken (SE)	07.04.2017	Water electrolysis	Trucked in (on site supply not ready)	HY-10
Gausstad (NO)	20.04.2017	Water electrolysis	Compressed	HY-9

Experiences with equipment



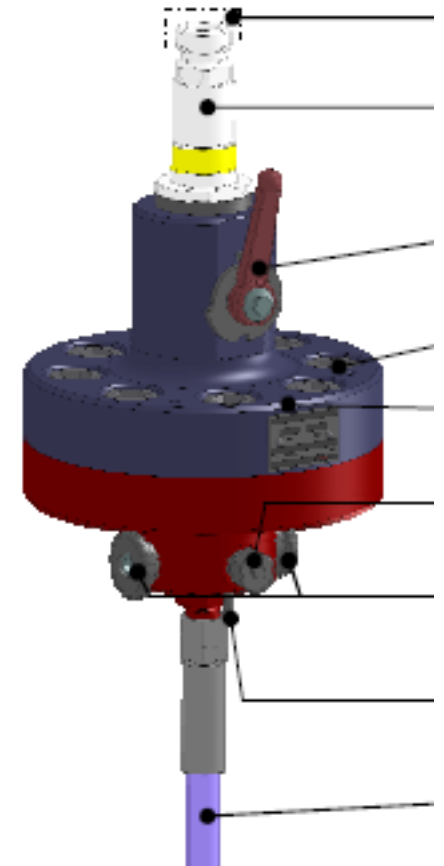
Experiences with equipment



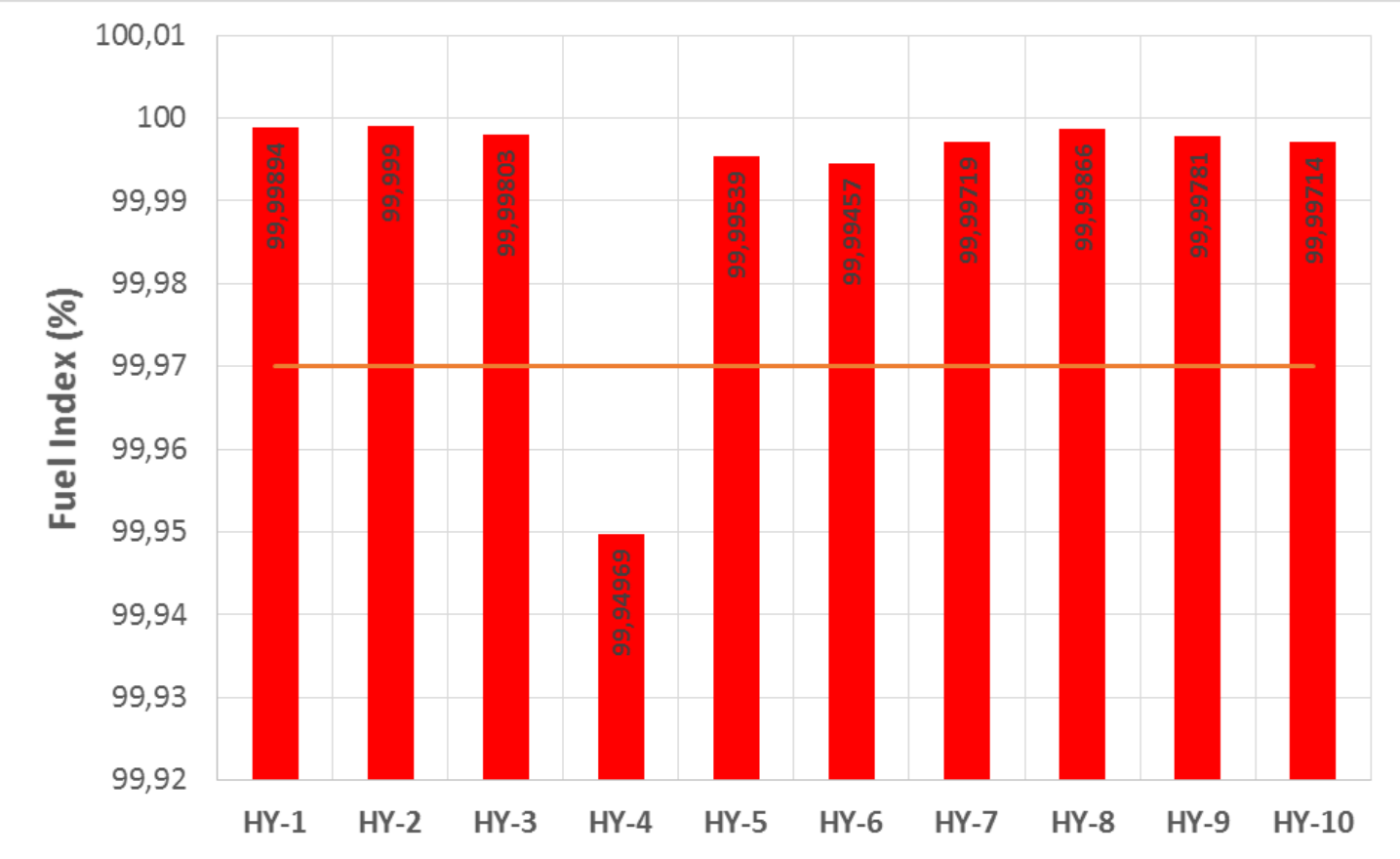
Experiences with equipment



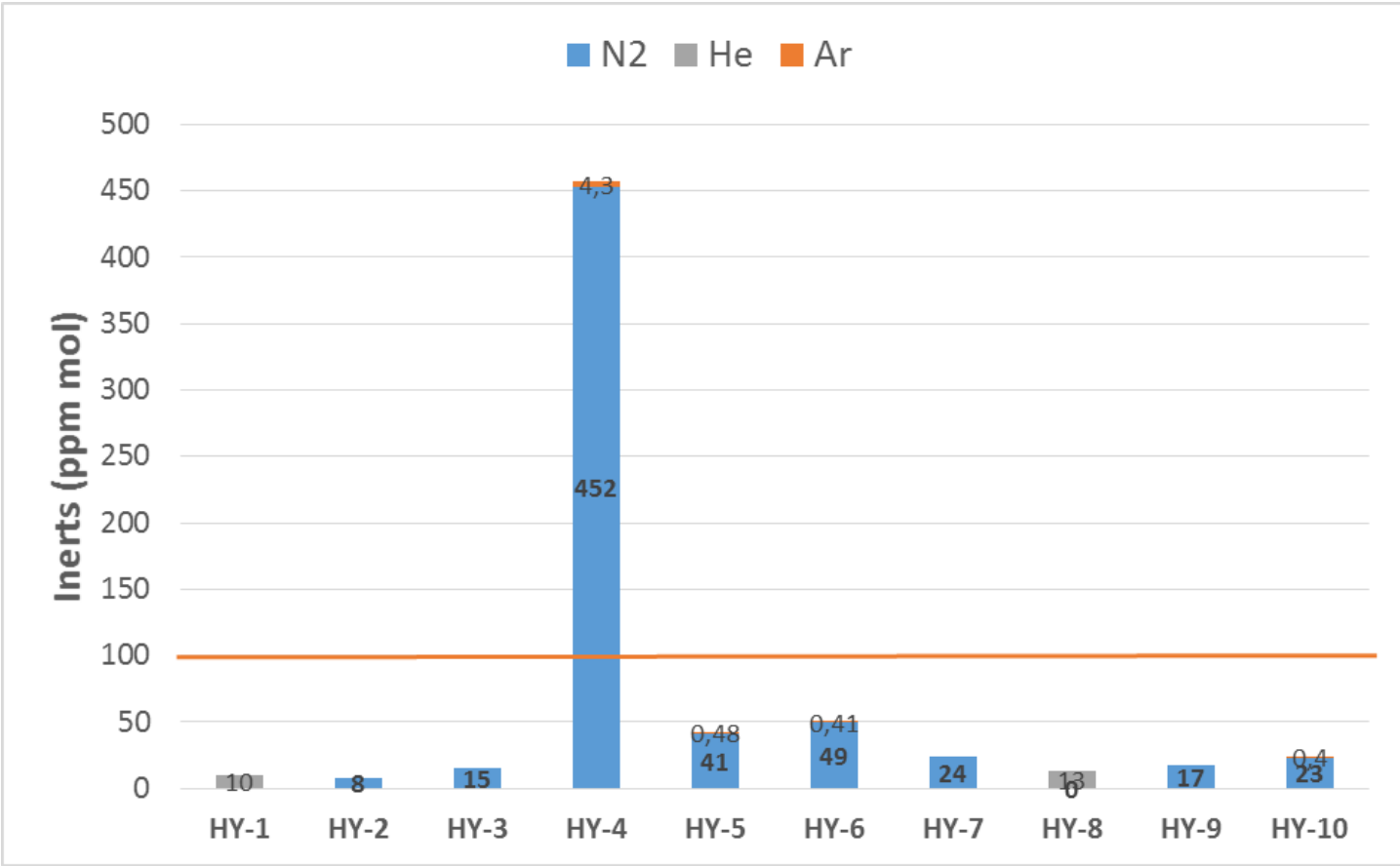
Experiences with equipment



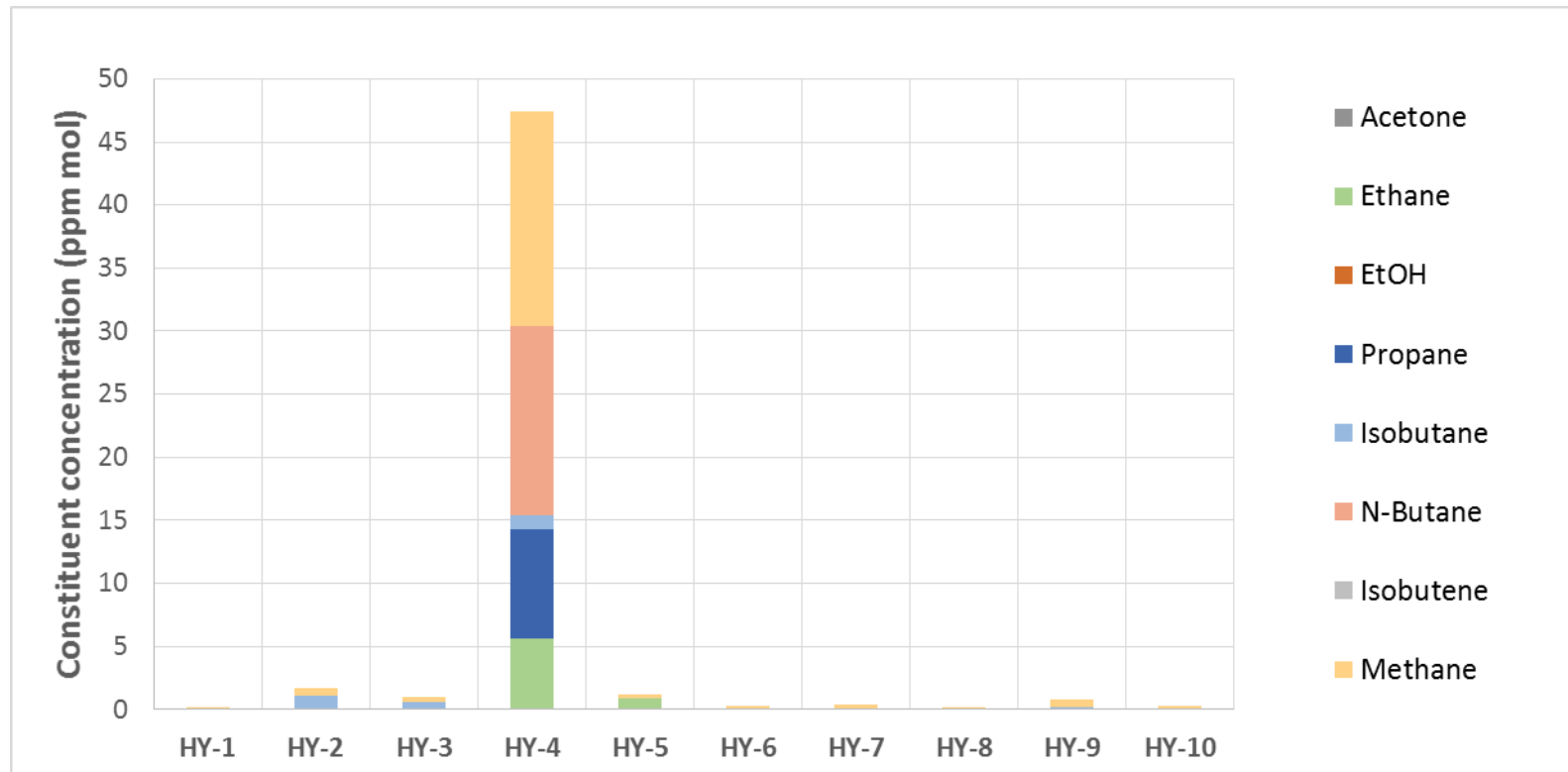
Fuel index



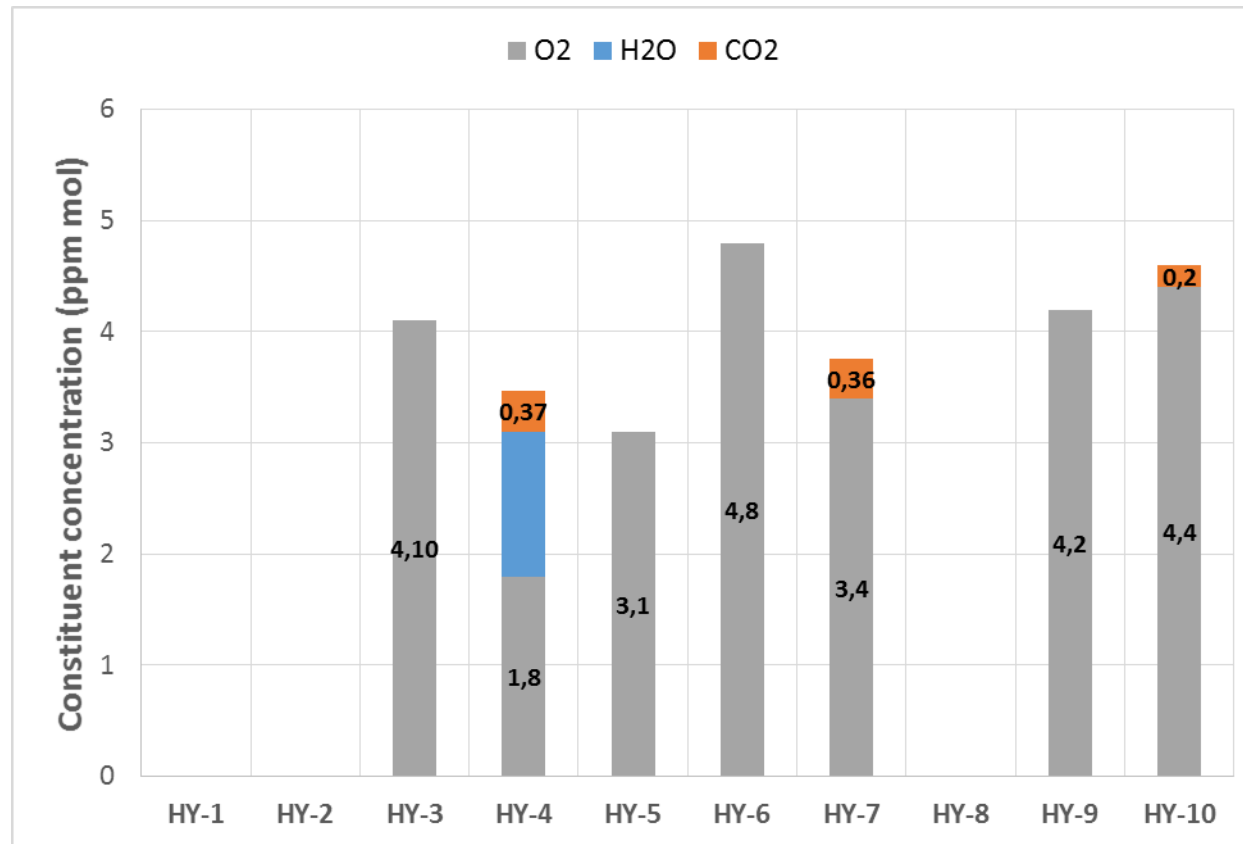
Inerts



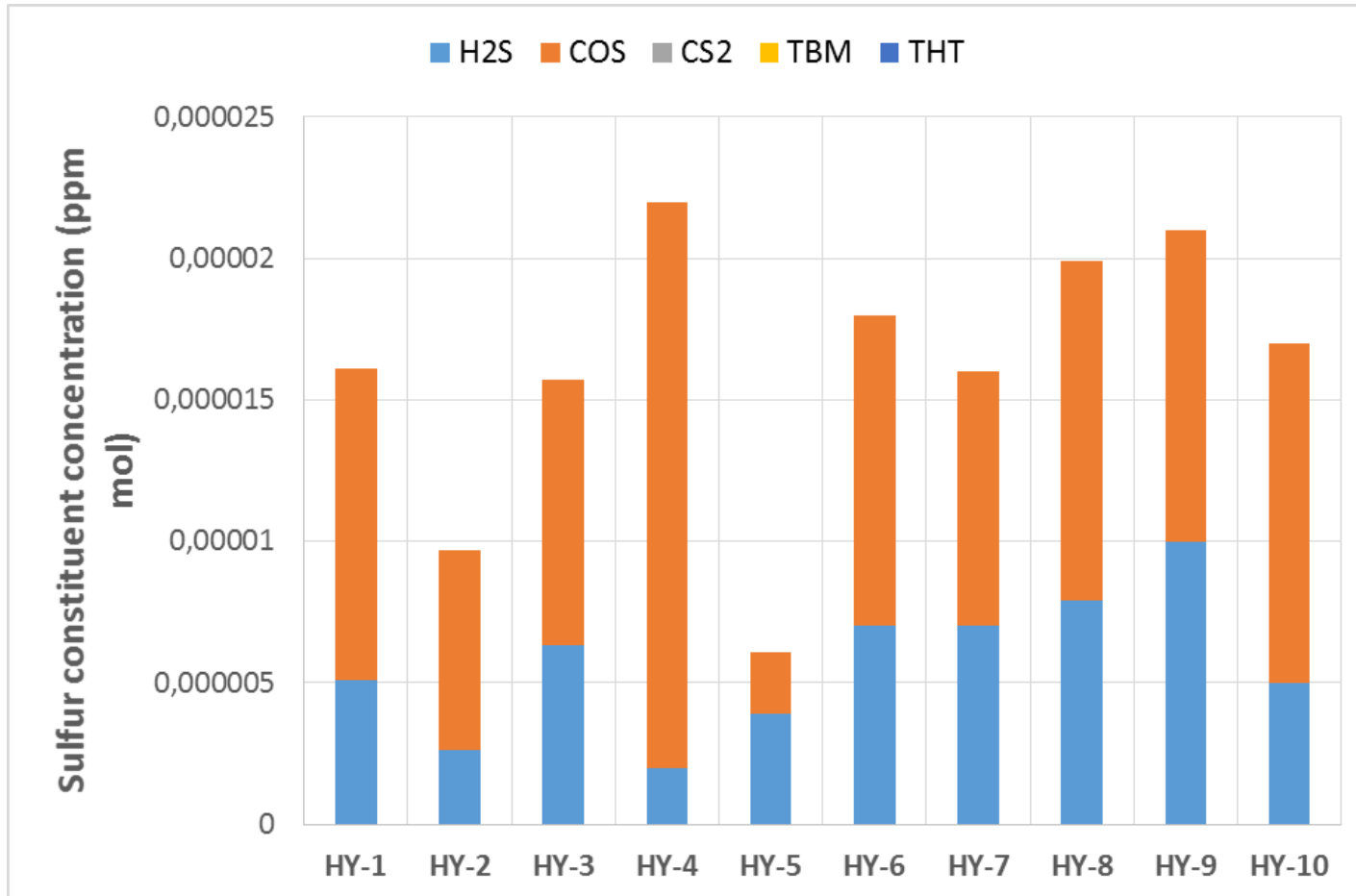
Total hydrocarbons



O₂, H₂O and CO₂



Sulphur and halogenates



Comparison of twin samples

ppm	HY-1	HY-9
City	Gausstad	Gausstad 2
Fuel Index	99,99894	99,99781
H2O	<1	<1
THC (C1)	0,22	0,8
THC (C1 - CH4)	0,01	0,22
Methane	0,21	0,58
Ethane		0,11
Propane	0,003	0,017
Isobutane	0,0064	0,027
N-Butane		0,011
Isobutene		0,052
O2	<1	4,2
He	10	<10
N2 & Ar		17
N2	<5	17
Ar	<0.4	<0.4
CO2	<0.1	<0.1
CO	0,0022	0,0035
TS	0,000016	0,000017
H2S	0,0000051	0,00001
COS	0,000011	0,000011
HCHO		
HCOOH		
TH	0,00067	0,0042
C4Cl4F6	0,00067	0,0042

Additional verifications

- Sample Hy-4 and Hy-9 had results deviating from the expectations
- Bottle Hy-4 had earlier been used for Geiselwind
- Bottle Hy-9 had earlier been used for Kolding

- Air could be introduced from deficiencies in purging / vacuuming of the bottles
- Hydrocarbons can not be explained by that

Particulate measuerments

- Drying of filters challenging – PP substrate with PTFE
- Improved drying from SC2 to SC3 have significantly reduced standard deviation (SC2 2xSD 0.2-0.3mg/kgH₂)
- No recorded weight gain on filters
- Placement after Linde sampler possible cause?
- Particulate samples should not be collected simultaneously?

	Mean before [mg]	Mean after [mg]	Difference [mg]	2x Std Dev [mg]	kg H ₂ filled	Weight gain per kg H ₂ [mg]	2xStd Dev / kg H ₂ [mg]
HY-5	100,403	100,153	-0,250	0,066	3,915	-0,064	0,017
HY-6	97,210	96,933	-0,277	0,098	3,900	-0,071	0,025
HY-7	100,520	100,430	-0,090	0,057	NA	NA	
HY-8	100,687	100,540	-0,147	0,10	3,266	-0,045	0,031
HY-9	99,963	99,893	-0,070	0,10	NA		
Field Blank	99,937	99,830	-0,107	0,059	NA		

Conclusions

- 10 samples collected in SC3
- Overall high quality, and only one sample that deviated from requirements
- Sampling equipment works flawlessly
- Simultaneous sampling of particulates and gas can not be recommended