

PUFF-BY-PUFF ANALYSIS OF MAINSTREAM SMOKE CONSTITUENTS OF NON-LIP/FSC AND LIP/FSC CIGARETTES

Abstract No. 44

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Agenda

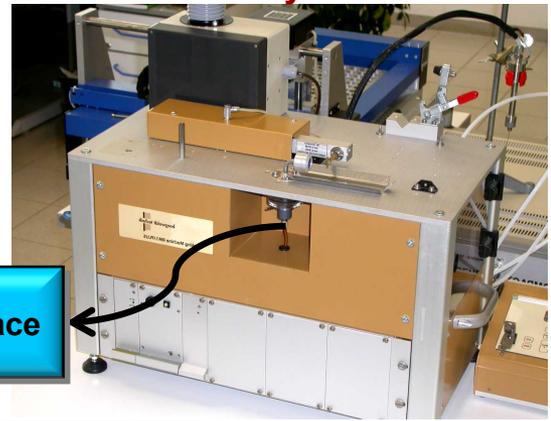
- Equipment
- Measurement Methods & Sample Sets
- Results
- Outlook

Equipment

AirSense

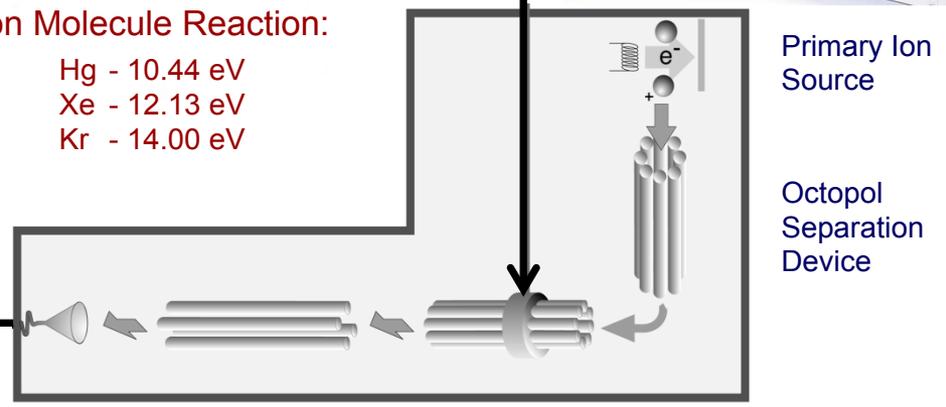


On-Line Puff-per-Puff Smoke Analysis



Ion Molecule Reaction:

- Hg - 10.44 eV
- Xe - 12.13 eV
- Kr - 14.00 eV



Particle Detector

Quadrupole Mass Filter

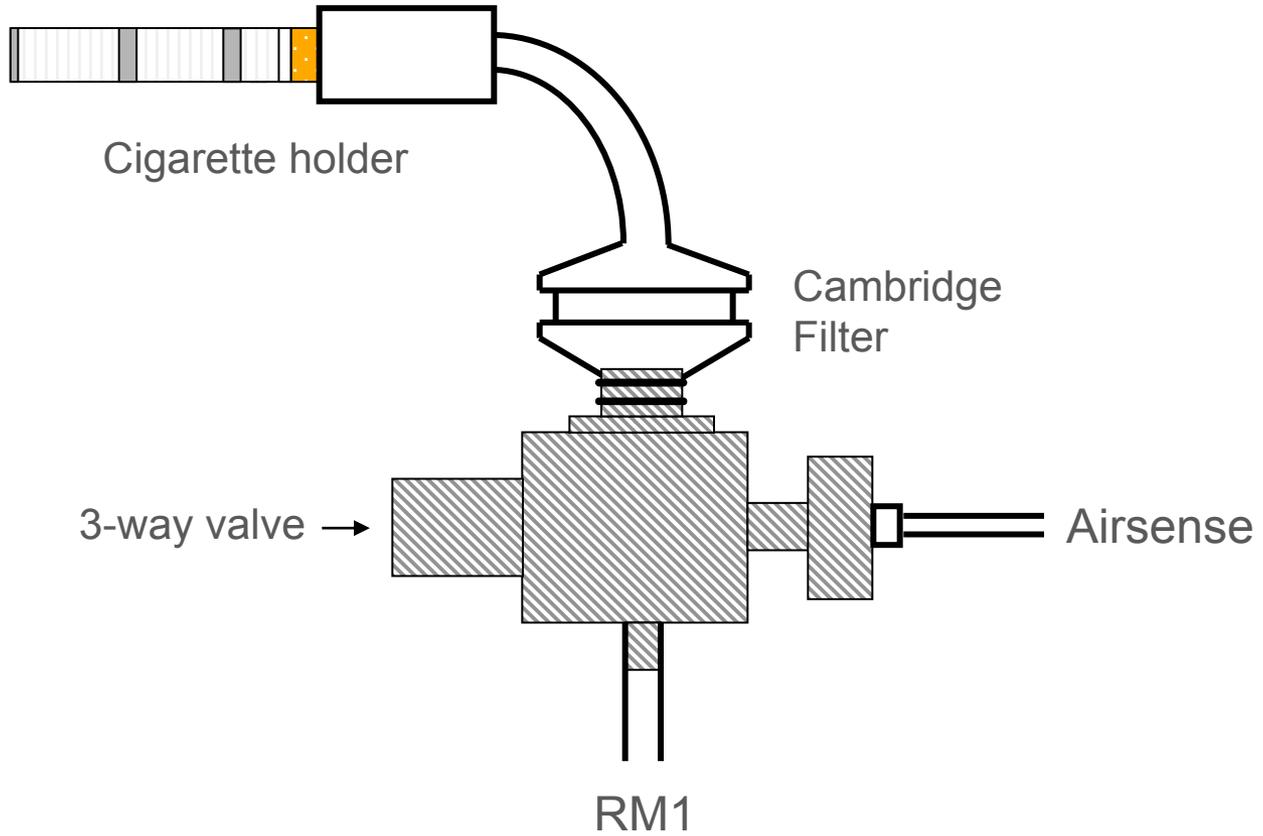
Charge Exchange Cell

Primary Ion Source

Octopole Separation Device

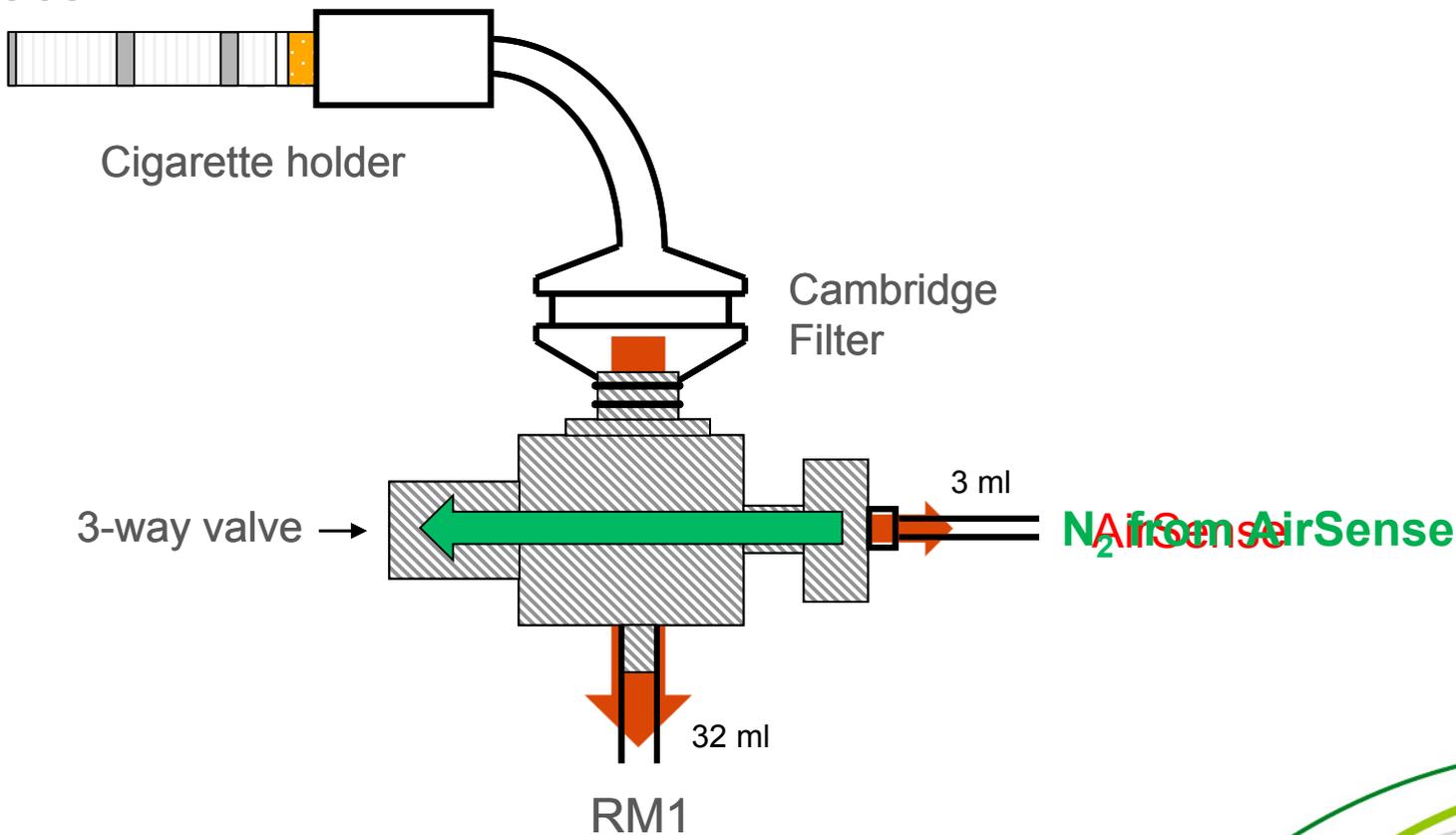
Equipment

Interface



Equipment

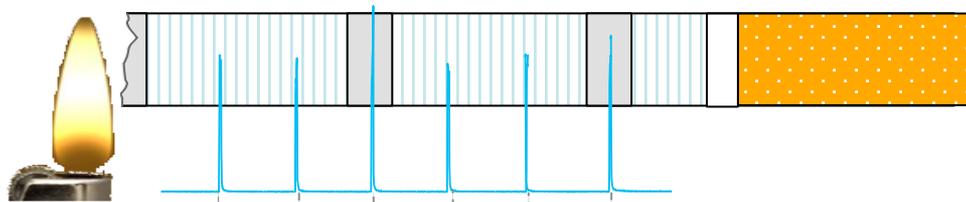
Interface



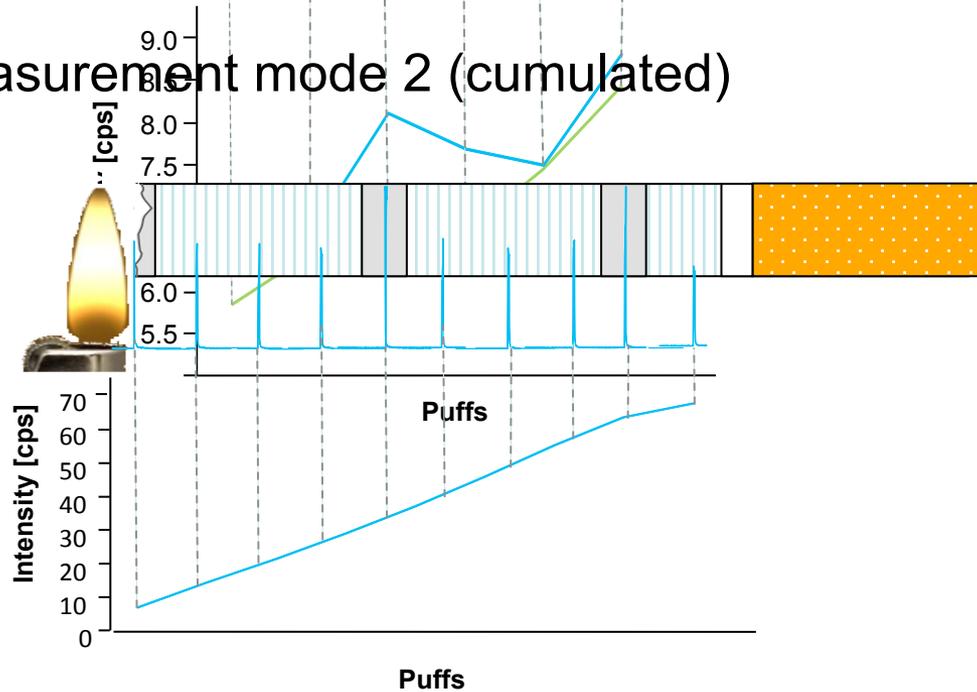
before starting of puff or between two puffs

Measurement methods

Measurement mode 1 (puff-by-puff)



Measurement mode 2 (cumulated)





Cigarette sample set

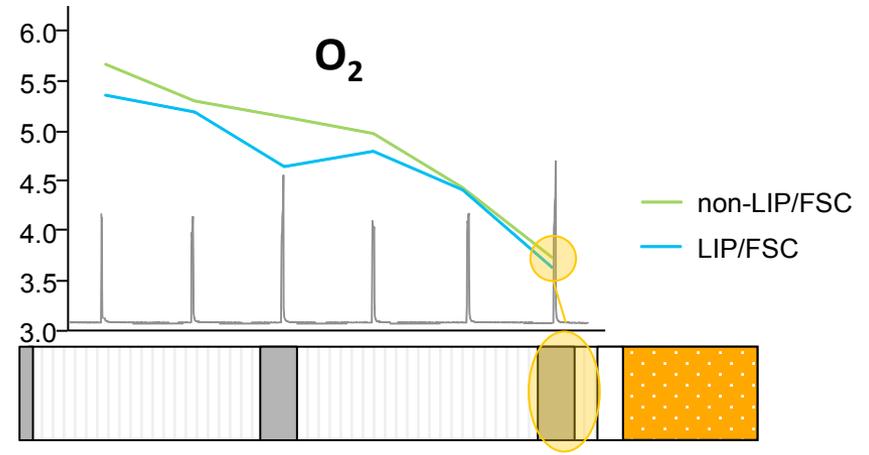
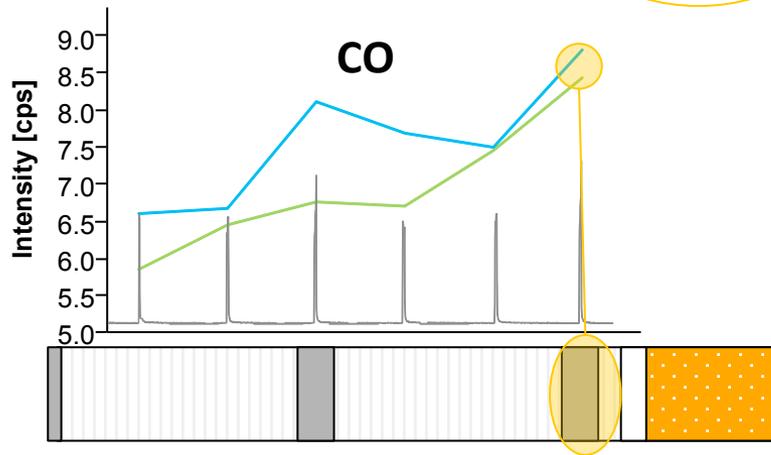
Cigarette sample set

Sample	permeability [CU]	burn additive [%]	band D* [cm/s]	band design
set 1: non-LIP vs. LIP				
non-LIP/FSC	75	2	-	-
LIP/FSC	75	2	0.05	6/18
set 2: base paper parameter - permeability				
LIP/FSC [75 CU]	75	1	0.05	6/18
LIP/FSC [125 CU]	125	1	0.05	6/18
set 3: base paper parameter - burn additive				
LIP/FSC [1%]	75	1	0.05	6/18
LIP/FSC [2%]	75	2	0.05	6/18
set 4: band diffusion capacity				
LIP/FSC [0.05 cm/sec]	80	1.5	0.05	6/18
LIP/FSC [0.15 cm/sec]	80	1.5	0.15	6/18

Results

SET 1: LIP/FSC vs. non-LIP/FSC cigarettes

Sample	paper parameters				smoke yield				
	permeability [CU]	burn additive [%]	band D* [cm/s]	band design	CO [mg/cig]	CO ₂ [mg/cig]	puff count [no.]	CO [mg/puff]	CO ₂ [mg/puff]
non-LIP/FSC	75	2%	-	-	11.5	42.9	8.5	1.35	5.1
LIP/FSC	75	2%	0.05	6/18	14.8	50.9	8.8	1.67	5.8



Findings

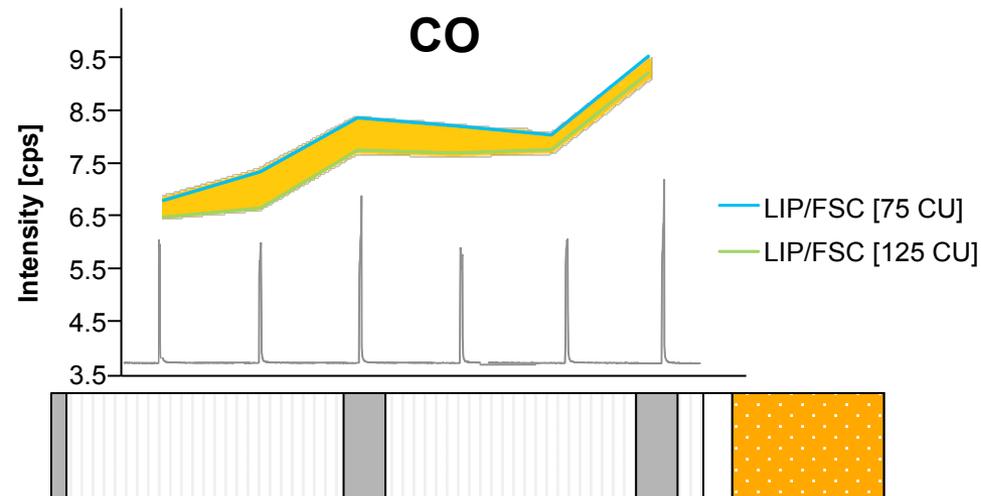
- LIP/FSC vs. non-LIP/FSC cigarettes
 - typical puff-by-puff profile of LIP/FSC cigarettes
 - higher CO levels in banded area
 - lower O₂ levels in banded area
 - end of cigarette
 - similar puff profile → **less influence of tobacco rod ventilation**

Results

SET 2: base paper parameters – permeability (75 CU vs. 125 CU)

Sample	paper parameters				smoke yield				
	permeability [CU]	burn additive [%]	band D* [cm/s]	band design	CO [mg/cig]	CO ₂ [mg/cig]	puff count [no.]	CO [mg/puff]	CO ₂ [mg/puff]
LIP/FSC [75 CU]	75	1%	0.05	6/18	16.1	51.8	9.6	1.68	5.4
LIP/FSC [125 CU]	125	1%	0.05	6/18	14.4	49.3	9.7	1.48	5.1

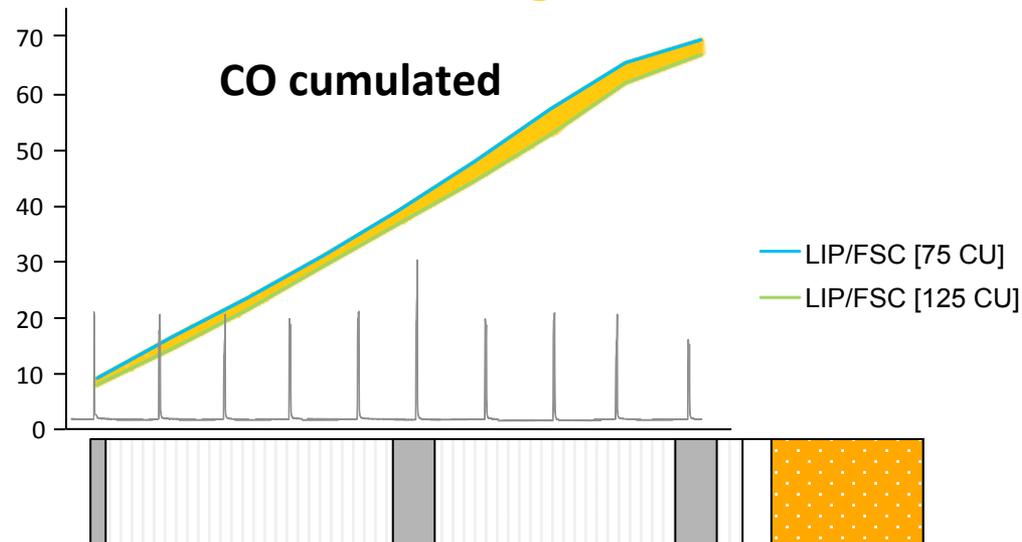
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Results

SET 2: base paper parameters – permeability (75 CU vs. 125 CU)

Sample	paper parameters				smoke yield				
	permeability [CU]	burn additive [%]	band D* [cm/s]	band design	CO [mg/cig]	CO ₂ [mg/cig]	puff count [no.]	CO [mg/puff]	CO ₂ [mg/puff]
LIP/FSC [75 CU]	75	1%	0.05	6/18	16.1	51.8	9.6	1.68	5.4
LIP/FSC [125 CU]	125	1%	0.05	6/18	14.4	49.3	9.7	1.48	5.1

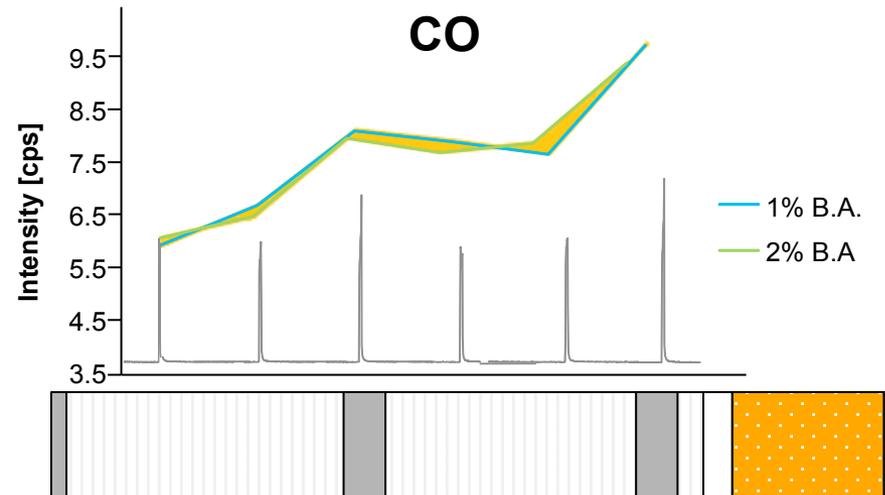


Results

SET 3: base paper parameters – burn additives (1% vs. 2%)

Sample	paper parameters				smoke yield				
	permeability [CU]	burn additive [%]	band D* [cm/s]	band design	CO [mg/cig]	CO ₂ [mg/cig]	puff count [no.]	CO [mg/puff]	CO ₂ [mg/puff]
LIP/FSC [1%]	75	1%	0.05	6/18	16.1	51.8	9.6	1.68	5.4
LIP/FSC [2%]	75	2%	0.05	6/18	14.8	50.9	8.8	1.67	5.8

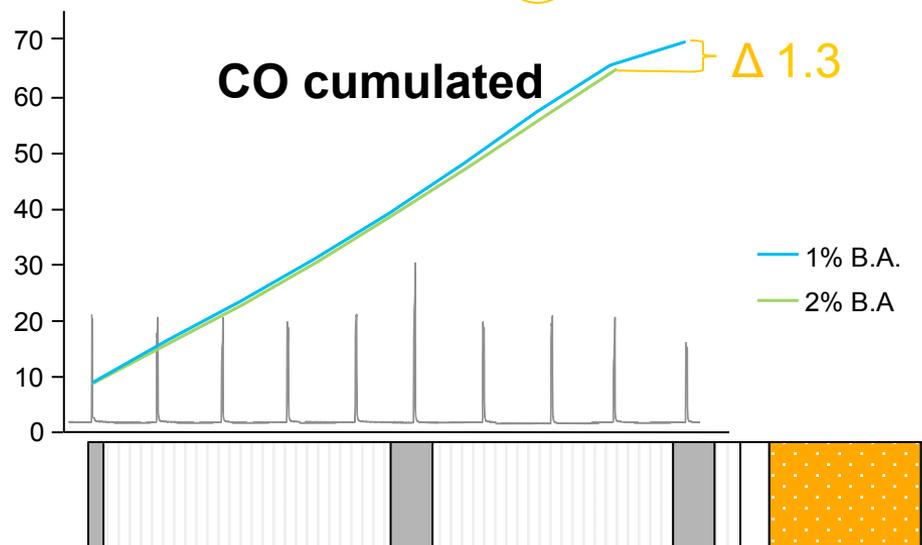
$\Delta 0.01$



Results

SET 3: base paper parameters – burn additives (1% vs. 2%)

Sample	paper parameters				smoke yield				
	permeability [CU]	burn additive [%]	band D* [cm/s]	band design	CO [mg/cig]	CO ₂ [mg/cig]	puff count [no.]	CO [mg/puff]	CO ₂ [mg/puff]
LIP/FSC [1%]	75	1%	0.05	6/18	16.1	51.8	9.6	1.68	5.4
LIP/FSC [2%]	75	2%	0.05	6/18	14.8	50.9	8.8	1.67	5.8



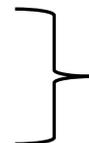
Findings

■ Base paper parameters

■ typical puff-by-puff profile for all LIP/FSC-samples

● permeability

- differences in CO/puff
- same puff count



differences in smoke yield/puff

● burn additives

- similar in CO/puff
- differences in puff count

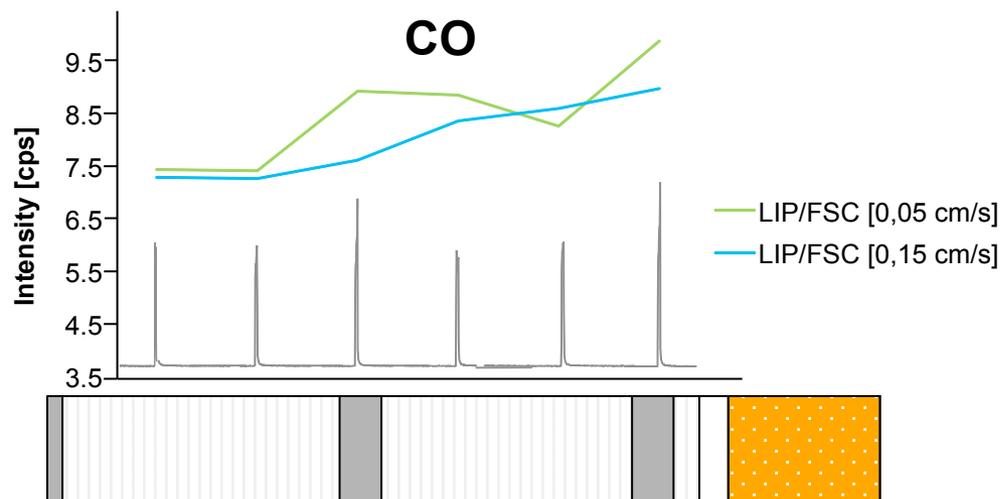


similar in smoke yield/puff

Results

SET 4: band diffusion capacity (0.05 cm/s vs. 0.15 cm/s)

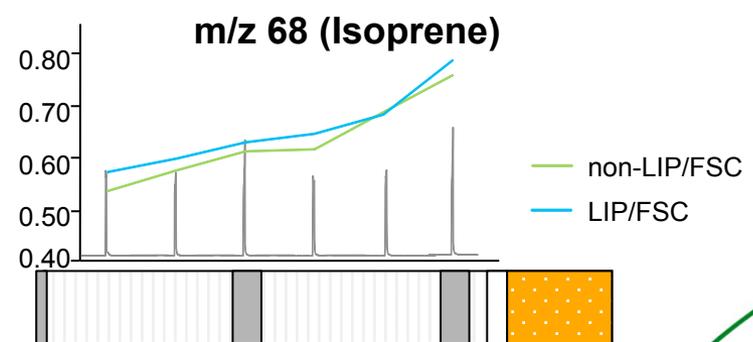
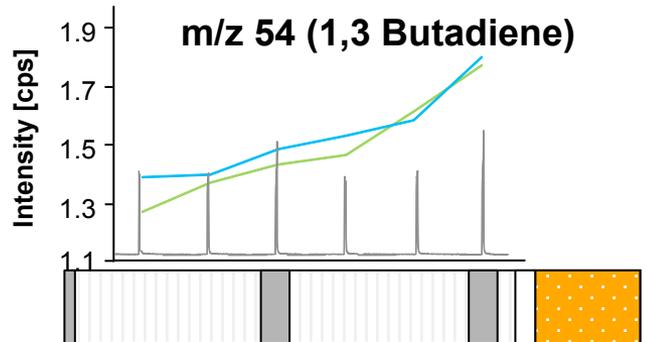
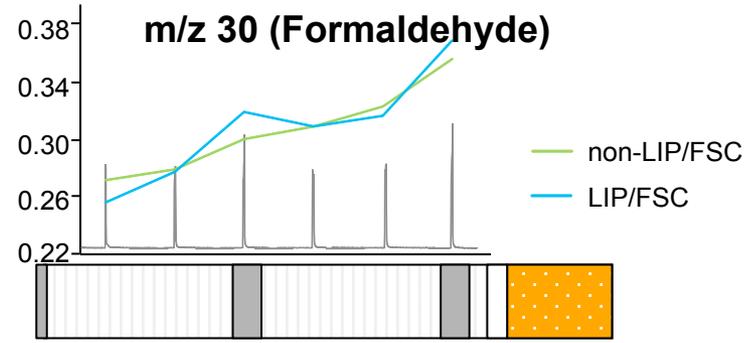
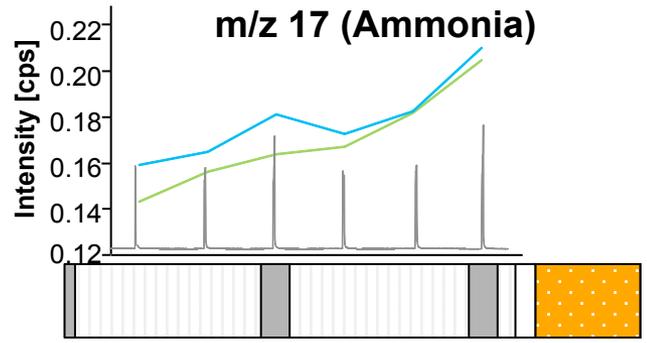
Sample	paper parameters				smoke yield				
	permeability [CU]	burn additive [%]	band D* [cm/s]	band design	CO [mg/cig]	CO ₂ [mg/cig]	puff count [no.]	CO [mg/puff]	CO ₂ [mg/puff]
LIP/FSC [0,05 cm/s]	80	1.5%	0.05	6/18	16.4	50.7	8.9	1.84	5.7
LIP/FSC [0,15 cm/s]	80	1.5%	0.15	6/18	14.9	49.0	9.0	1.65	5.4



Outlook

LIP/FSC vs. non-LIP/FSC cigarettes

Other analytes



Summary

- Typical puff-by-puff profile of LIP/FSC cigarettes
 - higher CO levels in banded area
 - lower O₂ levels in banded area

Exception: sample with high band diffusion capacity

- Observations:
 - trend for other analytes → under further investigation

PERFORMANCE
BY UNDERSTANDING



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THANK YOU!



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