Limitations in the characterisation of cigarette brands using different machine smoking regimes

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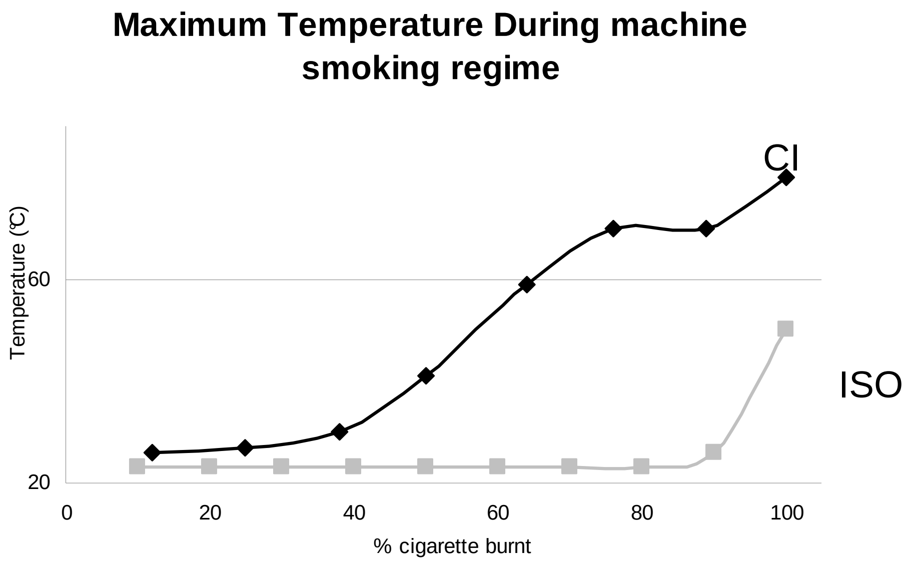
Background

- It is recognized that no single machine smoking regime can represent the different behaviors of individual human smokers

	ISO 3308 ISO	Massachusetts MA	Canadian "Intense" CI
Applicable in:	International Standard	Texas, Massachusett MA	Canada
Stated Purpose:	Cigarette Yield Ratings for Product Comparison	Estimate Nicotine Yield for an "Average" Consumer	Estimate "Maximum" Smoke Yields under "Realistic" Conditions

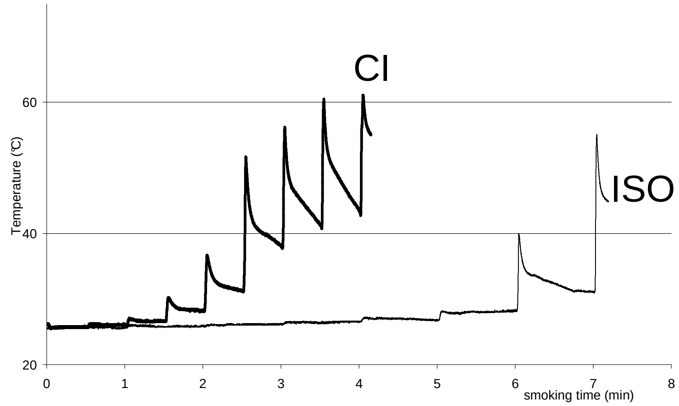
- Intense regime mandated for testing in Canada with 100% vent blocking is proposed for product characterization
- But what scenario does CI regime represent?
“average” or “maximum” yields as related to human intake.

Previous Findings- Initial results on temperature profiles



Adapted from Purkis. S.W. et al, The influence of cigarette designs and smoking regimes on vapour phase yields *Beitr. Tabakforsch. Int.* 24(1), 33-46.2010.

- Higher filter temperature in the last puffs
- Loss of efficiency of carbon filter for the retention of volatiles during CI smoking regime



Adapted from Investigation of filter temperatures and desorption of volatiles from carbon filters under different smoking regimes.
B. Teillet, et al, Coresta Congress 2009.
and Coresta Congress 2010.

- Blocking 100% filter ventilation does not allow the smoke cooling effect during the smoking period.
- High filter temperatures associated with the CI regime lead to a significant desorption of volatiles from carbon leading to an increase of mainstream smoke yield.

Objectives

- What about the filter T° increase in natural conditi ons for smoker?
  Are the CI conditions realistic?
  What are the limitations of using alternative machine smoking regimes ?
- Smokers modify their smoking behaviour on a per puff basis in ways not well reflected by the 100% ventilation blocking regime.

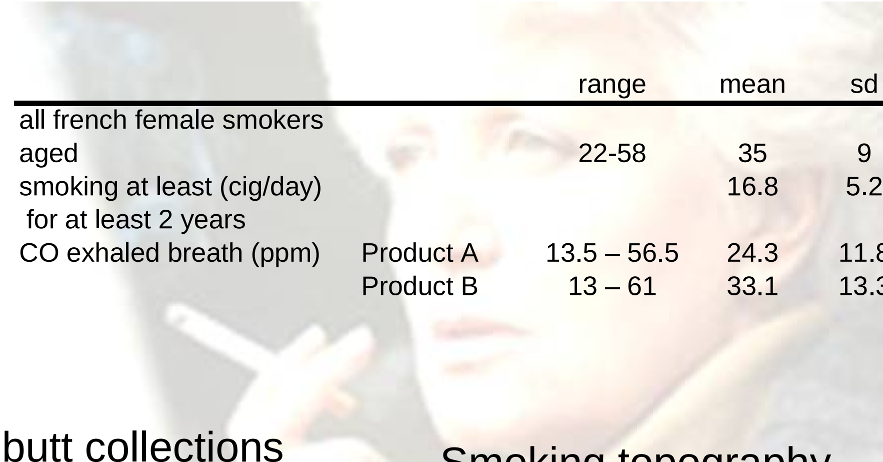
1. Human Smoker Yields & Topography results from a former smoking behavior study
2. Selection of a "representative panelist" for duplication
3. Recording duplication outcomes: lit PD, puff Volume, filter T° & smoke concentration under different regimes

Data source and handling

2 commercial brand	Tar (ISO) mg/cig.	smokers (own brand)
product A	3.4	30
product B	12	30

Delarue, B. et al, 2001

Brand specifications	A	B
Blend Style	USB	USB
Filter type	Acetate	Acetate
Butt length (mm)	35	29
Cigarette length (mm)	83	83
Filter length (mm)	27	21
Filter Ventilation (%)	49.3	0.5
Unlit PD (mm W.G.)	104	130
Unlit PD Vents Closed (mm W.G.)	155	130
Tobacco weight (mg)	620	773
Tar' (mg/cig) ISO	3.4	12
Nicotine (mg/cig) ISO	0.32	0.74



		range	mean	sd
all french female smokers				
aged		22-58	35	9
smoking at least (cig/day)			16.8	5.2
for at least 2 years				
CO exhaled breath (ppm)	Product A	13.5 – 56.5	24.3	11.8
	Product B	13 – 61	33.1	13.3

butt collections → **Human Smoker Yields**

Natural cond.

Smoking topography

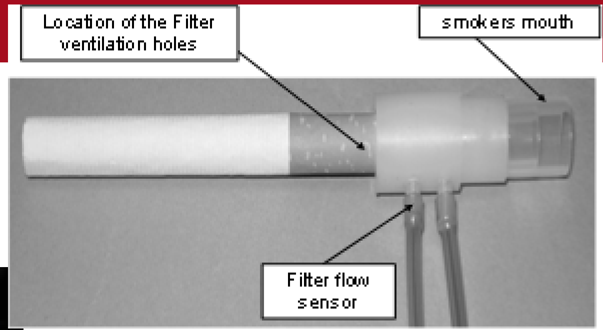
In the lab

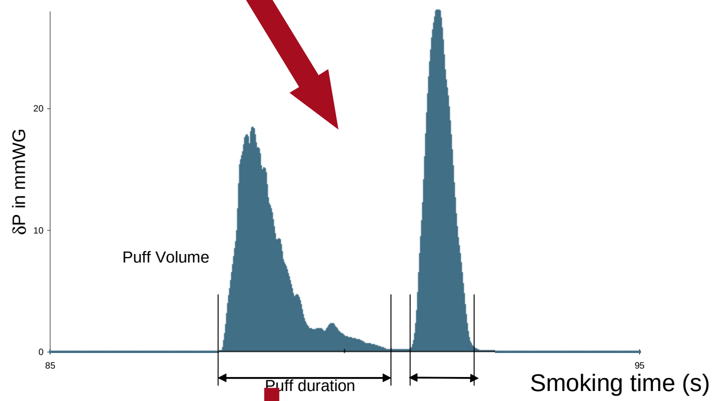
→ *ad lib.* smoking behavior measurements

→ Temperature issue

Topography : puffing behavior

SPA-D Sodim equipment





D87 Sodim equipment

<u>Key points :</u>
- Calibration of the flow was performed
- No human vent blocking using the device

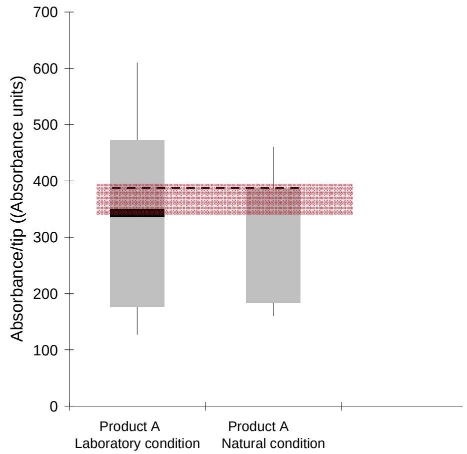
How to select a representative profile?

Filter Butt study: natural vs lab.

Step 1
Step 2
Step 3

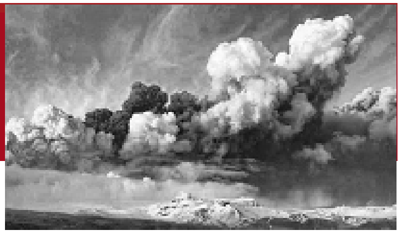
- How to take into account the over-estimation due to the lab condition (artificial setting) ?

- Human Smoker Yields
Filter butt study: amount of 'tar' on the filter proportional to the amount of 'tar' emerging from the filter.



90th percentile natural conditions
~ average Laboratory conditions
= representative smoker selected for duplication

How to select a representative profile?

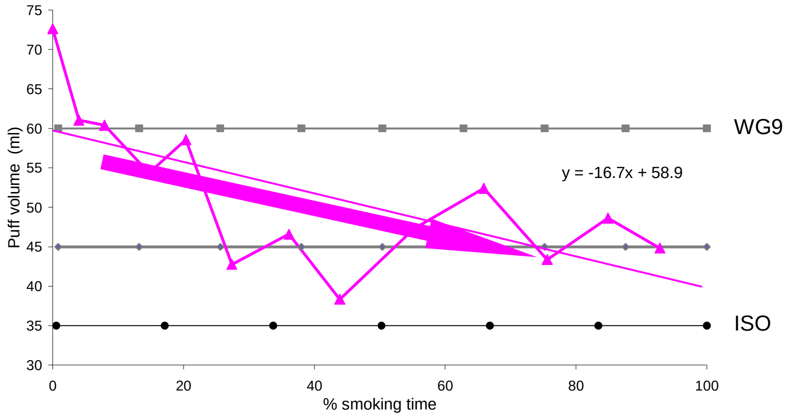


The rise in temperature mainly influenced by the puff volume

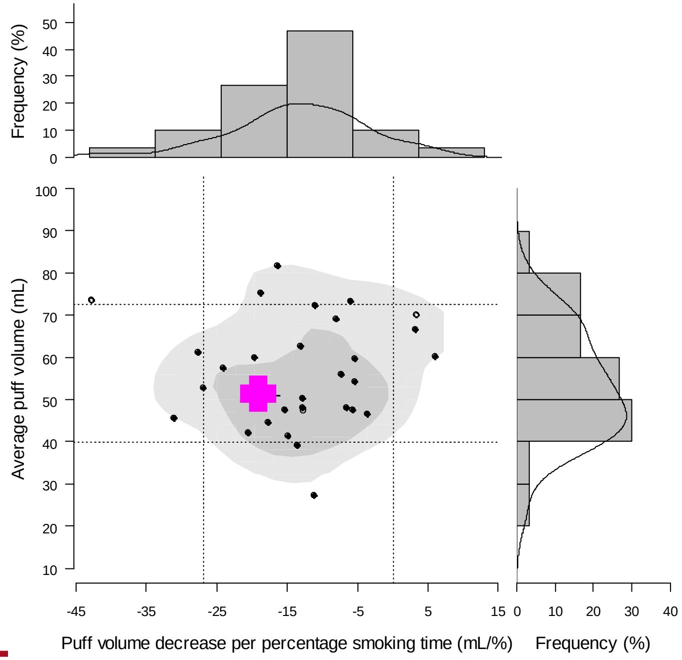
The temperature is a cumulative effect. Throughout the inter-puff duration, the temperature is likely to decreased.

Selection based on 2 criteria

1. Average puff volume
2. Puff volume decrease per % smoking time



Slope : -16.7 mL/% an estimate in the volume decrease. Smoker decreases by 16.7 mL between the first puff volume and the last puff volume



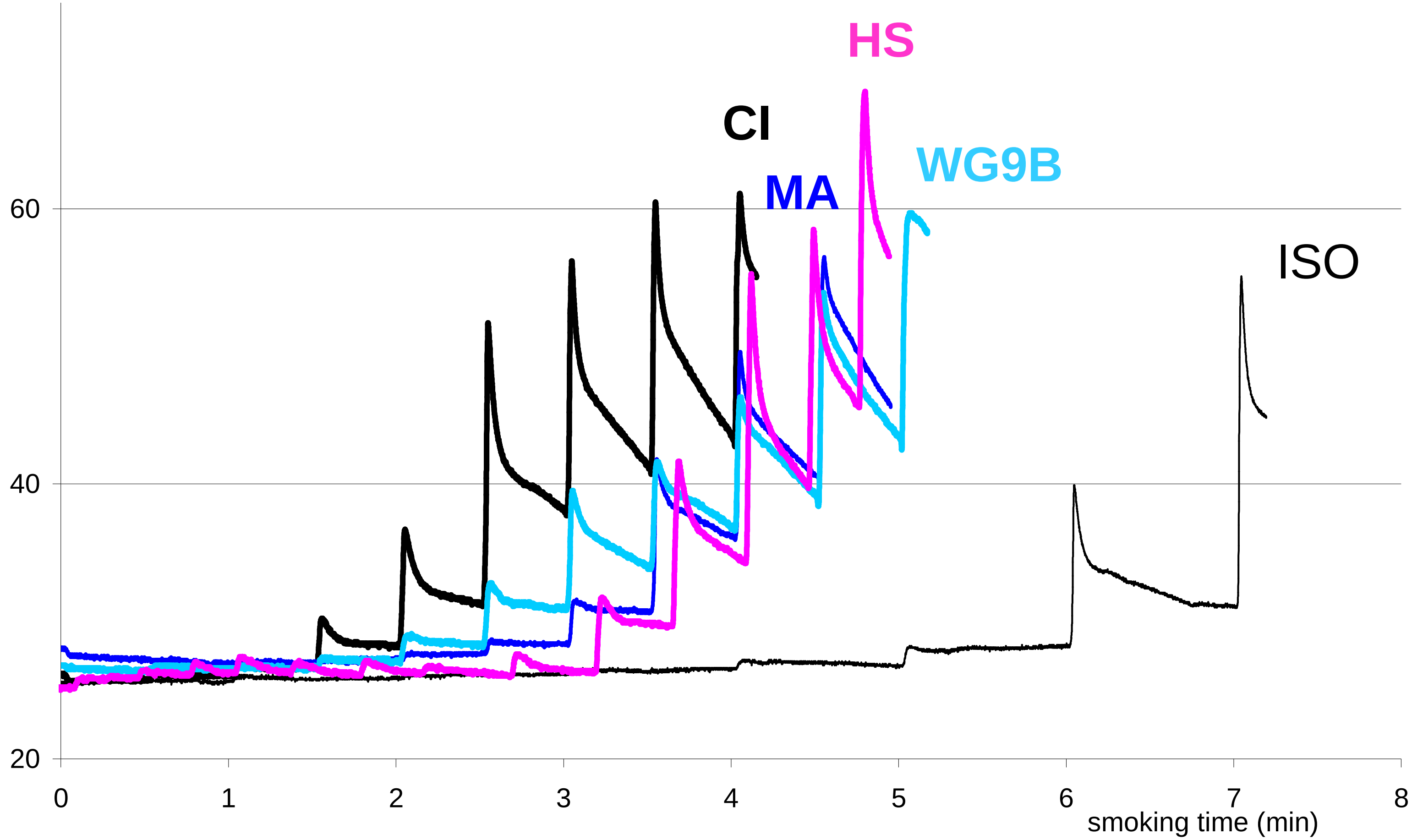
Method: *Highest Density Regions*
of Smoking Topography for product A

Smoking regime parameters

Machine smoking regimes

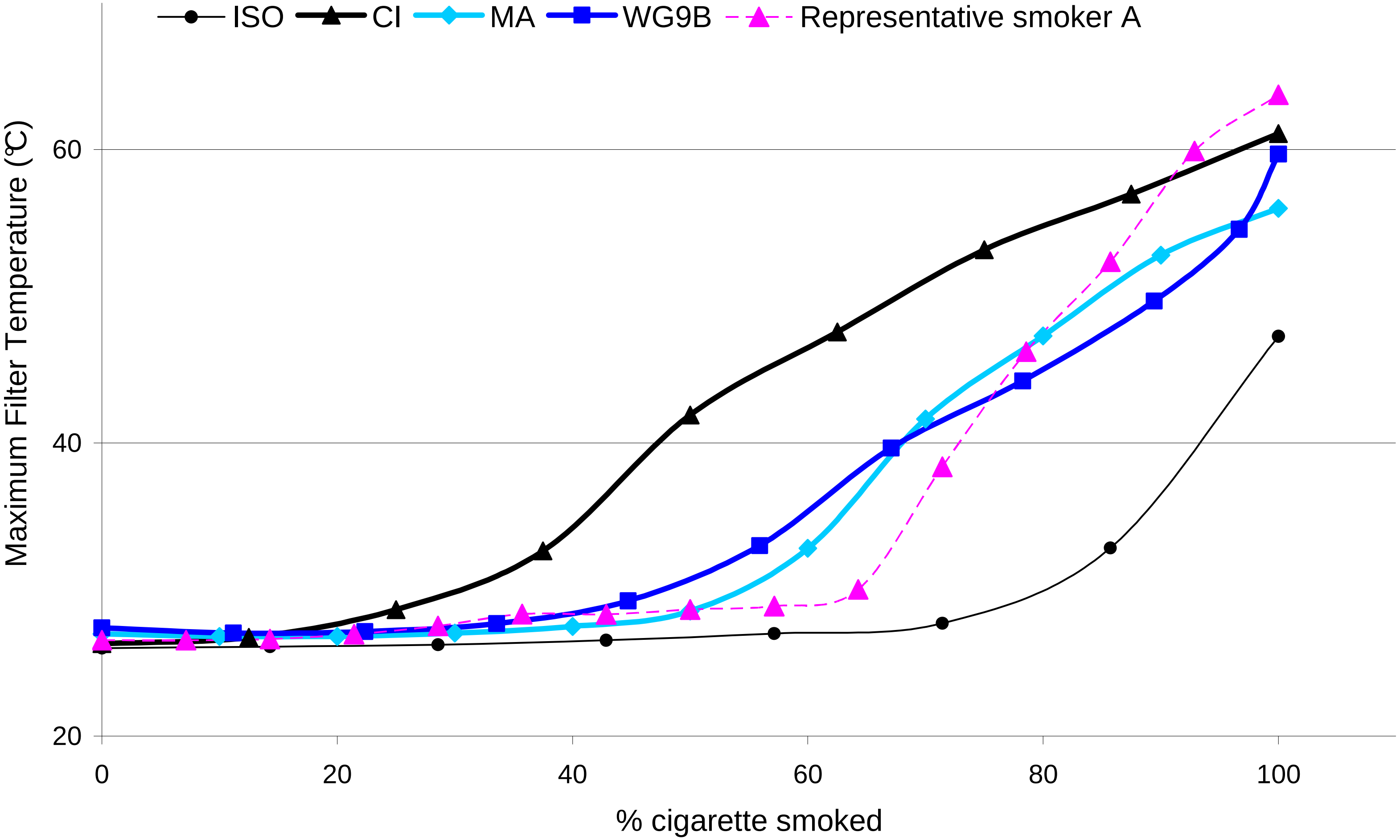
Representative smoker *average value*		ISO	MA	WG9B	CI
51.5 ml	Puff volume	35 ml	45 ml	60 ml	55 ml
2.3 sec	Puff duration	2 sec	2 sec	2 sec	2 sec
1,44 l/min	Puff flow rate	1,05 l/min	1,35 l/min	1,80 l/min	1,65 l/min
21.4 sec	Puff frequency	60 sec	30 sec	30 sec	30 sec
No	Vent blocking	No	Yes 50%	Yes 50%	Yes 100%

Temperature in the filter (℃)



Method: 1 cig/smoking.
K type thermocouple. 20 mm inside mouth end
55ms time profile

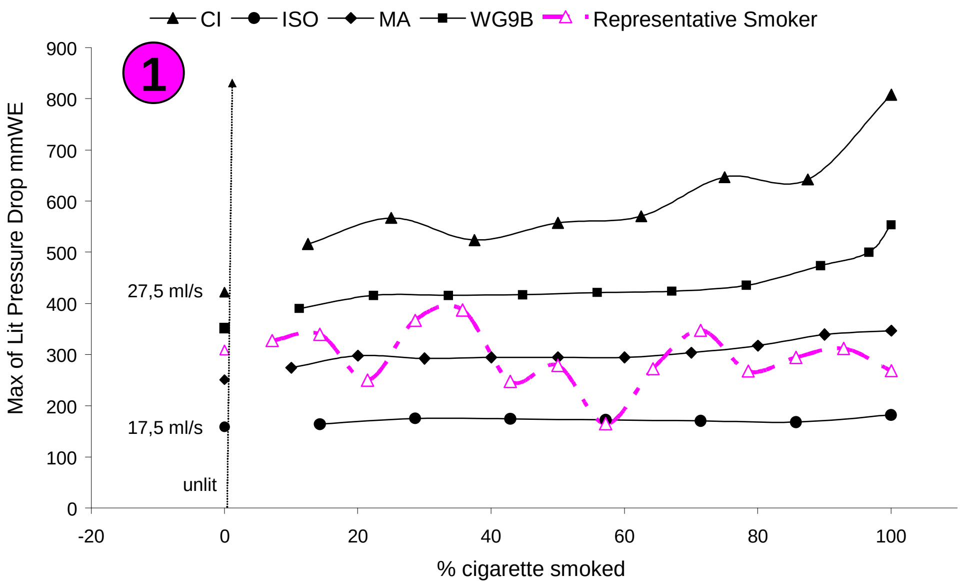
Temperature in the filter-maximum



Method: 1 cig/smoking. 6 replicates per regime.
Maximum temperature,
Normalized X axe.
K type thermocouple. 20 mm inside mouth end
55ms time profile

Lit Pressure Drop

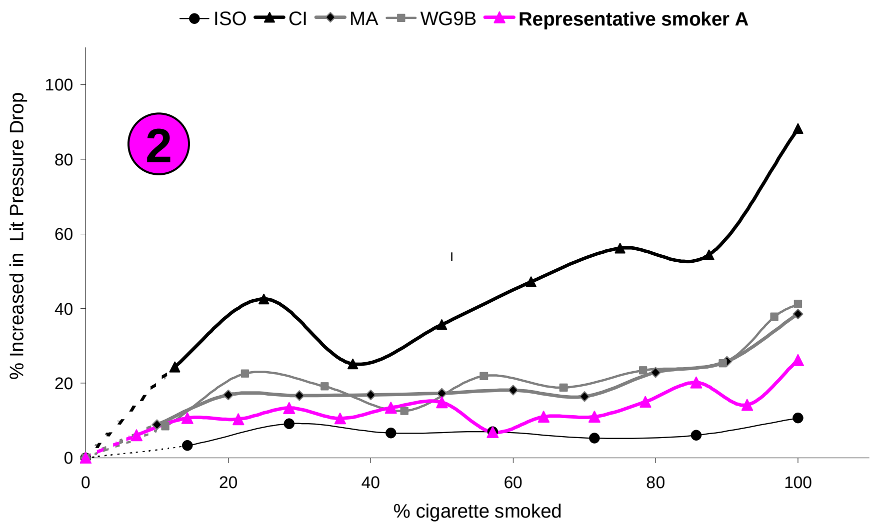
lit pressure drop during the smoking



Increases in lit pressure drop versus the unlit cigarette

Unlit PD Vents Open (VO) (mm W.G.): **104**

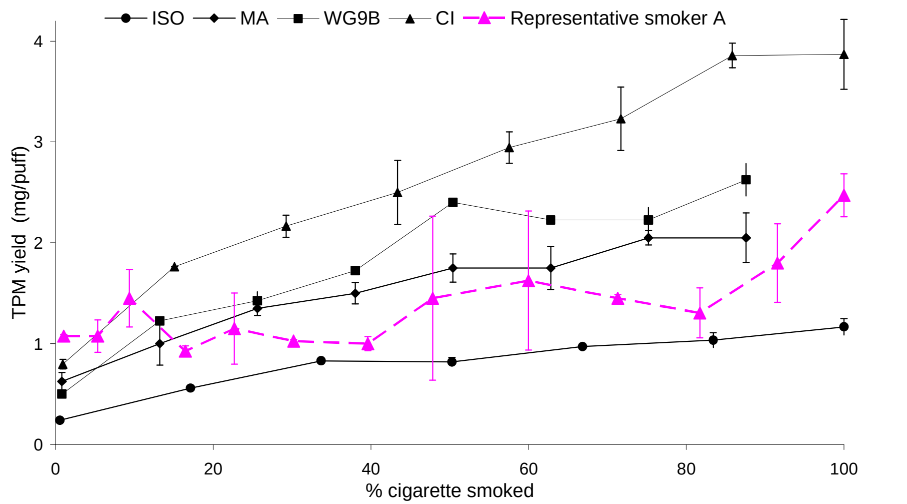
Unlit PD Vents Closed (VC) (mm W.G.): **130**



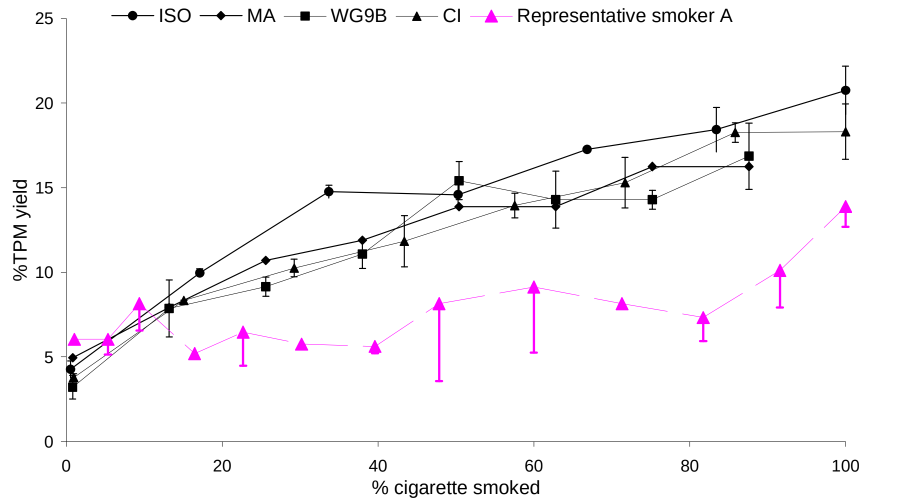
- Increases in lit PD due to temp. increases
- The observed rise in lit PD was likely to explain the reductions in the observed human puff flow rates and puff volumes.

Smoke concentration

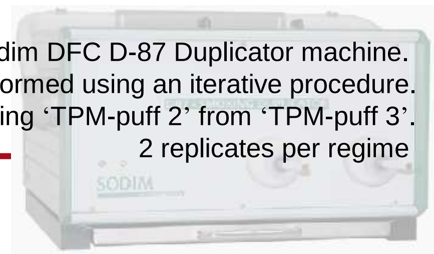
Changes in per puff **total particulate matter (TPM)** during the course of machine and human smoking of product A



<u>Percentage</u> change in per puff total particulate matter (TPM) during the course of machine and human smoking of product A



- CI smoking regime : higher TPM compared to all other regimes
- Flatter duplicated profile compared to the machine smoking regimes



<u>Method:</u> Sodim DFC D-87 Duplicator machine.
TPM was collected on a 25 mm CFP._Smoking runs performed using an iterative procedure.
The TPM in mg per puff was determined by subtracting ‘TPM-puff 2’ from ‘TPM-puff 3’.
2 replicates per regime

Sum up

- On <u>a per puff basis</u>, smokers reduce their smoking intensity in response to increases in smoke temperatures, in draw resistance and smoke concentrations.

- These findings suggest that to base a smoking regime on extreme human smoking behaviour

  using a combination of the highest puff volume linked to the longest duration, the shortest puff interval as obtained from any databank of human smoking data and use it in combination with 100% ventilation blocking

  will provide data that will give a misleading characterisation of cigarette smoke.

Purkis. S.W, et al., 2010. Limitations in the characterization of cigarette products using different machine smoking regimes.
Regulatory Toxicology and Pharmacology, in press

Thank you for your attention