

Impact of Self-Extinguishment during Smoking on Consumer Exposure

Part II - Simulations

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The Possible Causes of Cigarette Self-Extinguishment ...

Tobacco



- Filling density
- Carbon, Potassium content
- Humectants, Moisture

Environment



- Temperature
- Relative Humidity
- Wind
- Rain

Cigarette Paper



- Grammage/Fibre density
- Filler (CaCO_3)
- Burning Additives (Potassium Citrates)
- Porosity

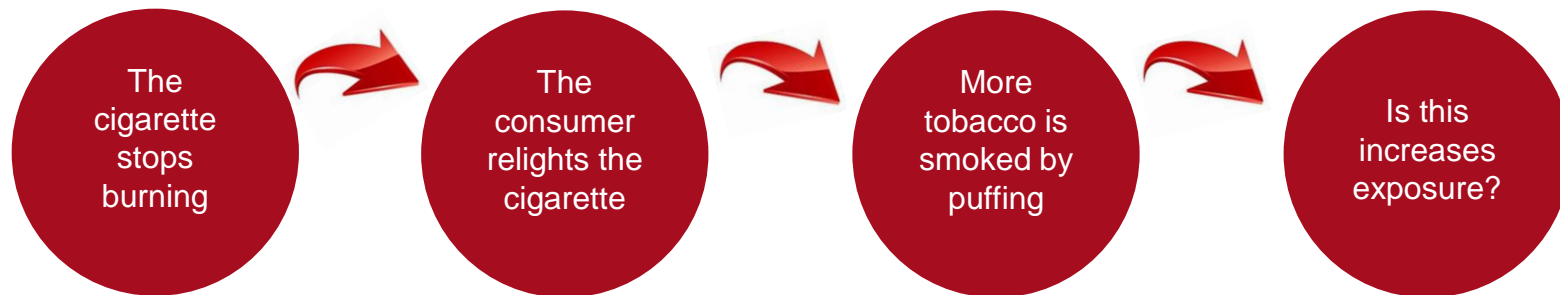
Consumer behaviour



- Contact with a substrate (Heat transfer)
- Low Puffing Intensity

... and what are the consequences?

The Consequences



It has been published that after LIP regulation that:
“smokers reported their cigarettes ‘often’ extinguish between puffs and the effect was strongest among those who reported longer duration between puffs”*



We propose to investigate the case of the Lower Ignition Propensity cigarettes

(*) R J O'Connor, G A Giovino, B V Fix, A Hyland, D Hammond, G T Fong, U Bauer, K M Cummings, Smokers' reactions to reduced ignition propensity cigarettes. Tobacco Control 2006;15:45–49

The Lower Ignition Propensity Cigarette Case

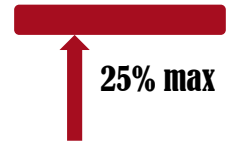
- **Lower Ignition Propensity Cigarettes designed to self-extinguish when laid down on a specified substrate in laboratory conditions (ISO 12863/ASTM E2187)**



- Band of low porosity added along the rod to stop the burning
- In some countries: less than 25% of full length burnt is required
- Unavoidable increased probability of self-extinguishment during smoking

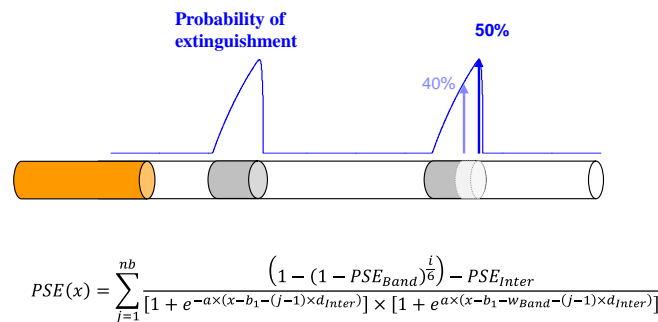
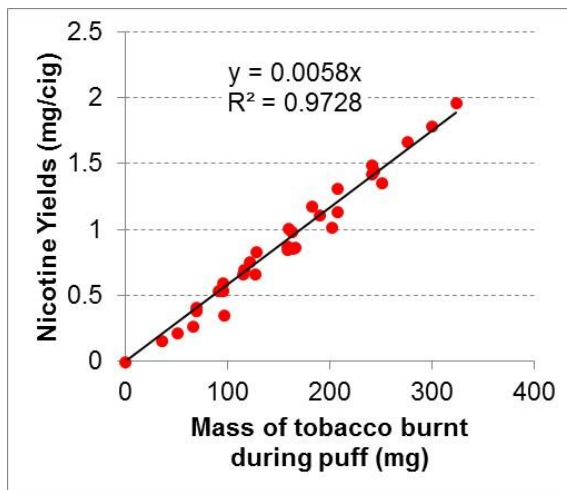
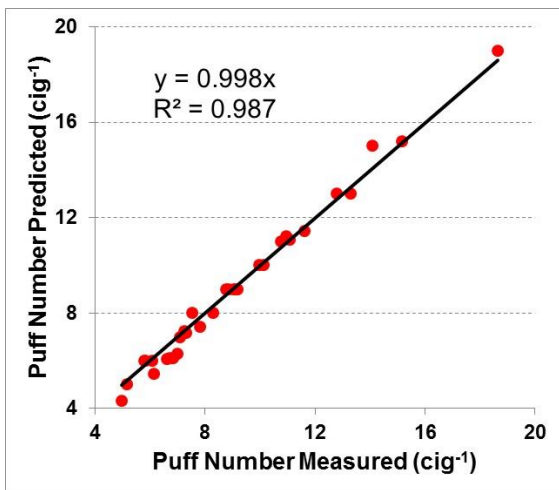


... which could influence consumer behaviour associated with the possible need to relight the cigarette.



Modelling and Simulation Protocol

- Based on a model(*) previously published and validated over a wide range of smoking intensity
- Yields proportional to the mass of tobacco actively smoked
- Improved model to include probability of extinguishment – see Part I (ST26)



(*) S. Colard, Prediction Model for Cigarette Yields Derived from Data Obtained under Two Different Machine Smoking Regimes. Beiträge zur Tabakforschung International Contributions to Tobacco Research. Volume 26 No. 7 September 2015, p320-333.

Inputs

Scenario

Outputs

Free burning rates

L: 1mm/min
H: 8mm/min



Cigarette design

83/25/21mm



LIP band positions

6/20mm
Random

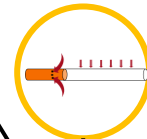


Probability of extinguishment



FV
0%
30%

Filter ventilation



Puff duration



1s	2s	3s
20-35ml	30-60ml	55-70ml
30-90s		

Puff volume

Puff interval

Puffing conditions*



- Smoking conditions were randomly selected within these realistic ranges
- 2000 calculations were made for each of the 5 probabilities of self-extinguishment

Proportion of tobacco rod actively smoked

MIN

MEDIAN

MAX

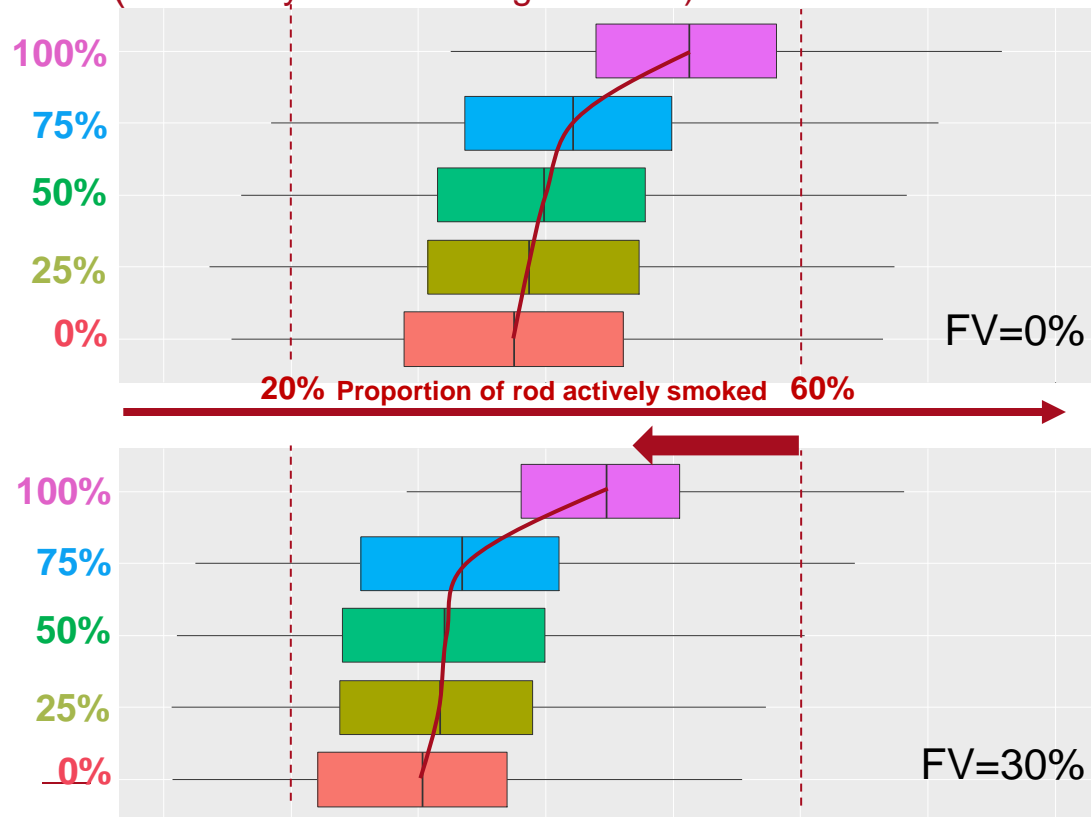
PSE

0%, 25%, 50%, 75%, 100%

* See ISO/TR 17219:2013

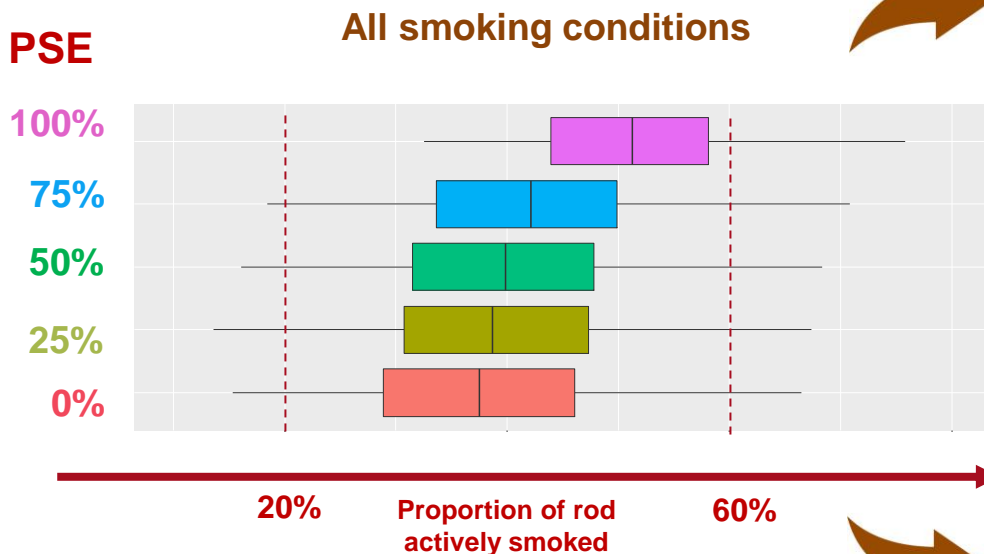
Results

PSE (Probability of Self-Extinguishment)

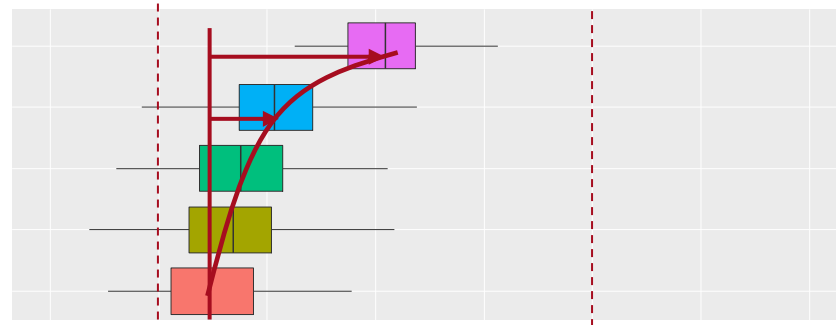
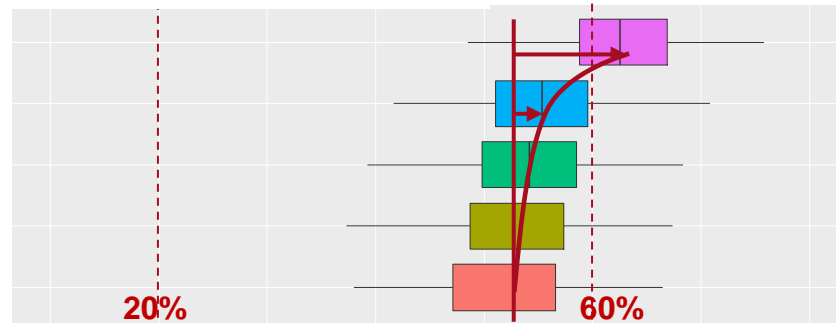


- A wide range of tobacco rod can be smoked
 - From 10% to 70%
- The range of tobacco smoked moves toward upper levels when the PSE increases
- A lower range of tobacco smoked is observed when the filter ventilation increases

Effect of smoking intensity - FV=0%



Intense smoking conditions



Non-intense smoking conditions

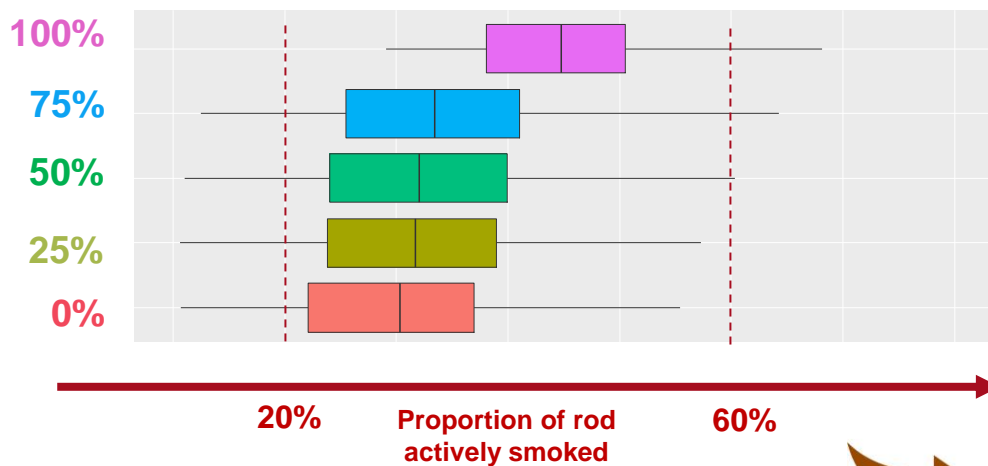
Intense: $T_{puff} \geq 2s$ and $T_{inter} \leq 60s$ and $V_{puff} \geq 45ml$
Non-intense: $T_{puff} \leq 2s$ and $T_{inter} \geq 60s$ and $V_{puff} \leq 45ml$

The absolute and relative impact of PSE seem influenced by the smoking intensity

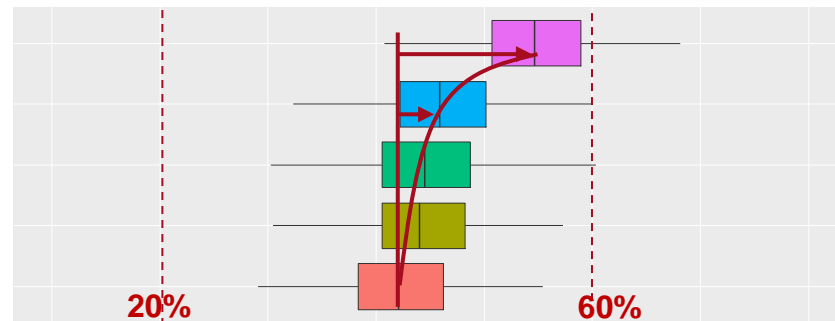
Effect of smoking intensity - FV=30%

PSE

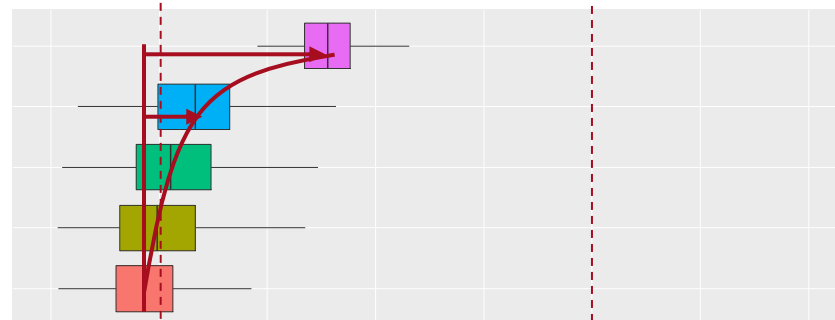
All smoking conditions



Intense smoking conditions



Non-intense smoking conditions



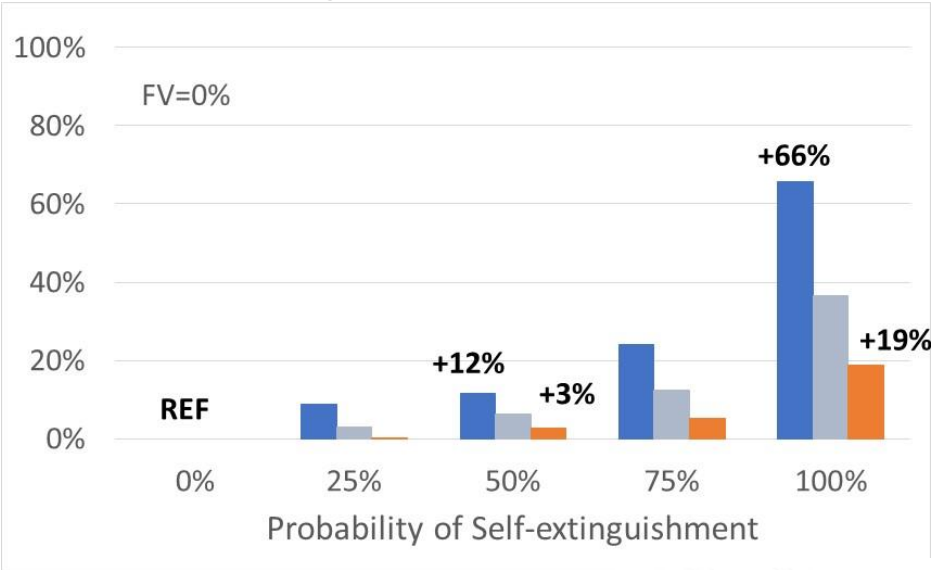
Intense: $T_{\text{puff}} \geq 2\text{s}$ and $T_{\text{inter}} \leq 60\text{s}$ and $V_{\text{puff}} \geq 45\text{ml}$
Non-intense: $T_{\text{puff}} \leq 2\text{s}$ and $T_{\text{inter}} \geq 60\text{s}$ and $V_{\text{puff}} \leq 45\text{ml}$

The absolute and relative impact of PSE seem influenced by the smoking intensity

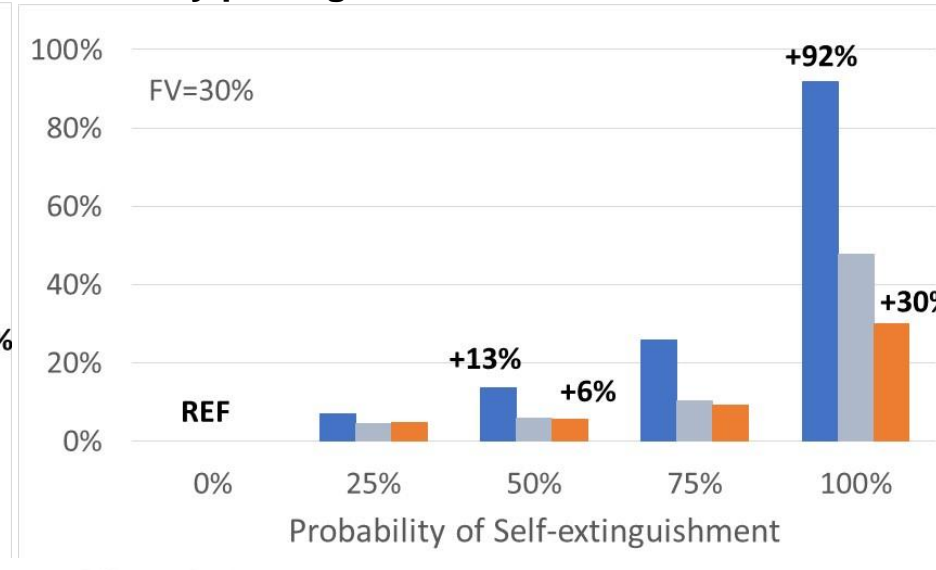
Tobacco rod smoked versus probability of extinguishment



Relative increase of tobacco smoked by puffing



Relative increase of tobacco smoked by puffing



■ Non-intense ■ All ■ Intense

An higher probability of self-extinguishment increases exposure
The impact is much more significant for non intense smokers

Conclusion

- Several cigarette features can cause self-extinguishment during the course of smoking
 - LIP requirement is one of them
- A mathematical model enabled the assessment of the impact of self-extinguishment on the amount of tobacco actively smoked per cigarette
- An increase of smoker exposure with the probability of self-extinguishment was shown, in particular for non intense smokers
 - This could be an unintended consequence of LIP regulations, and corroborates previous publications reporting an increase of biomarker after LIP regulations was implemented*
- Before implementing more stringent LIP regulations, impact on smoker exposure should be then considered carefully, for example with premarket studies.

(*) Kristie M June, David Hammond, Andreas Sjödin, Zheng Li, Lovisa Romanoff and Richard J O'Connor. Cigarette ignition propensity, smoking behaviour, and toxicant exposure: A natural experiment in Canada. Tobacco Induced Diseases 2011, 9:13.



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