

LIP cigarettes: Effect of band positioning

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Outline

1. What is a LIP cigarette?
2. Context & objective
3. Global simulation process
 - Required assumptions
 - Bands positioning simulation
 - Butt length simulation
 - Band effect to stop burning
4. Applications

What is a LIP cigarette?



A LIP cigarette has a reduced propensity to burn when left unattended

The most common LIP cigarette technology consists of a standard cigarette paper on which zones with starch or another material with reduced air permeability have been printed equidistantly.

The porosity of the LIP zones (reduced porosity zones) is designed to act as “speed-bumps” and increase the likelihood that a cigarette will be extinguished when burning through these zones (minimum 75% test) when both conditions, that is, not puffed and in contact with a standard substrate, are satisfied.

Context & Objective



What is the context?

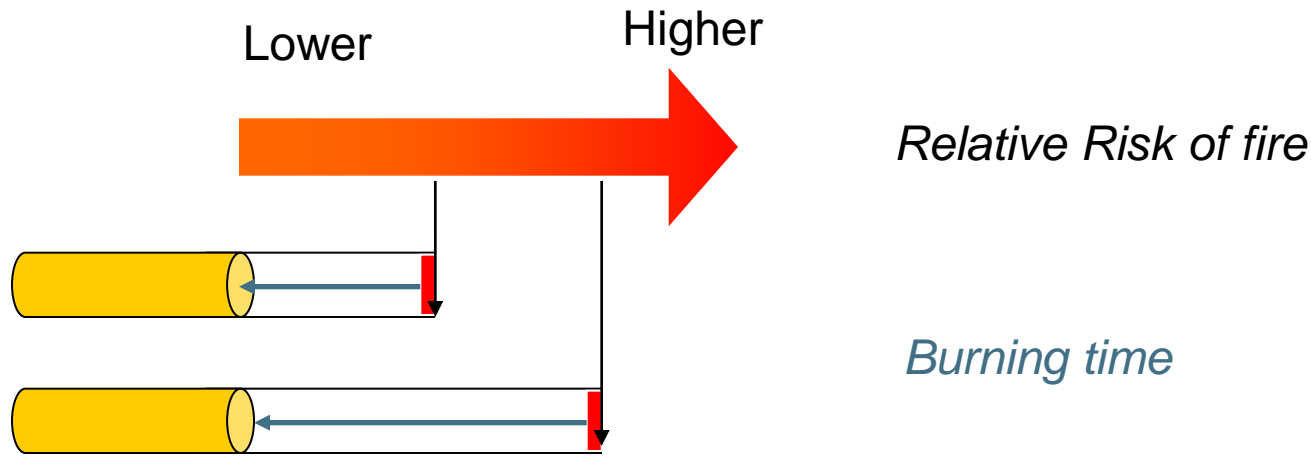
Currently, for technical reasons, the use of LIP band technology leads to bands on the cigarettes that fall completely at random positions.

What is the aim of the study?

We decided to study the impact of the band positioning (random and controlled) on self extinguishment, taking into account the butt length (time when the smoker left his cigarette).

Required assumptions

Assumption 1: In the same conditions, the same environment, the chance of accidental fires between two identical cigarettes depend only on the **burning time**.



Assumption 2: whatever the environment and conditions

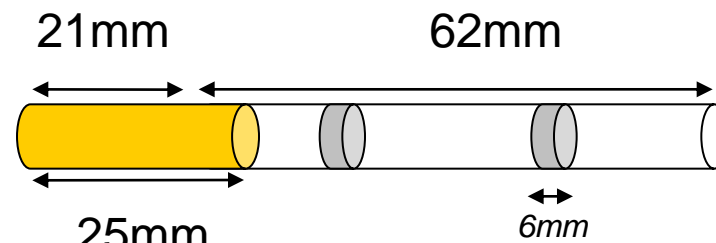
- 1) paper speed burning time is constant 6mm/min;
- 2) band effect is constant (stop burning in 75% of cases)

The burning time after dropping the cigarette is used to determine if the control of the band position could decrease the chances of accidental fires.

Simulation approach

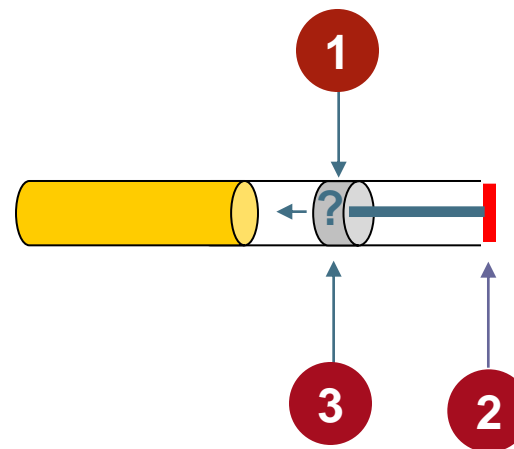
Characteristics

Tobacco length	62mm
Tipping paper length	25mm
Filter length	21mm
LIP band width	6mm
Smouldering Rate	6mm/min



Simulations

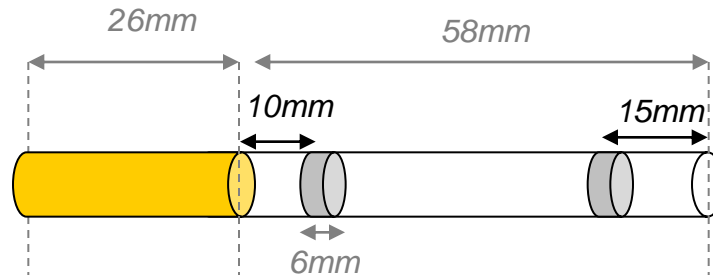
- 1 Band position
- 2 Position of the coal when the cigarette was left (butt length)
- 3 Band effect stop/continue



1 Positions of bands

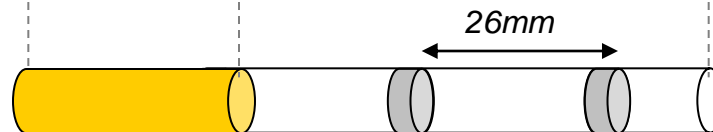
Two different strategies are tested : controlled or random position of bands

1 Controlled position



The positions of bands are fixed at **10mm** from the wrapping paper and **15mm** from the lighting end

2 Random position

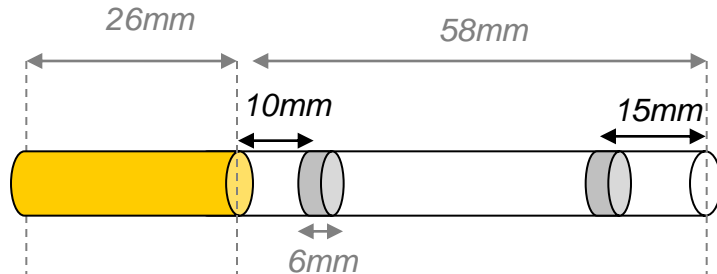


The distance between two bands is fixed to **26mm**.

1 Positions of bands

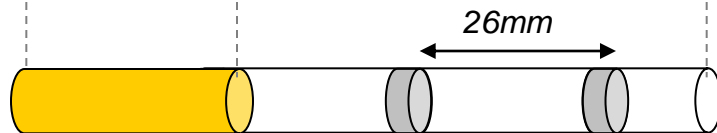
Two different strategies are tested : controlled or random position of bands

1 Controlled position



The positions of bands are fixed at **10mm** from the wrapping paper and **15mm** from the lighting end

2 Random position



To simulate the bands position we used an uniform distribution between 0 and 58mm

The distance between two bands is fixed to **26mm**.

The random process generates two bands on the tobacco rod but in some specific situations it generates up to three bands.

2 Cigarette butt length simulations:

When does the smoker leave his cigarette?



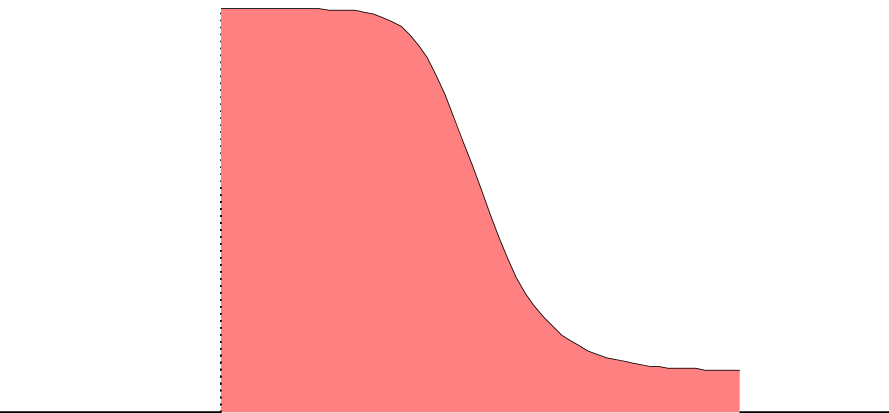
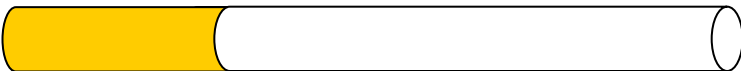
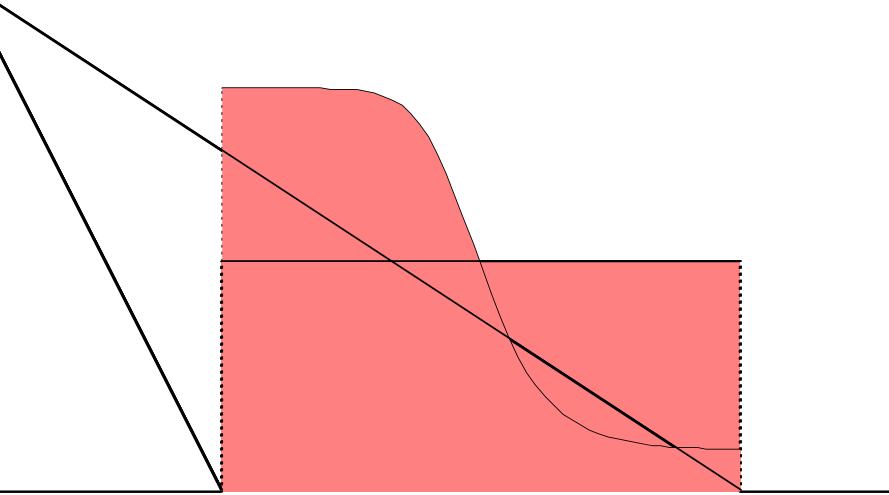
*Population behavior
risk to generate
accidental fires*

Uniform distribution

Probability that the smoker leaves the cigarette butt on the ground is **independent** on the tobacco length smoked.

Logistic distribution

Probability that the smoker leaves the cigarette butt on the ground is **dependent** on the tobacco length smoked.



3 Self extinguished simulation (1)



Cigarette “stops” combustion in 75%

⇒ Bernoulli distribution $B(0.75)$

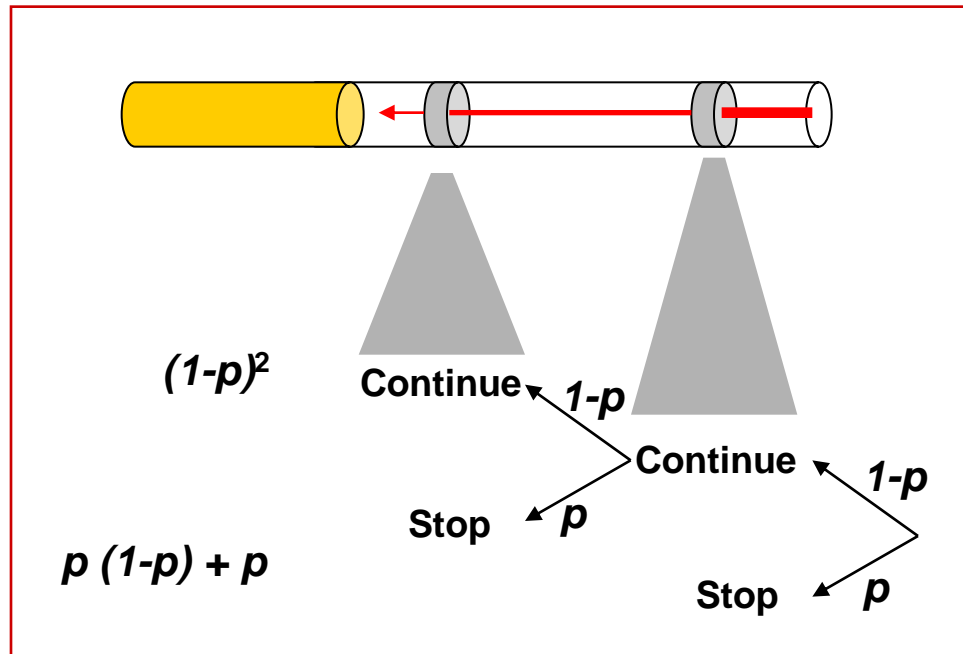
Band “stops” combustion in $p\%$ of cases

⇒ Bernoulli distribution $B(p)$

3 Self extinguished simulation (1)

Cigarette “stops” combustion in 75% of cases \implies Bernoulli distribution $B(0.75)$

Band “stops” combustion in $p\%$ of cases \implies Bernoulli distribution $B(p)$

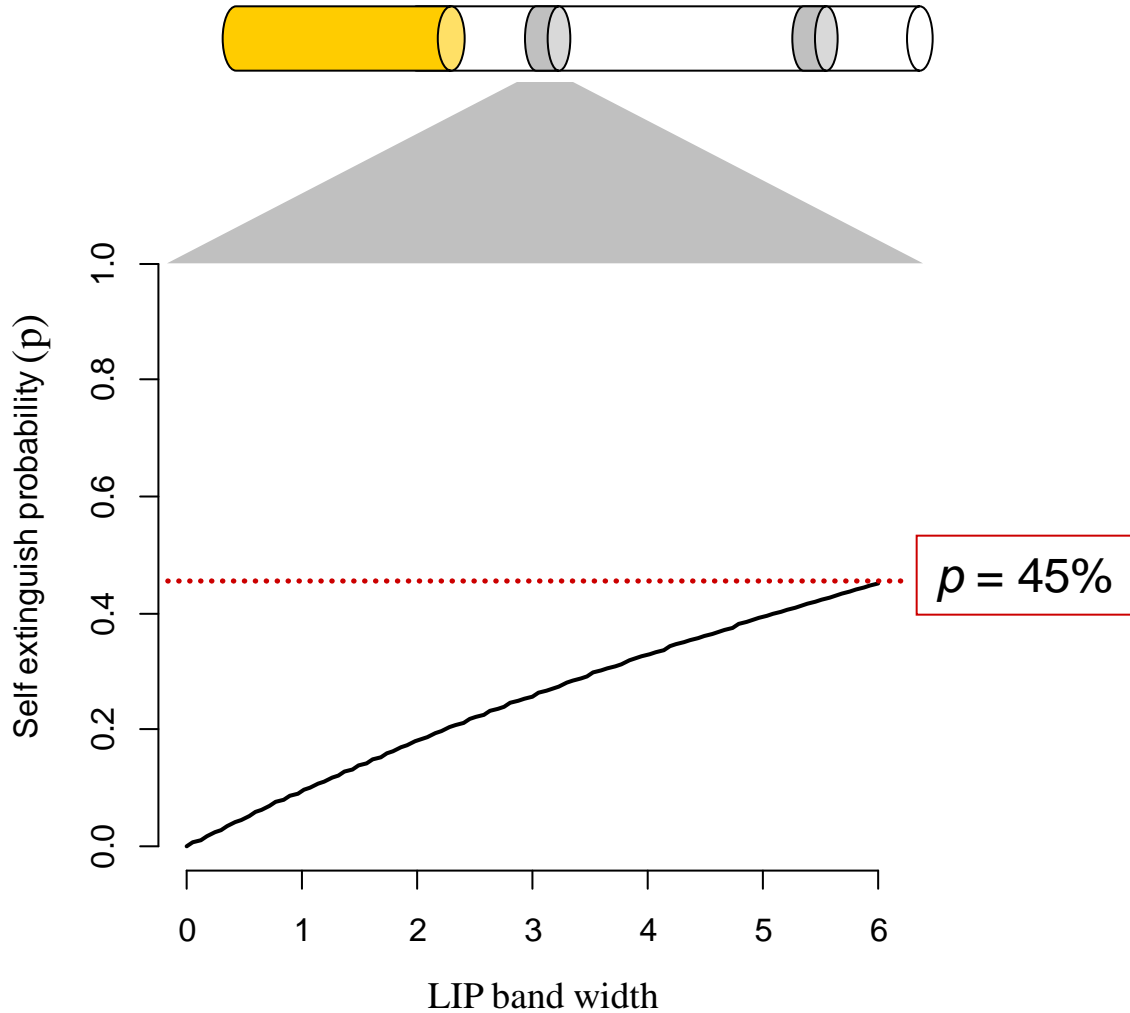


$p(1-p) + p = 75\%$ \implies $1-(1-p)^2 = 75\%$ \implies $p = 50\%$ 2 bands
 $p = 40\%$ 3 bands

Therefore, we will use in simulations

For random bands $p = 45\%$
For controlled bands $p = 50\%$

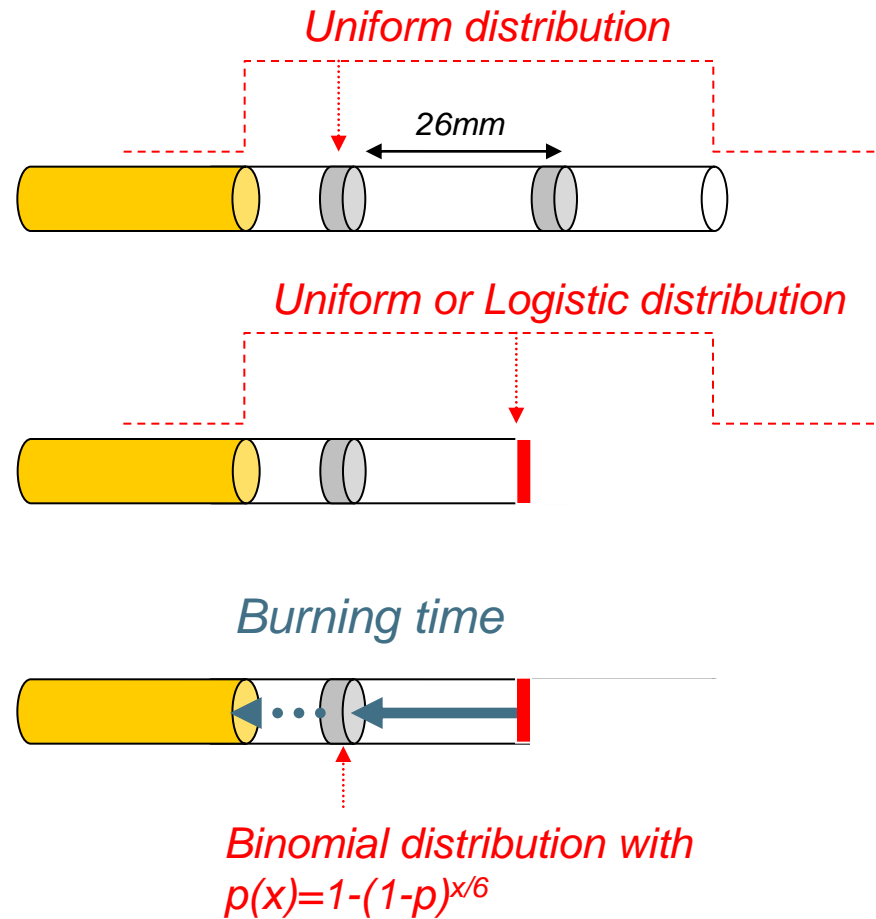
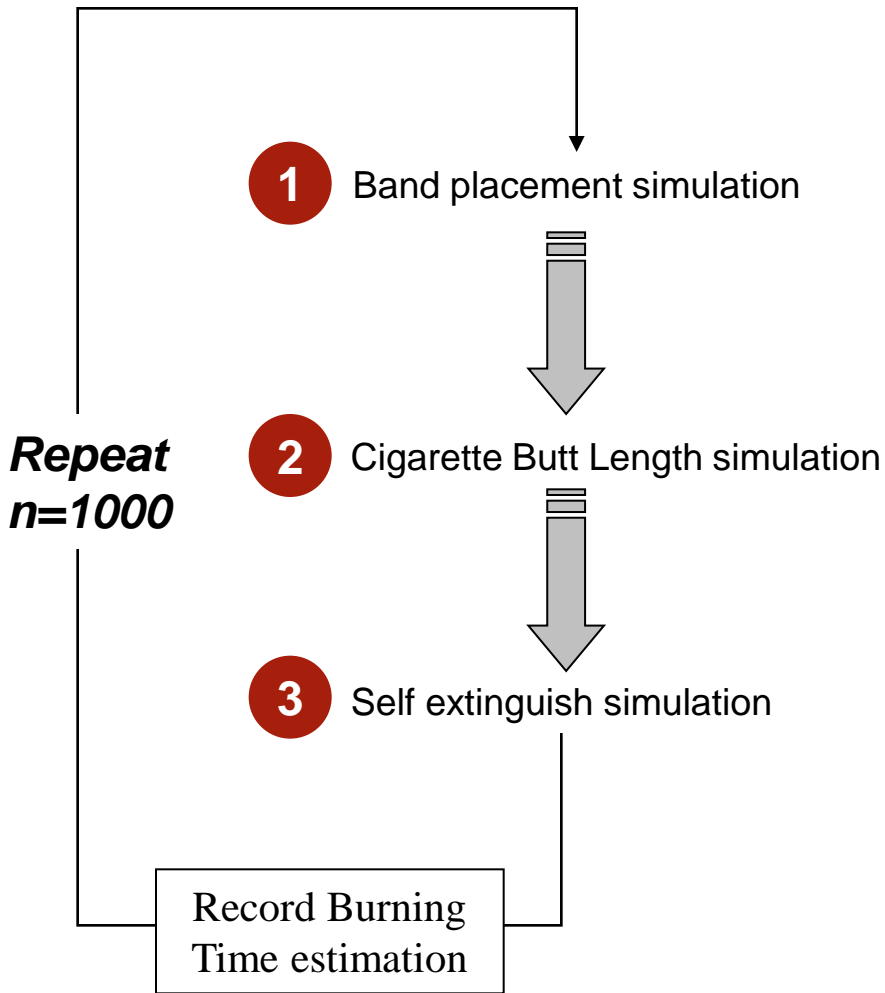
3 Self extinguished simulation (2)



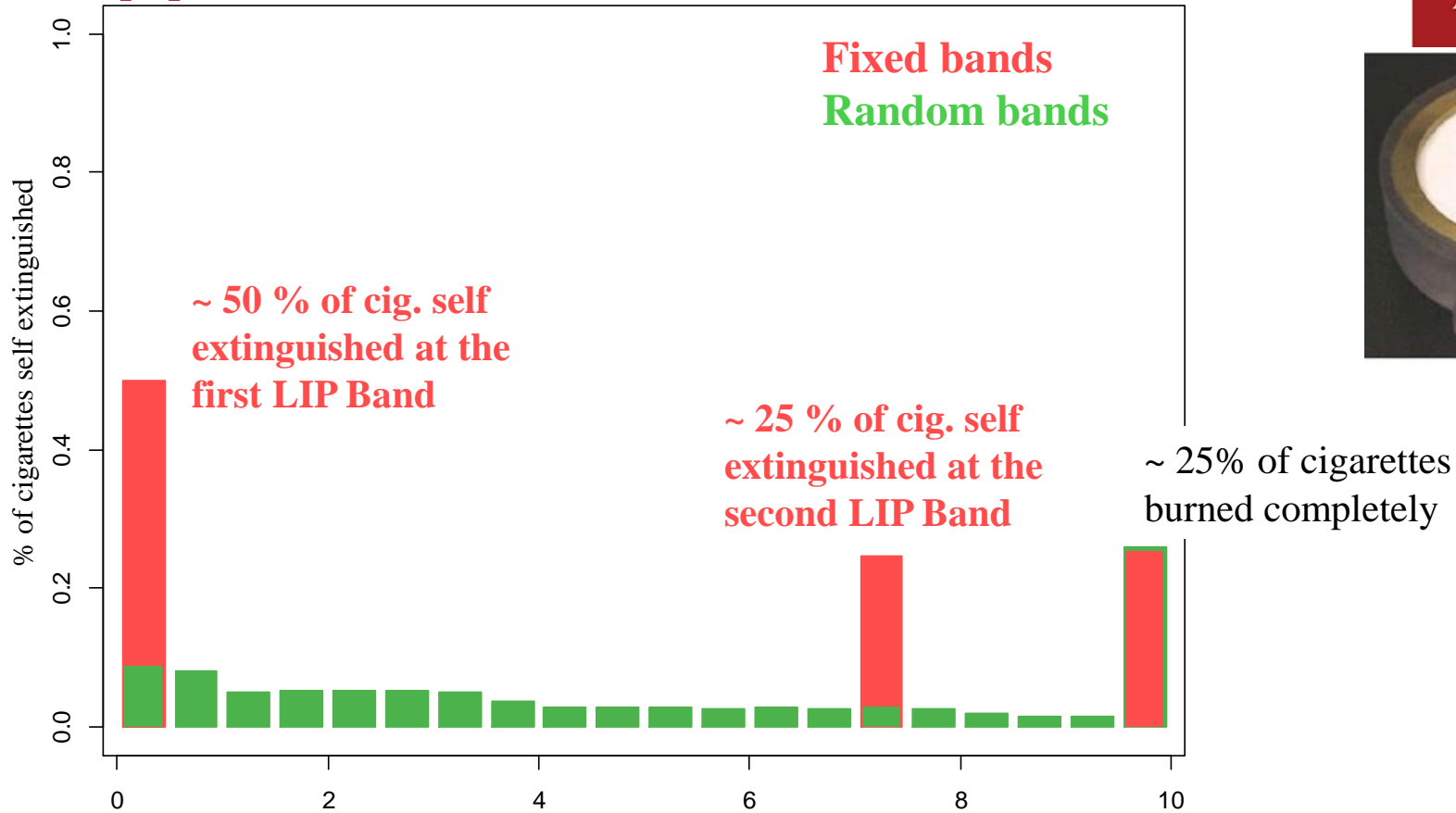
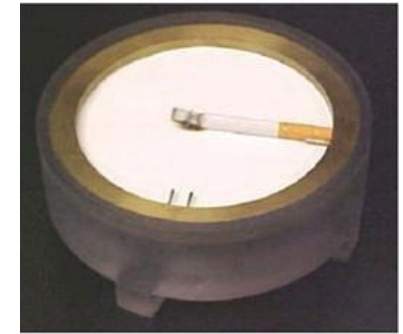
The self extinguishment probability is function of the LIP band width that still at the moment that the smoker leave his cigarette butt

$$p(x) = 1 - (1-p)^{x/6}$$

Global simulation process



Application: Lab conditions



Average of test duration:

- Fixed bands position ~ 3h
- Random bands position ~ 3h46min

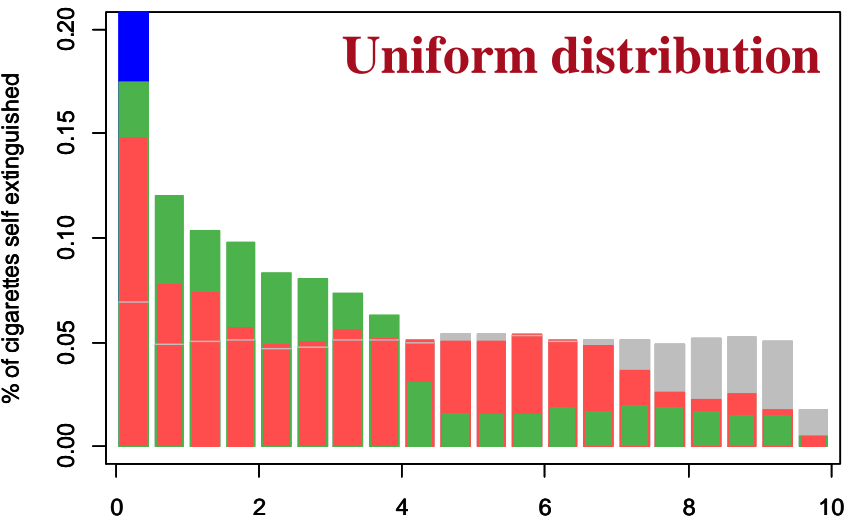


**Fixed bands position
reduce testing time**



Simulation in line with expected results

Application: Natural conditions

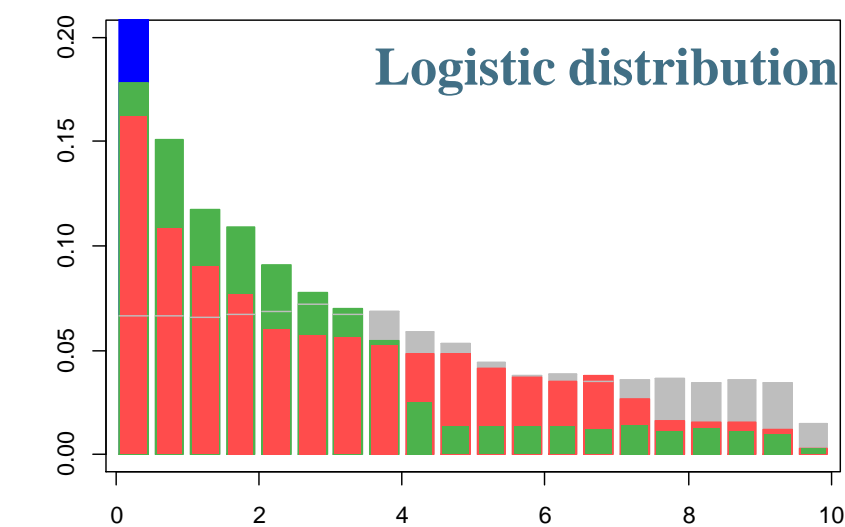


No LIP Cigarette

Perfect situation

4.8 min	4.2 min
~ 0 min	~ 0 min

➔ “Random bands” reduce the burning time compare to “fixed bands” when cigarette left unattended



Fixed bands

Random bands

3.8 min	3.2 min
2.7 min	2.4 min

Conclusions



Based on these simulations, for a KS cigarette

Lab
conditions

When we consider the condition of the LIP test,

 **“Fixed bands” position reduce the testing time**

Natural
conditions

When we take into account the moment when the smokers left their cigarettes:

 **“Random bands” position reduce the burning time compare to “controlled bands” when cigarette left unattended**