

CIGARETTE PAPERS

FOR

CIGARETTES



Effects of Pulp Composition of Cigarette Papers on the Characteristics of Cigarettes



Man Seok Seo, Jong Yeol Kim and Ick Joong Kim

KT&G R&D Group

KT&G
KOREAN TOBACCO & GINSENG



- ***Introduction***
- ***Research Background***
- ***Research Objectives***
- ***Experimental***
 - ***Part 1 : Partial replacement of papers from flax into wood***
 - ***Part 2 : Total replacement of cigarette in the column part***
- ***Results & Discussion : Part 1 & 2***
- ***Conclusions***



● Cigarette paper for cigarettes

- ✓ Type of paper specially designed to wrap tobacco and generally based on bleached pulps from annual and perennial plants

Tobacco encyclopedia, 2000



Cellulosic fiber



Cigarette paper



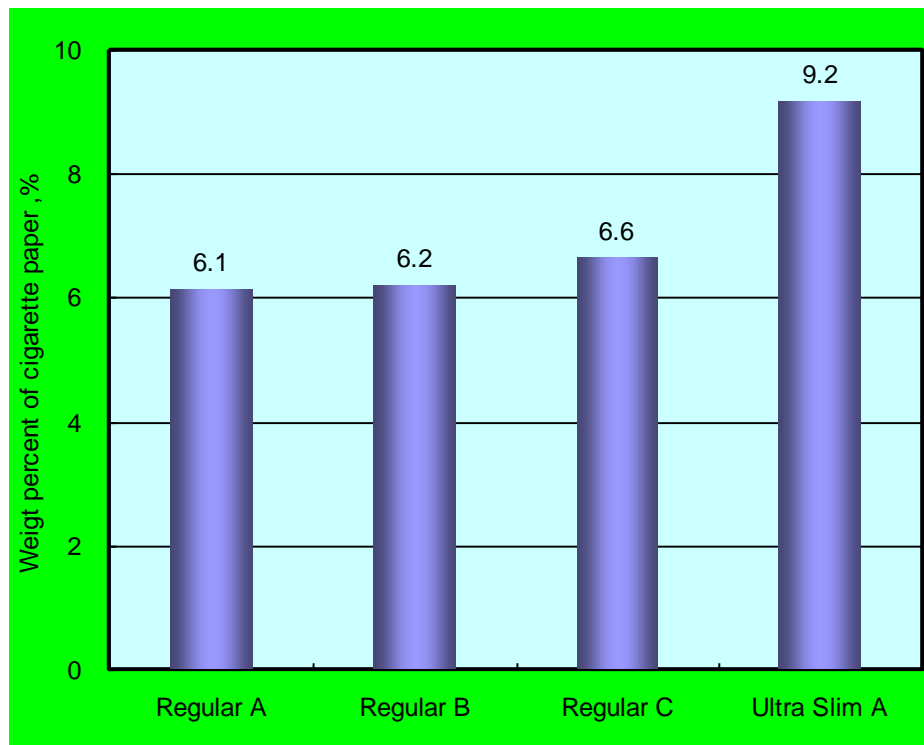
Cigarette



Smoking



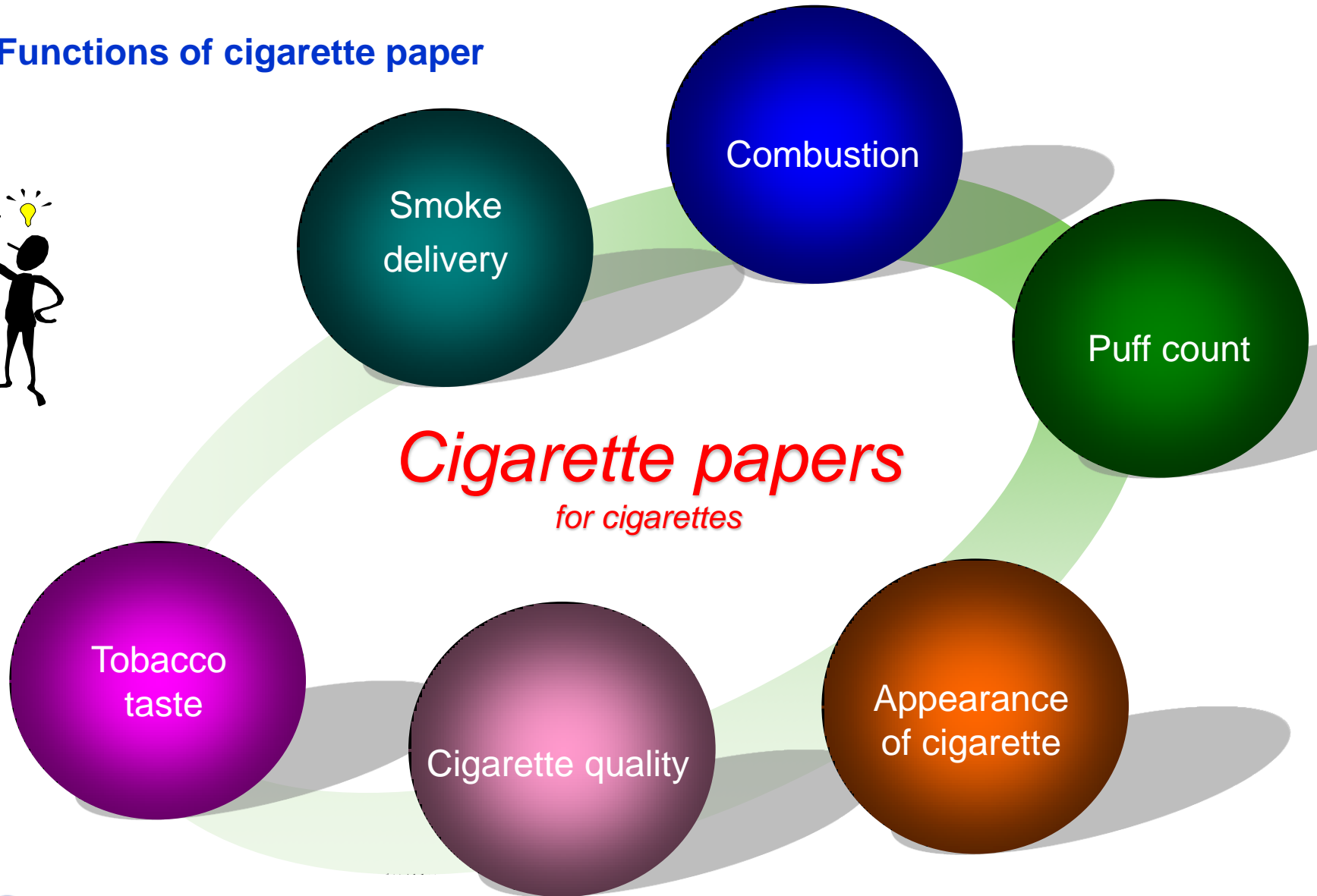
Weight percent of cigarette paper in column part of cigarette



- ✓ Regular cigarette : 5%~7%
- ✓ Ultra-slim cigarette : 9%

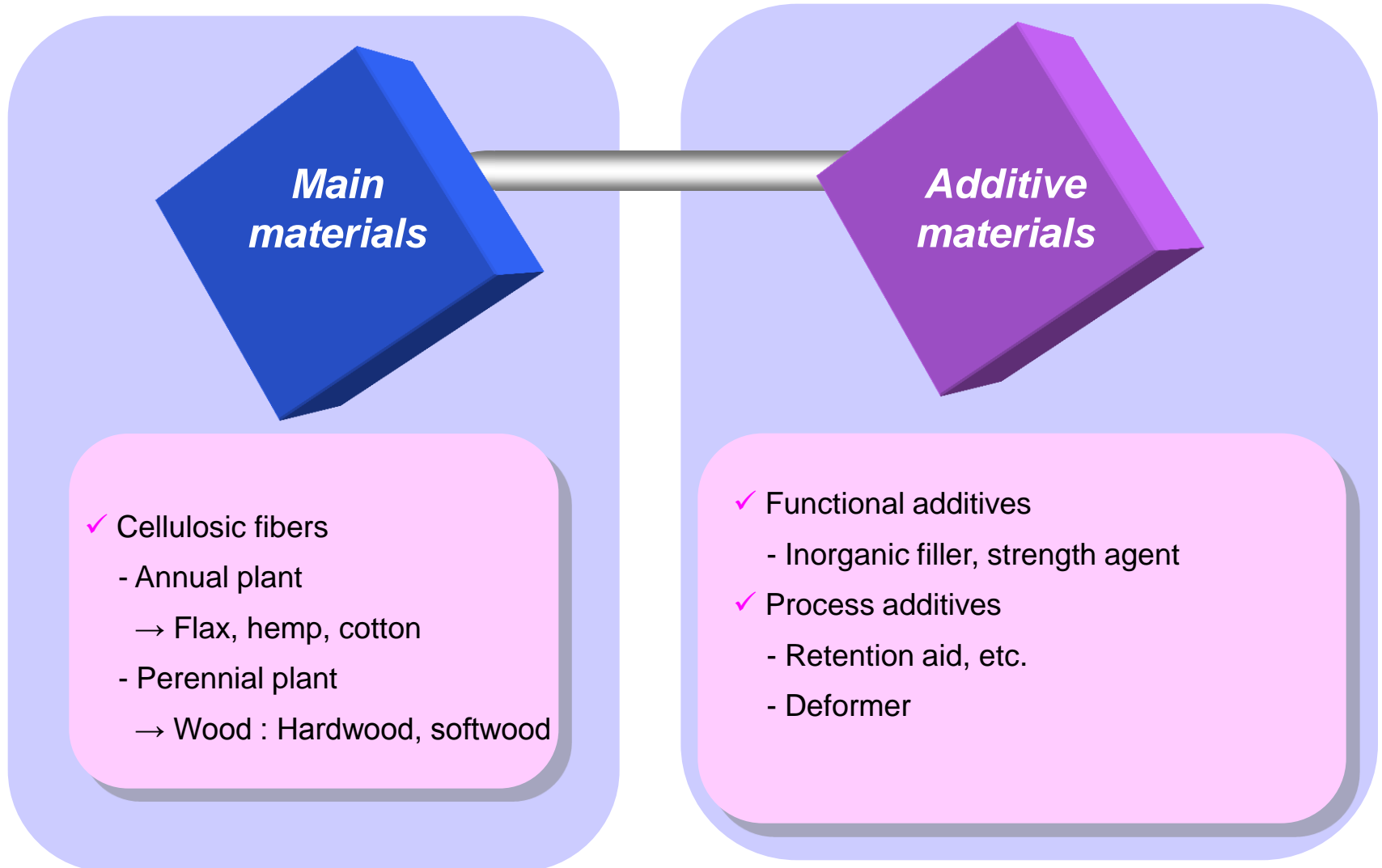


Functions of cigarette paper





Composition of cigarette papers





Chemical components of cigarette paper

Main materials

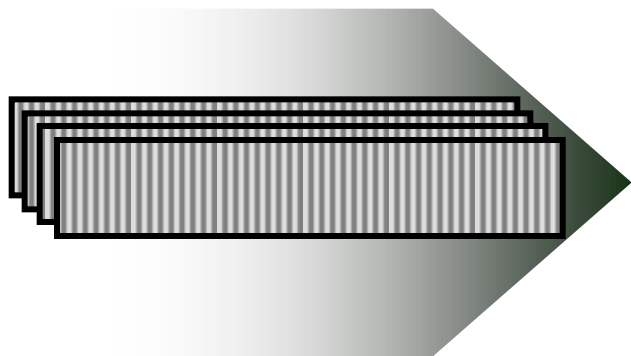
- ✓ Cellulosic fibers
- ✓ Sources of raw materials
 - Annual plant
 - Perennial plant

- ✓ Cellulose
- ✓ Hemicellulose
- ✓ Lignin : Adhesive
- ✓ Pectin
- ✓ Extracts

- ✓ *Cellulose fibers with various chemical components*



Interaction of cigarette papers during smoking



Cigarette papers

✓ Cigarette paper only

- Dehydration, fragmentation, elimination, condensation
- Gaseous products, complex semi-volatile liquid tar
- Residual carbonaceous char

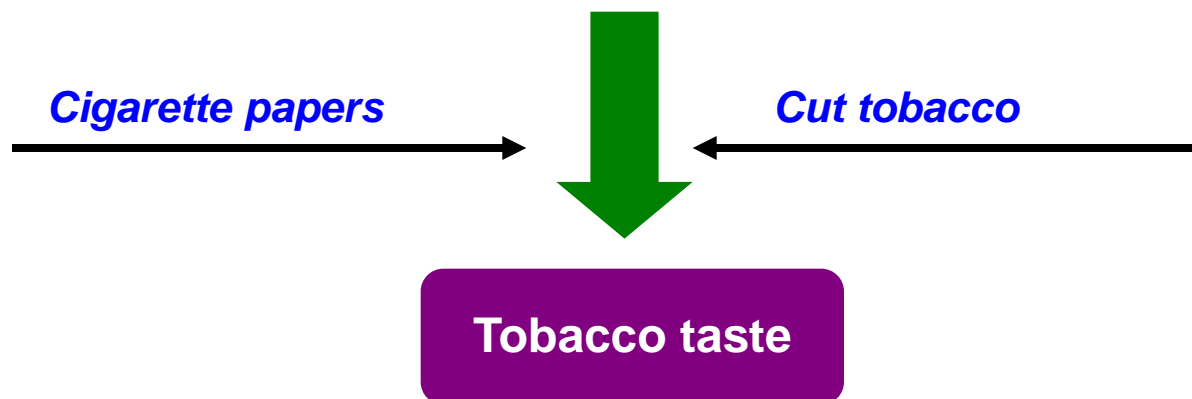
✓ Interaction of cigarette paper with cut tobacco

- Pyrolysis of cigarette paper
- Combined pyrolysis of cigarette paper and cut tobacco
- Smoke delivery, combustion, tobacco taste

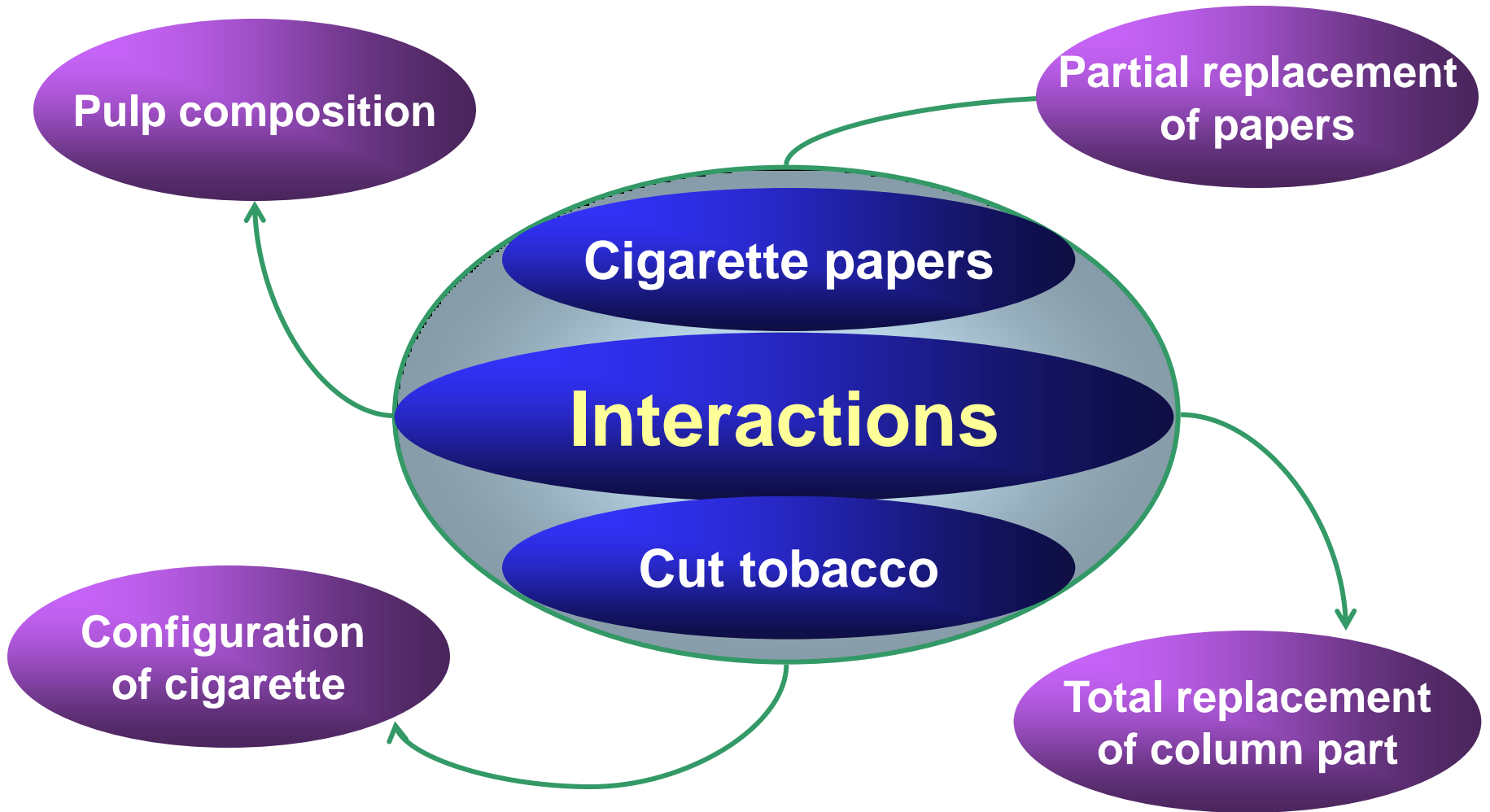


Interaction of cigarette papers during smoking

- ✓ Interaction of cigarette paper with cut tobacco
 - Pyrolysis of cigarette paper
 - Combined pyrolysis of cigarette paper and cut tobacco
 - Smoke delivery, combustion, tobacco taste



In real smoking condition, the interaction of cigarette paper with tobacco takes place





Experimental & Methods

Part 1 : Partial replacement of cigarette paper

Part 2 : Total replacement of cigarette in column part



Materials used for cigarette

Specification		Regular cigarette	Ultra-slim cigarette
Configuration	Column	60	70
	Filter	24	30
Cigarette paper		Flax Wood	Flax Wood
Filter		Acetate Mono filter	Acetate Mono filter

All the materials for cigarette used were the same except for cigarette papers



Application of cigarette paper

✓ *Partial replacement of cigarette papers*

✓ *Total replacement of cigarette in column part*

All the materials for cigarette used were the same except for cigarette papers

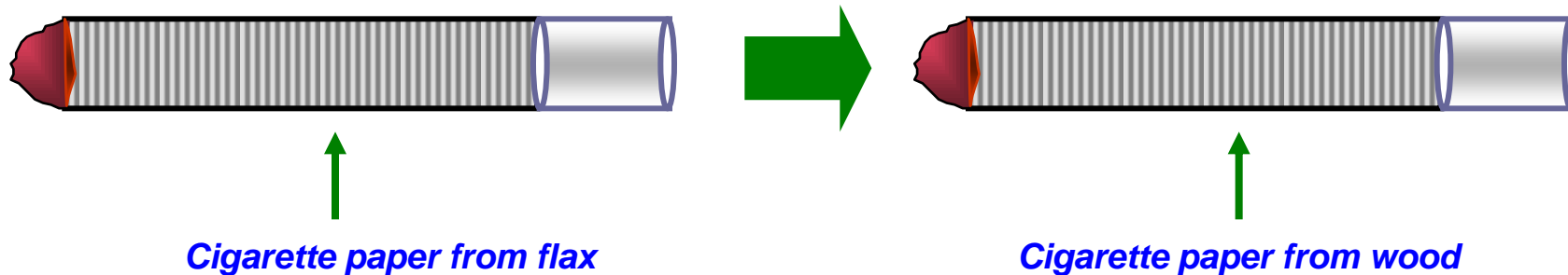


Physical and chemical properties of cigarette papers

Properties	Unit	Cigarette paper from flax	Cigarette paper from wood
Basis weight	g/m ²	27	26
Porosity	CU	35	36
Tensile strength	Kg _f /26.5mm	2.5	2.8
Filler content (As CaCO ₃)	%	29	31
Burning chemicals (Na citrate:K citrate=1:1)	%	0.71	0.79
Pulp composition	%	Flax 100%	Wood 100%



● Partial replacement of cigarette paper



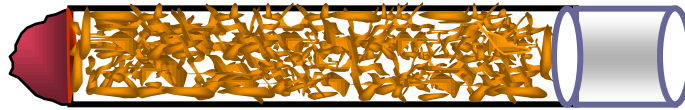
✓ Regular and ultra-slim cigarette were prepared

Experimental method



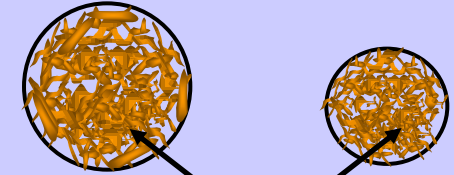
Total replacement of cigarette in column part of cigarette

Step 1



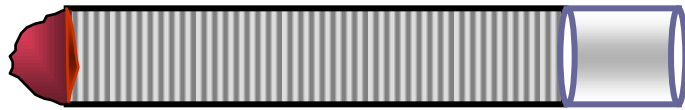
Cut tobacco + cigarette paper from flax

- ✓ Removal of cut tobacco
- ✓ Filled with cut paper instead of cut tobacco

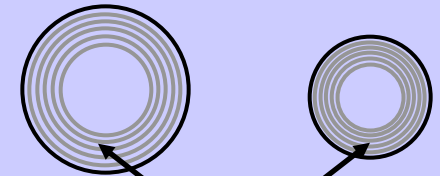


Cut tobacco

Step 2

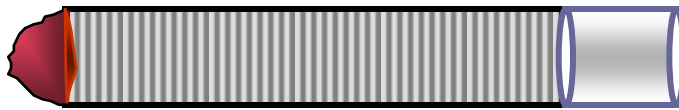


Cut flax paper + cigarette paper from flax



Cut cigarette paper

Front side
(Regular / Ultra-slim)



Cut wood paper + cigarette paper from wood



Partial replacement of cigarette paper

Properties	Unit	Regular cigarette	Ultra-slim cigarette
UPD (Uncapsulated pressure drop)	mmH ₂ O	135±5	545±10
Ventilation rate	%	46±2	67±2

Total replacement of cigarette in column part

Properties	Unit	Regular cigarette	Ultra-slim cigarette
EPD (Encapsulated pressure drop)	mmH ₂ O	87±4	128±4
Ventilation rate	%	0	0



Analytical method

✓ Chemical composition of cigarette paper : ^1H NMR Spectroscopy

✓ Smoke analysis : Mainstream smoke, Whole smoke
- Based on relevant ISO method

✓ SSI : Selected similarity index



Analysis of chemical composition for cigarette papers

Specification	¹ H NMR Spectroscopy	
Model	Bruker, AVANCE NMR Spectrometer (500 MHz)	
Solvent	D2O (Heavy water)	
Pulse	11 μsec	
Delay between pulse	10 sec	
Acquisition time	2.73 sec	
Sweep width	10 ppm	
Center of spectrum	4.5 ppm	
Temperature	295.6 K	



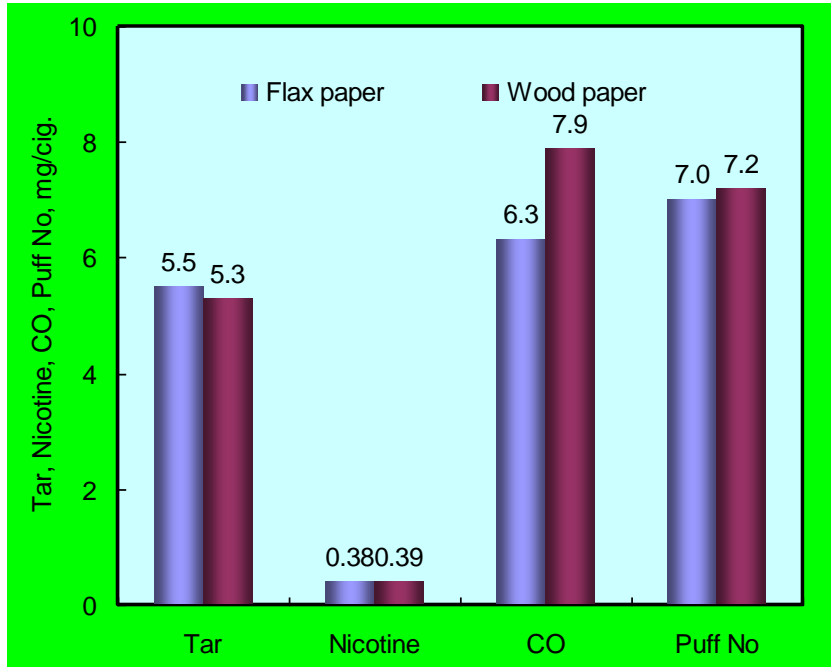
Results & Discussion

Part 1 : Partial replacement of cigarette paper

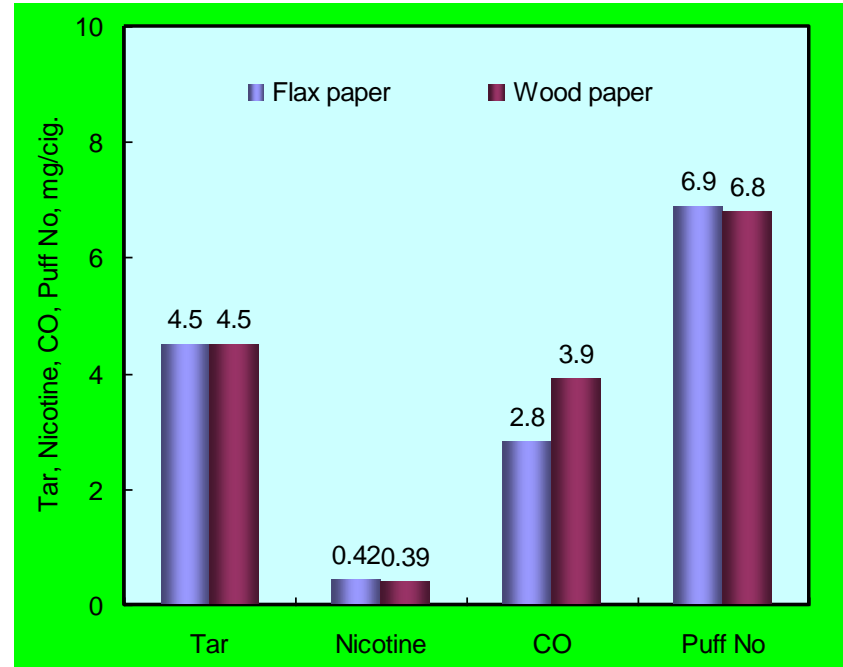
Part 2 : Total replacement of cigarette in column part



Analysis of mainstream smoke



Regular cigarette

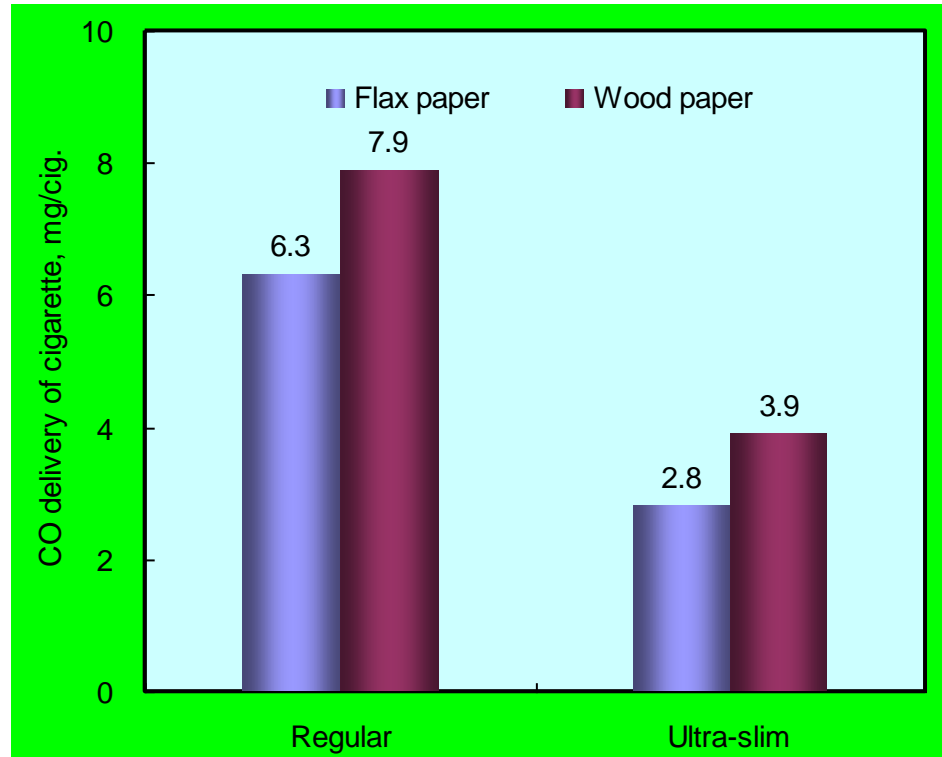


Ultra-slim cigarette

- ✓ Tar, nicotine, Puff No of cigarette with flax paper showed the similar results from cigarette with wood paper
- ✓ Increase of CO delivery was observed by use of wood paper



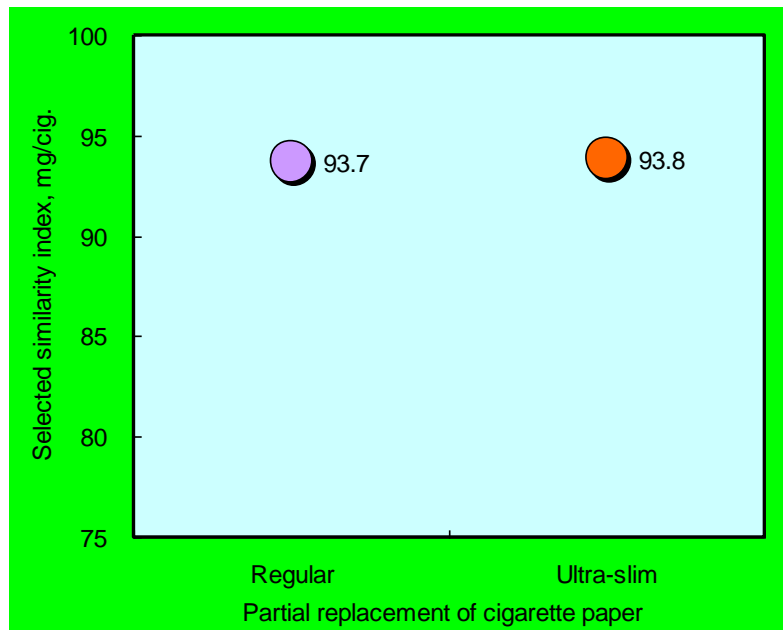
Analysis of mainstream smoke



✓ Increase of CO delivery was observed by use of wood paper



Selected similarity index

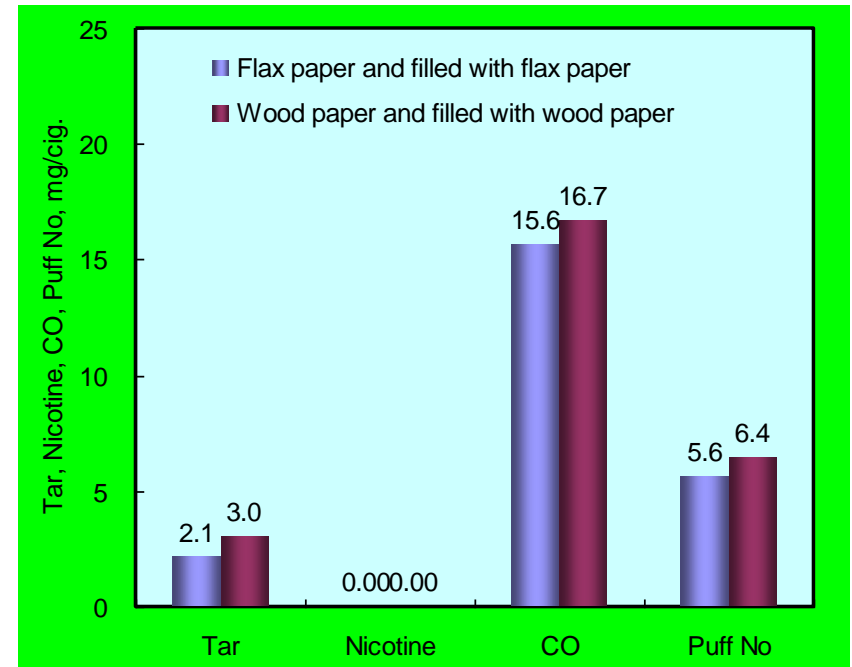
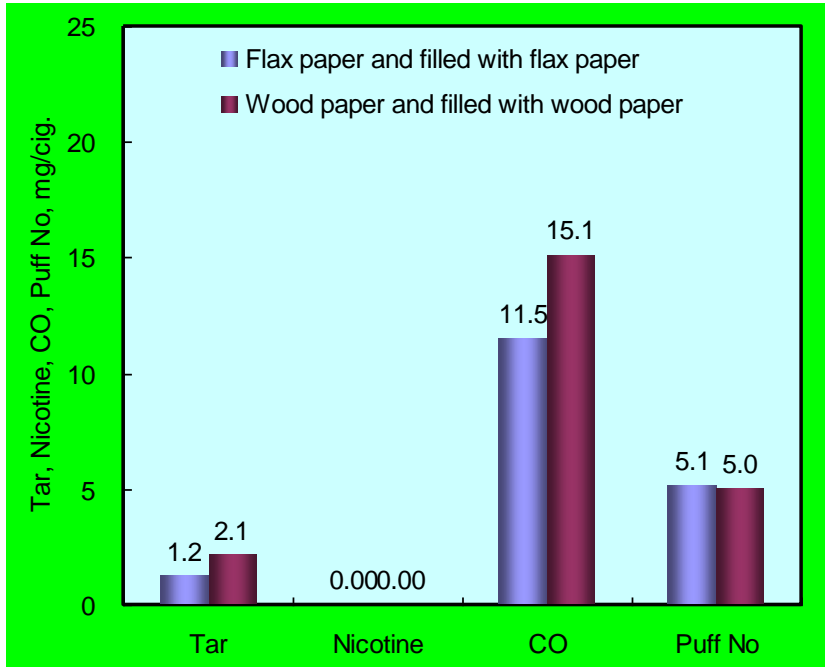


Configuration	Cigarette	SSI(%)
Regular cigarette	Cigarette with flax paper vs Cigarette with wood paper	93.7
Ultra-slim cigarette		93.8

✓ Higher SSI was obtained by the partial replacement from flax into wood paper



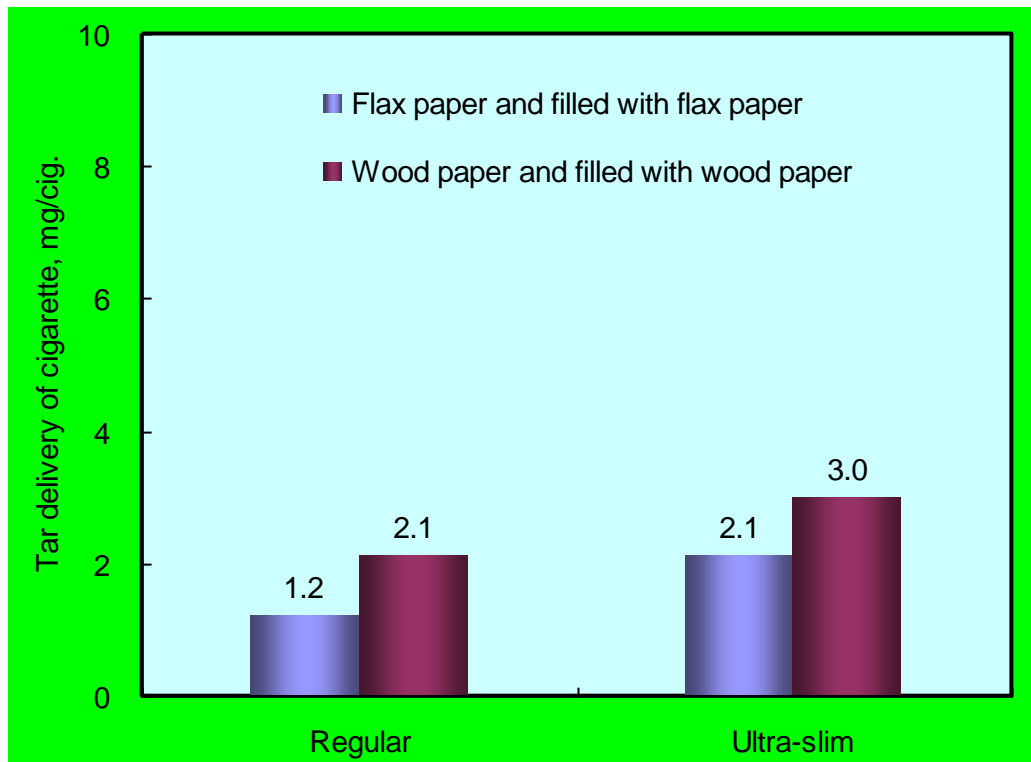
Analysis of mainstream smoke



- ✓ Different results were shown compared to the partial replacement
- ✓ Tar, CO, Puff No of cigarette increased by total replacement method
- ✓ No nicotine was observed in total replacement of cigarette



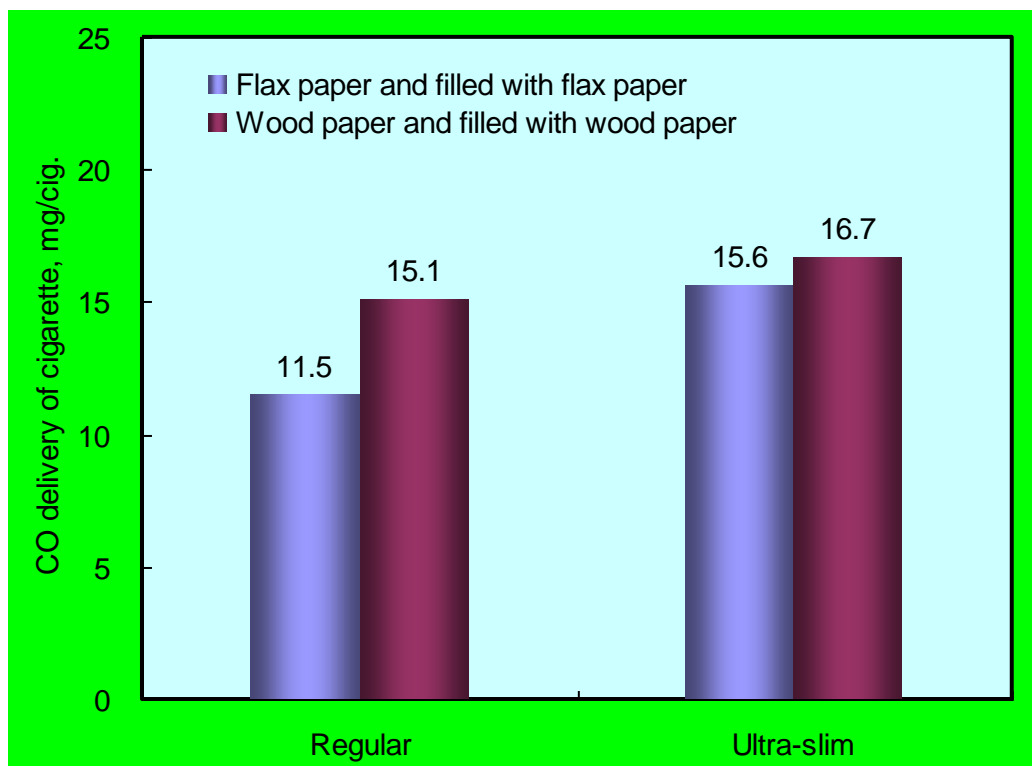
Analysis of mainstream smoke



✓ Tar delivery of cigarette increased by total replacement method



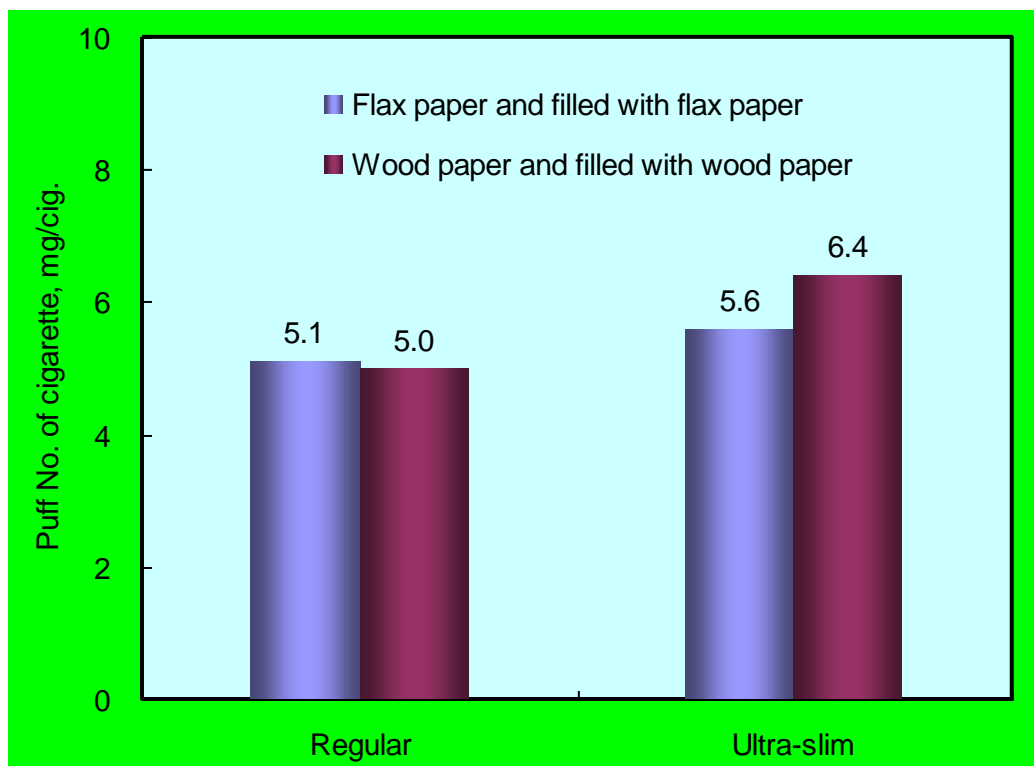
Analysis of mainstream smoke



✓ CO of cigarette increased by total replacement method



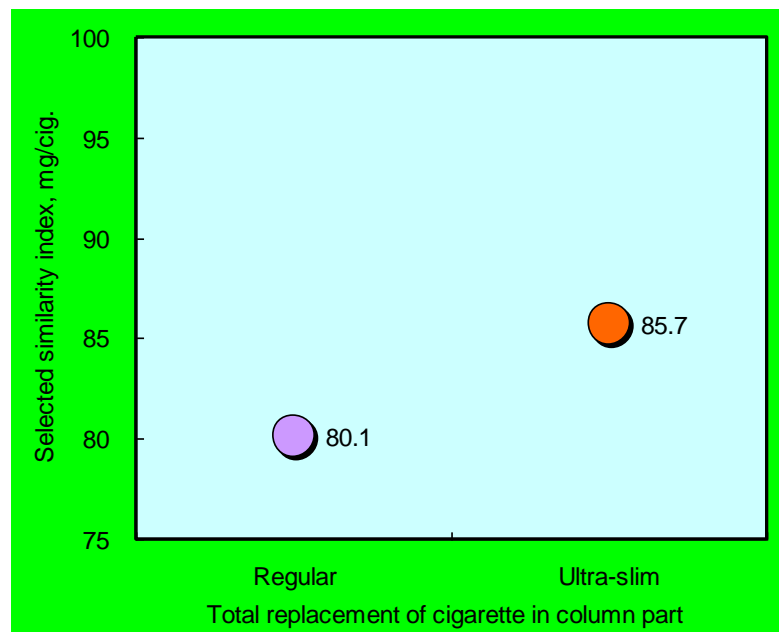
Analysis of mainstream smoke



✓ Puff No of cigarette increased by total replacement method



Selected similarity index



Configuration	Cigarette	SSI(%)
Regular cigarette	Cigarette with flax paper and filled with cut flax paper vs Cigarette with wood paper and filled with cut flax paper	80.1
Ultra-slim cigarette		85.7

✓ Lower SSI was obtained by the total replacement from flax into wood paper



What is the difference by flax and wood?

Tar, Nicotine, Puff No =

SSI ↑ (Over 93%)

CO ↑

- Partial replacement +

Tar, Puff No ↑

SSI ↓ (Below 85%)

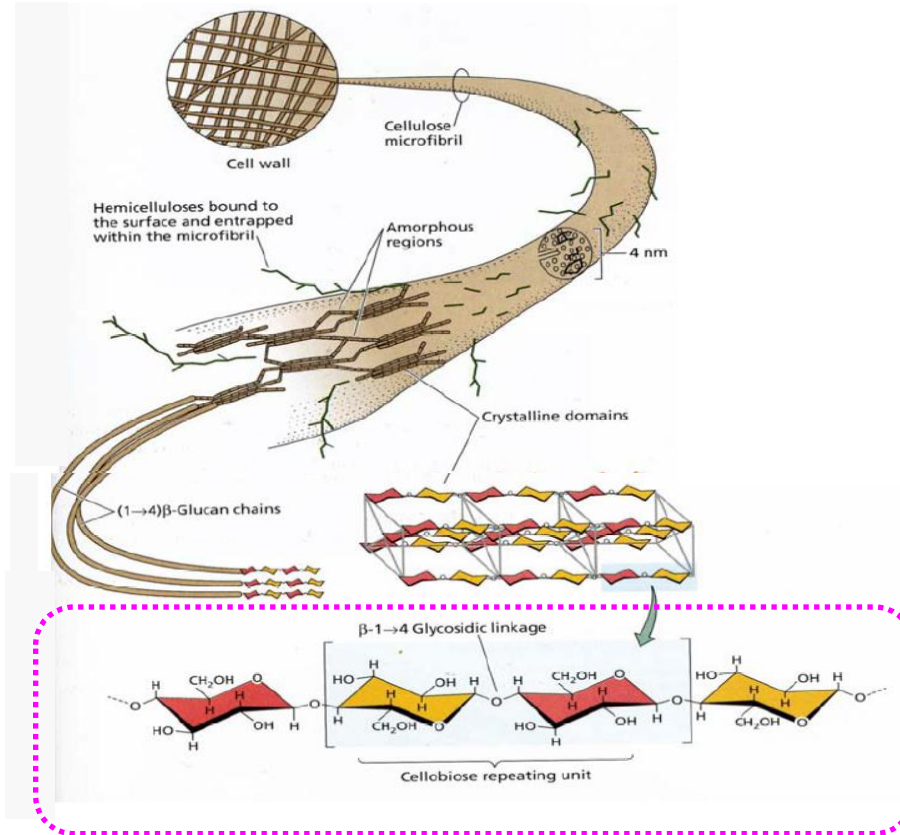
CO ↑

- Total replacement +

Effects of cellulosic fibers



- ✓ *Wood cigarette paper*
 - *Increase of CO in mainstream*



Source materials for flax and wood are cellulosic fibers



Chemical composition of cigarette papers

Cigarette paper	Hot water extract(%)	Acetone extract(%)	Hollocellulose (%)	Lignin (%)	Cellulose (%)	Xylan (%)
Cigarette paper from flax	1.88	0.50	69.0	Not valid	57.3	11.7
Cigarette paper from flax	2.70	0.67	64.3	Not valid	55.2	9.2

※ Not valid : Calculated values were less than 1.0%

Cellulose content

Flax > Wood

Extract by hot water and acetone

Wood > Flax

Xylan content

Flax > Wood



Source material for cellulose

- ✓ *Wood cigarette paper*
 - *Increase of CO in mainstream*

Flax

Wood

Growth period

Annual plant

Perennial plant

Degree of polymerization

700 ~ 1,800

About 3,000

Molecular weight (g/mol)

100,000 ~ 300,000

About 500,000

Molecular weight of unit cellulose (162) : Lee et al, J of Industrial and Engineering Chemistry, 2011



✓ Higher degree of polymerization (DP) of cellulose

✓ Higher molecular weight (MW) of cellulose



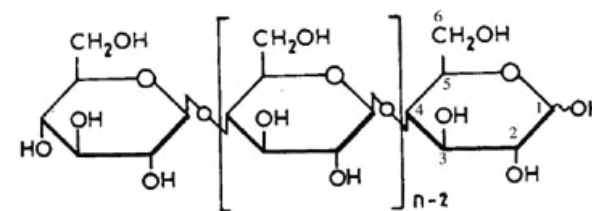
More site to generate CO during thermal pyrolysis

✓ Cleavage of carbon chain during pyrolysis

✓ Combination of carbon with oxygen



Increase of CO delivery by use of wood fiber

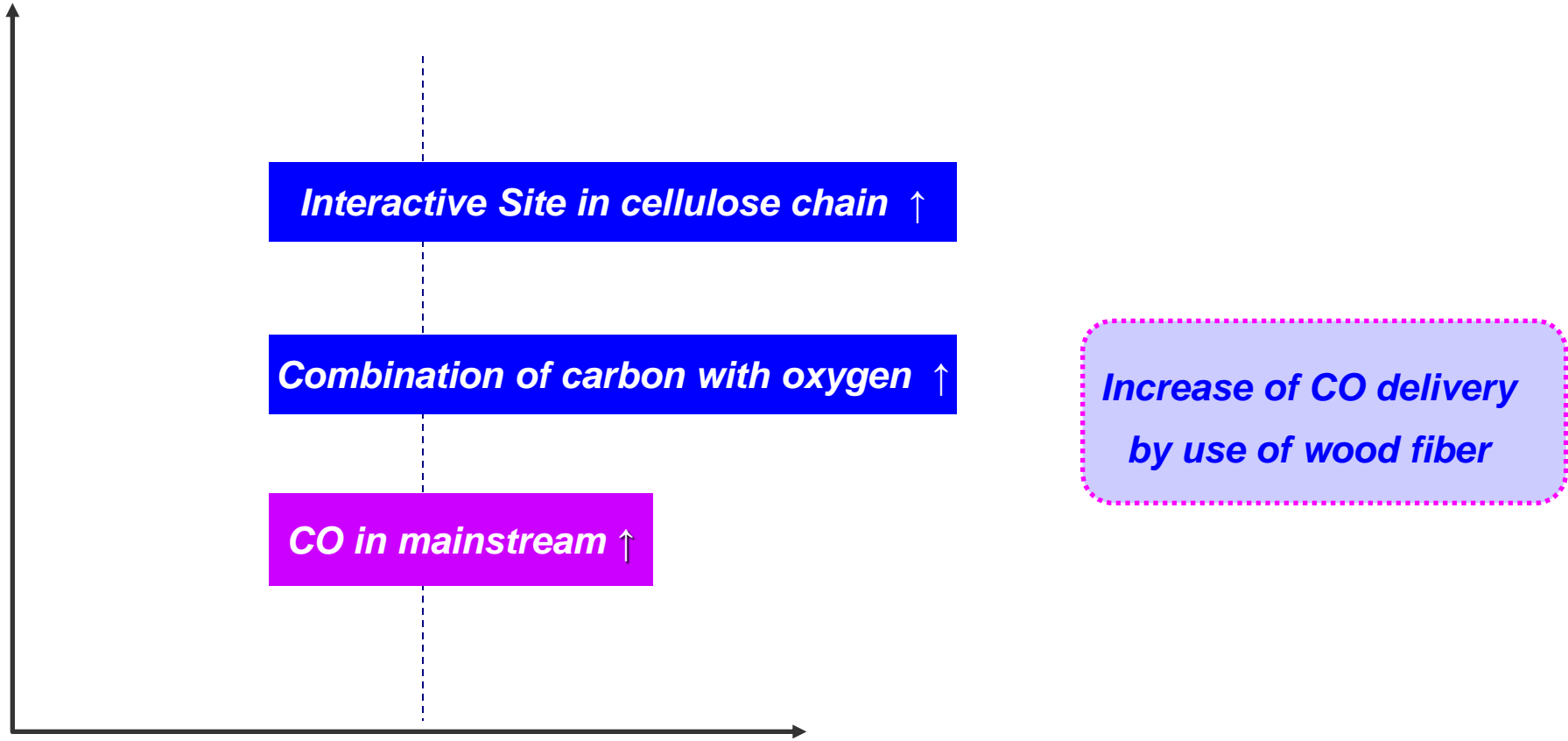


[Cellulose unit]

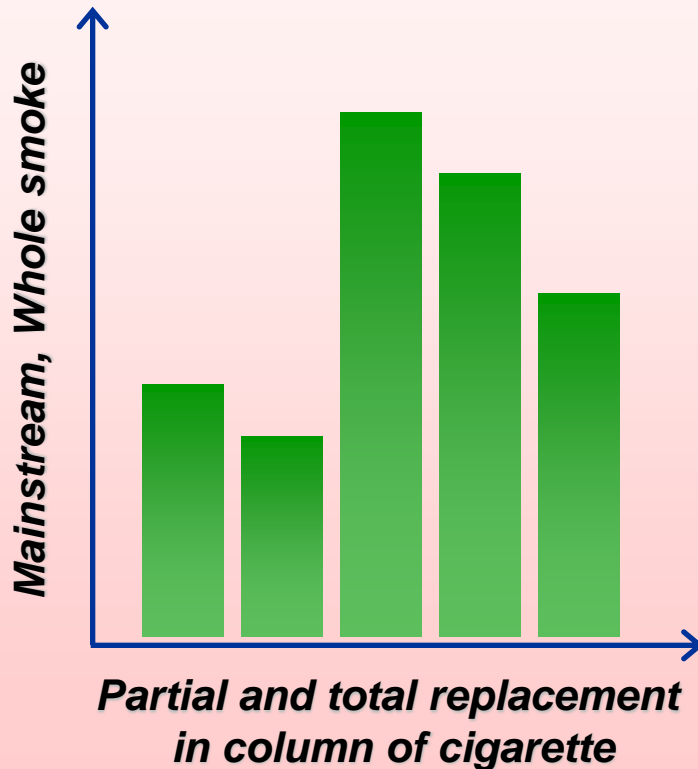




Effect of cellulosic fiber on increase of CO



- Increase of DP and MW +



- ✓ **Simulation for pulp composition effect**
 - Partial replacement
 - Total replacement
 - Regular cigarette
 - Ultra-slim cigarette
- ✓ **Weight portion of cellulosic fibers in cigarette**
 - Influencing mainstream, whole smoke
- ✓ **CO increase in mainstream**
 - Higher degree of polymerization
 - Higher molecular weight



Thank you for your attention!!

0505sms@ktng.com