



# The Binder Role in CelFX™ Matrix Technology Structures Used for Tobacco Smoke Filtration

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CelFX™ technology is not intended for use in cigarettes manufactured for commercial distribution in the United States

# Overview

## ▶ Objective

- Determine the role of CelFX™ binder for mainstream smoke filtration
- Determine the role of CelFX™ binder for vapor phase component filtration

## ▶ CelFX™ Matrix Technology Introduction and Overview

## ▶ Physical Analysis

## ▶ Smoke Chemistry

- Particulate Phase
- Carbonyls

# CelFX™ Matrix Technology

## *Overview*

- ▶ Multi-year development effort
- ▶ Response to market needs
  - Solution for new and increasing regulations
  - Brand innovation
  - High performance filtration
- ▶ Commercial cigarette filter developed by Celanese
- ▶ Focused on preserving the smoking experience while harnessing Celanese broad filtration knowledge



# CelFX™ Matrix Technology

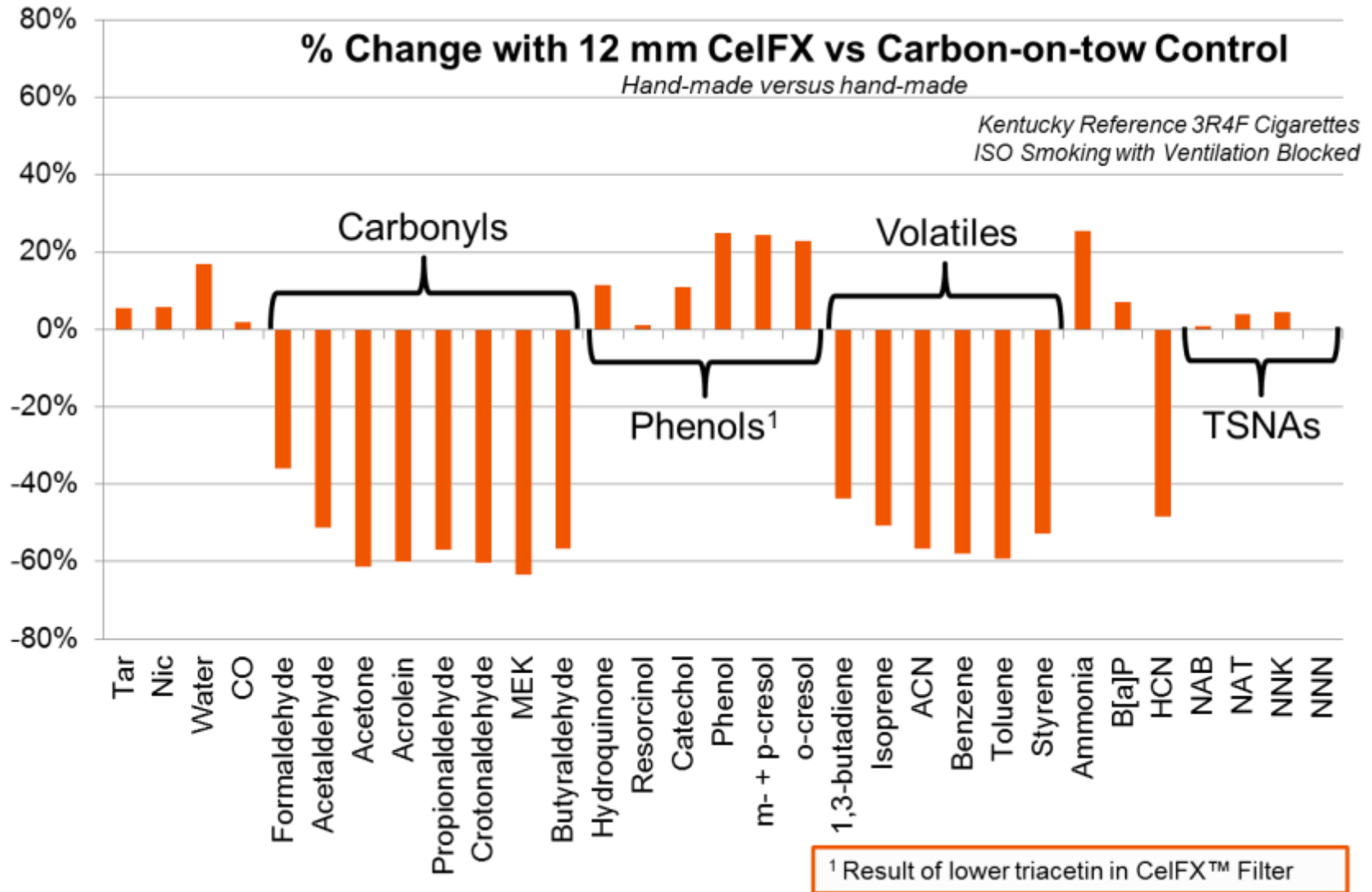
## *Overview*

- ▶ Uses proprietary binder technology /manufacturing process:
  - High active ingredient loadings (activated carbon)
  - Control pressure drop to target (low or high)
  - Lower dust products, despite much higher loadings
- ▶ Expands filter design beyond traditional boundaries
  - Example: Carbon loading in super-slim > 5.5 mg/mm with EPD of 2.0 mm/mm (less than possible with tow only)



# Overview

## Smoke Filtration Performance



*Significant improvement in removal efficiency of gas-phase components vs. carbon-on-tow (40-60% improvement)*

# Overview

## Ingredients

Carbon



Paper



Seam  
Glue



Binder



*All ingredients  
meet German  
Tobacco Ordinance  
Requirements*



**CelFX™ Rods**



**Acetate Rods**



**Combined Rods**

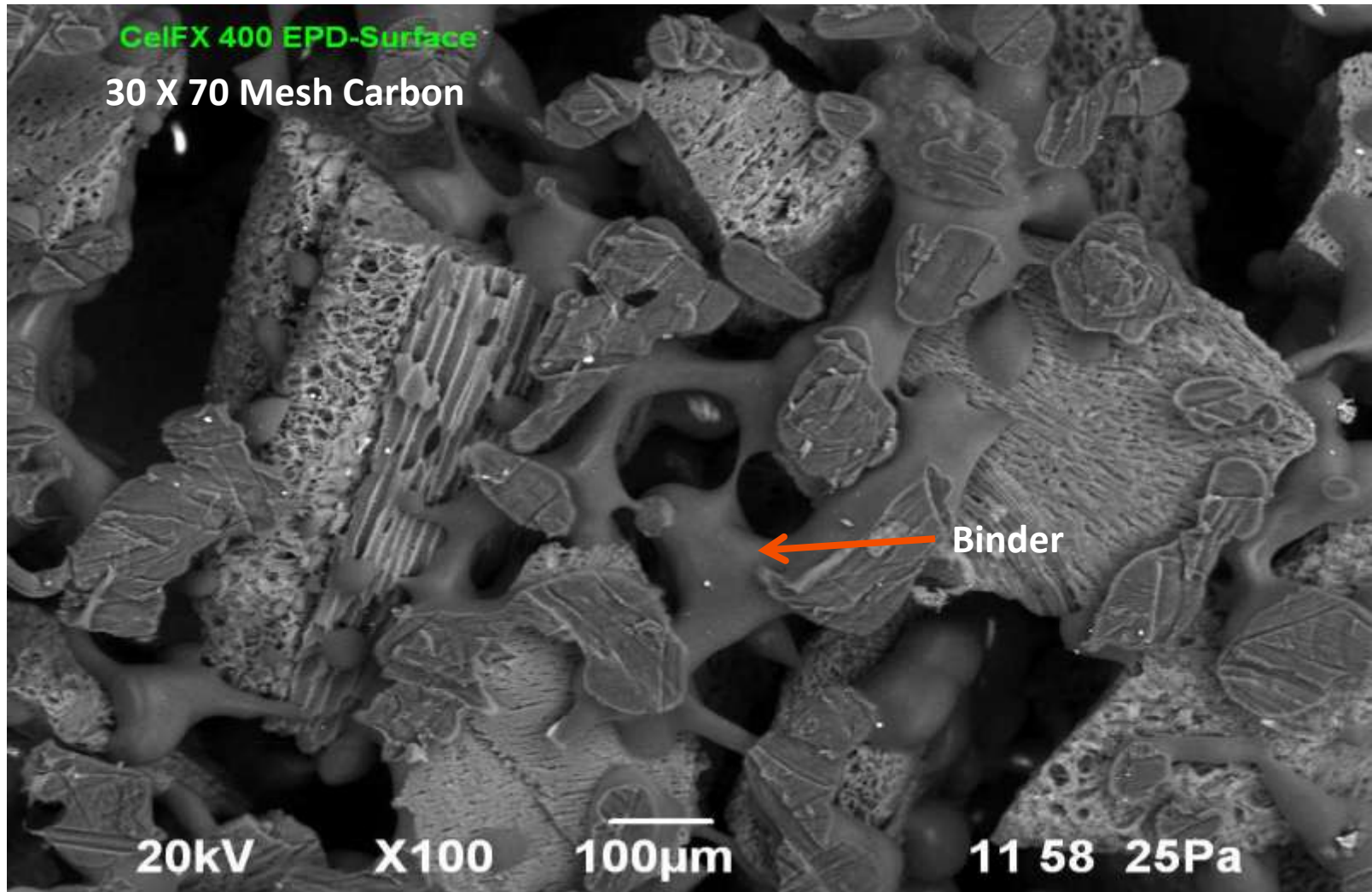
# Binder

## *Overview*

- ▶ Binder is a customized material manufactured by Celanese
- ▶ Binds to active material without coating or deactivating the material
- ▶ Suitable for use in food and drinking water contact applications
- ▶ Listed ingredient in the German Tobacco Ordinance (Verordnung über Tabakerzeugnisse)
- ▶ Binder plays a key role and this presentation seeks to explore the contribution and impact of the binder only, independent of any active ingredient

# Binder

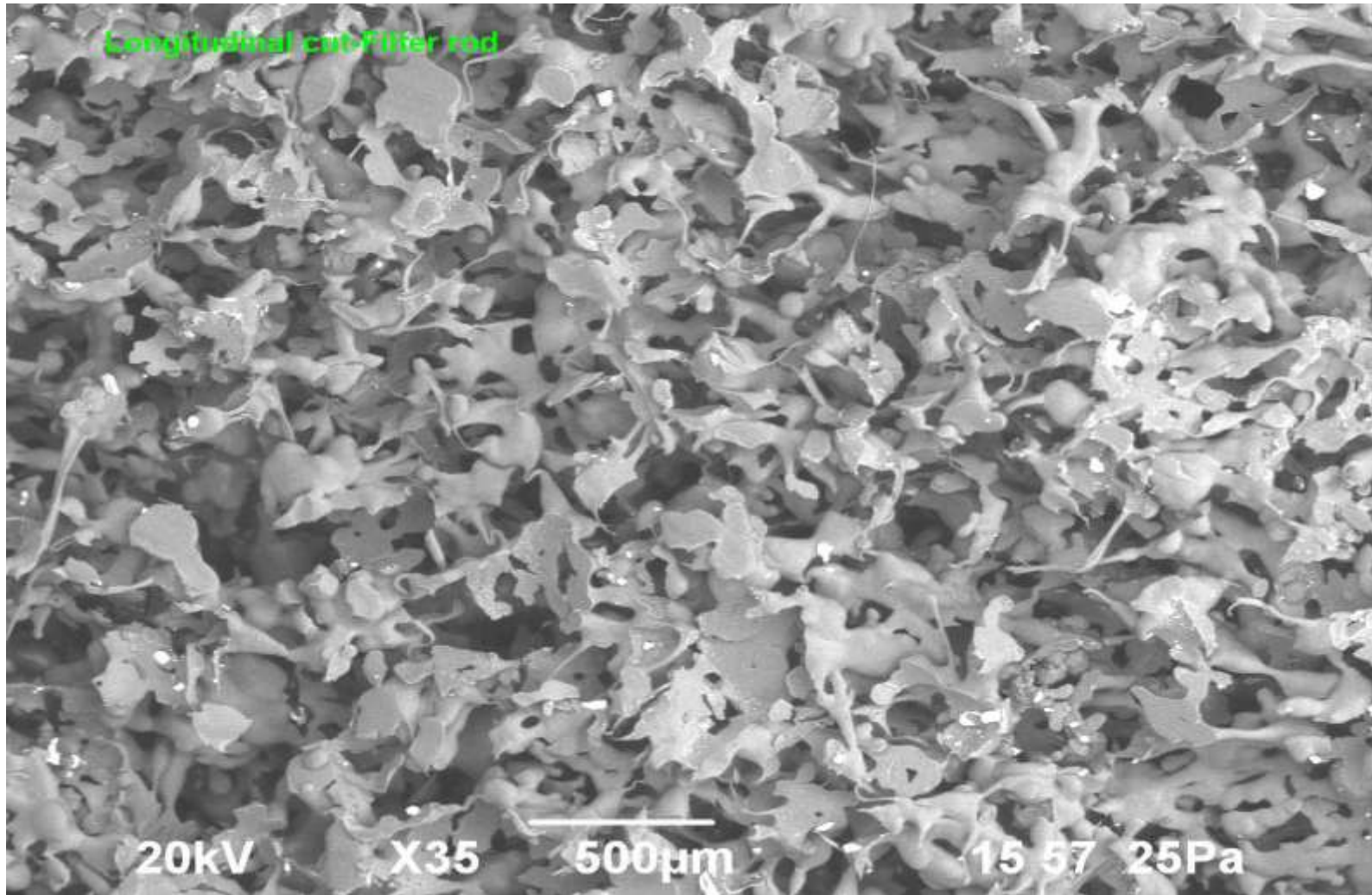
## *Inside Look*





# Binder

*Inside Look - Binder Only*



# Physicals Comparison

	Filter Length	Pressure Drop (mm water)	
		PD/filter	PD/mm
Kentucky 3R4F	27	113	4.2
Std Size Binder only*	27	35	1.3
Commercial Super Slim	27	124	4.6
Super Slim Binder only*	27	40	1.5

\*Much lower EPD though no risk of hot collapse due to rigid, firm structure

# Experimental Design

## ▶ Cigarettes

- Kentucky 3R4F
- Commercial Super Slim (American Blend)

## ▶ ISO 3308 – vent holes blocked

- Cigarettes as received
- Tobacco column only
- Tobacco column + binder only filter

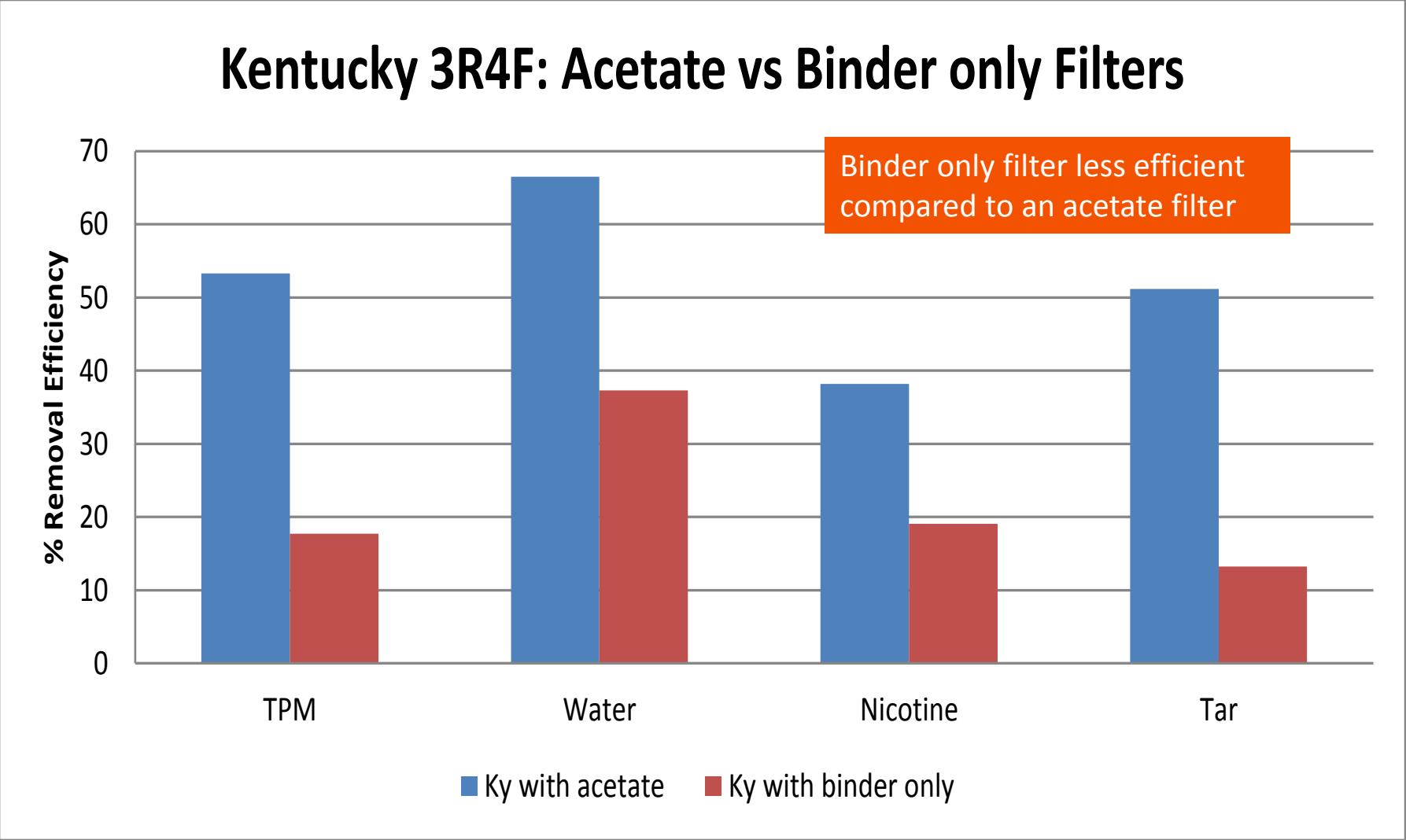
## ▶ Triplicate Testing

- Tar, Nicotine, Water
- Carbonyls normalized by nicotine

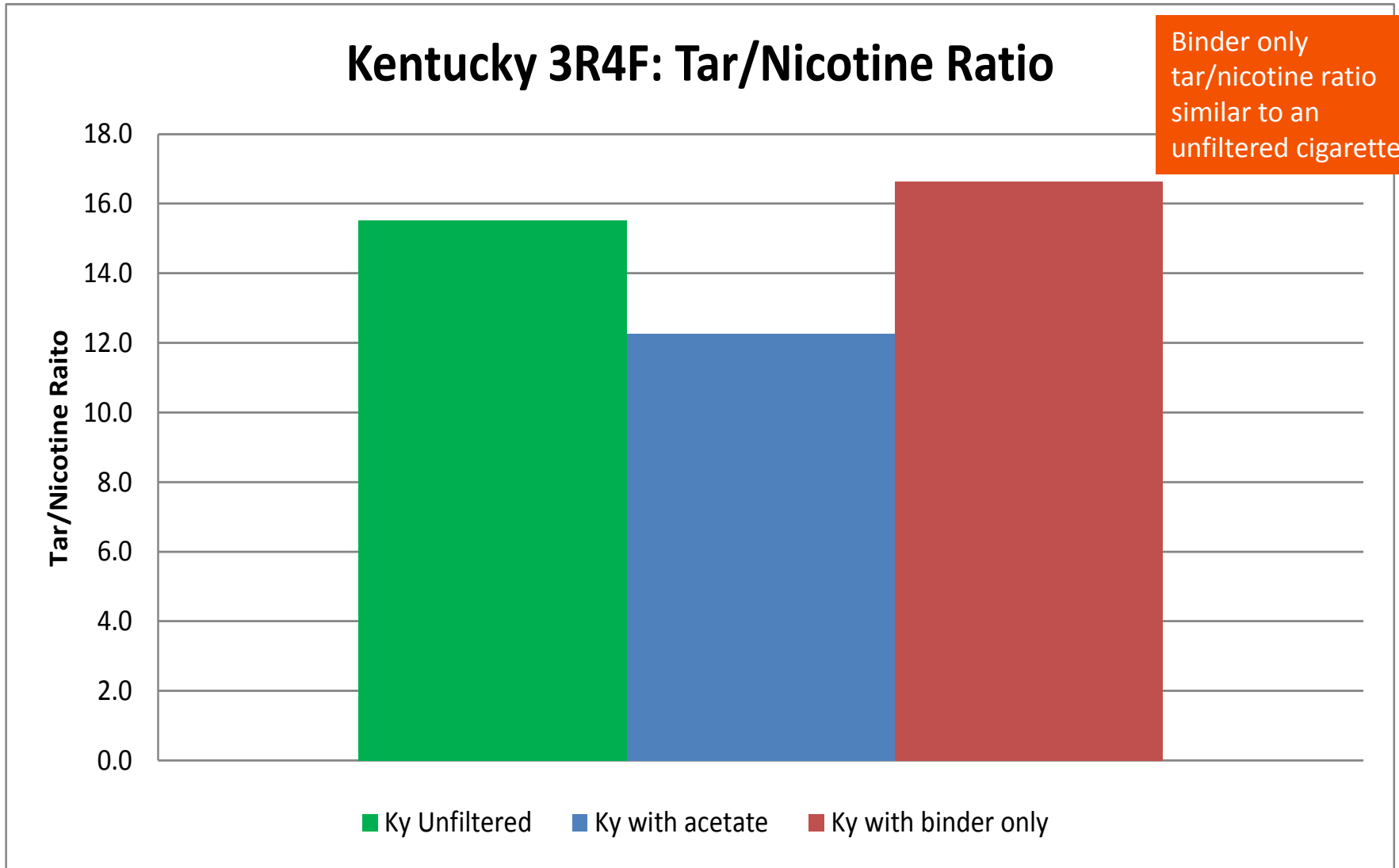
# Mainstream smoke filtration

Tar, Nicotine, Water

# Kentucky 3R4F Reference Cigarette

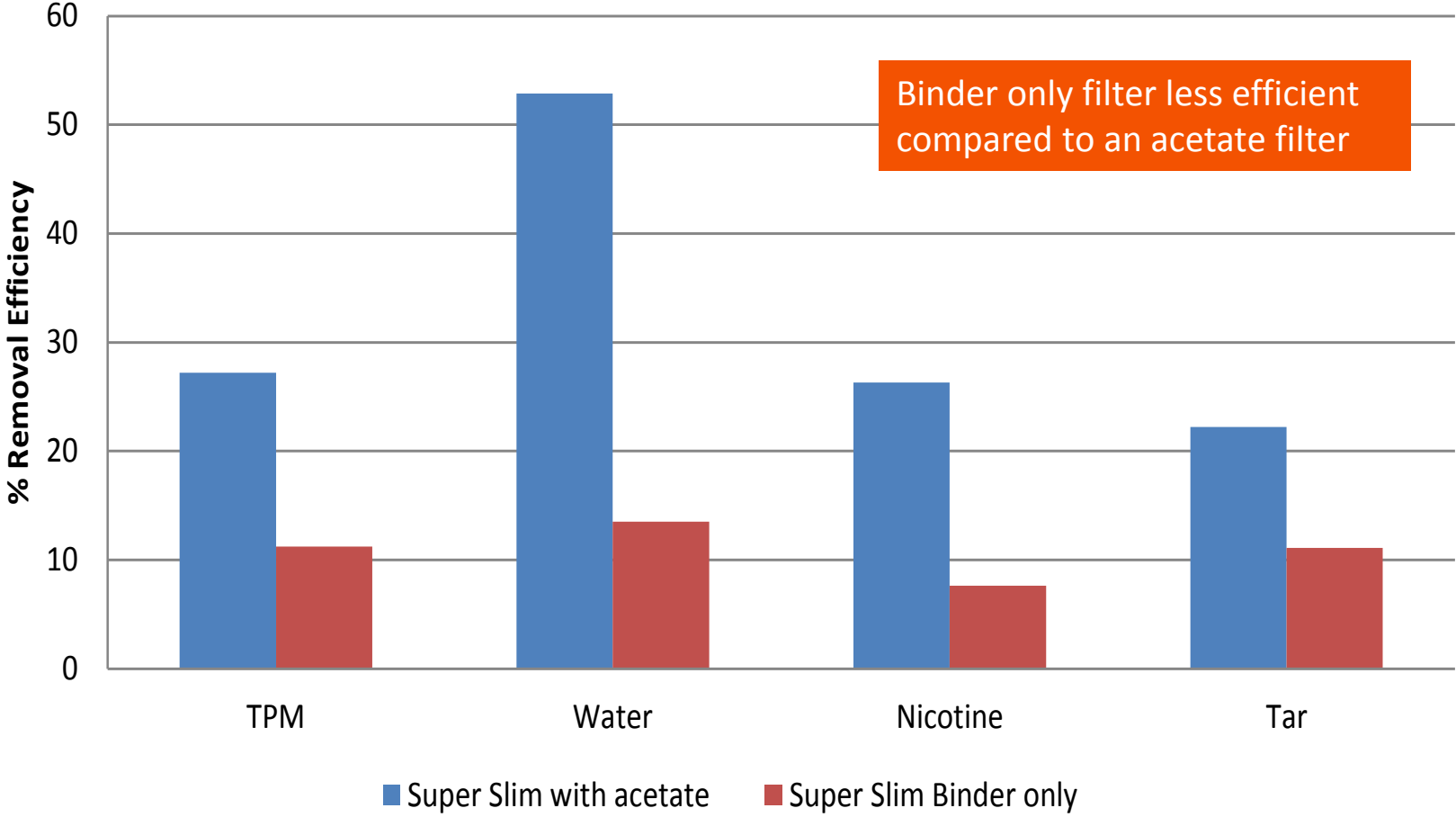


# Kentucky 3R4F Reference Cigarette



# Super Slim

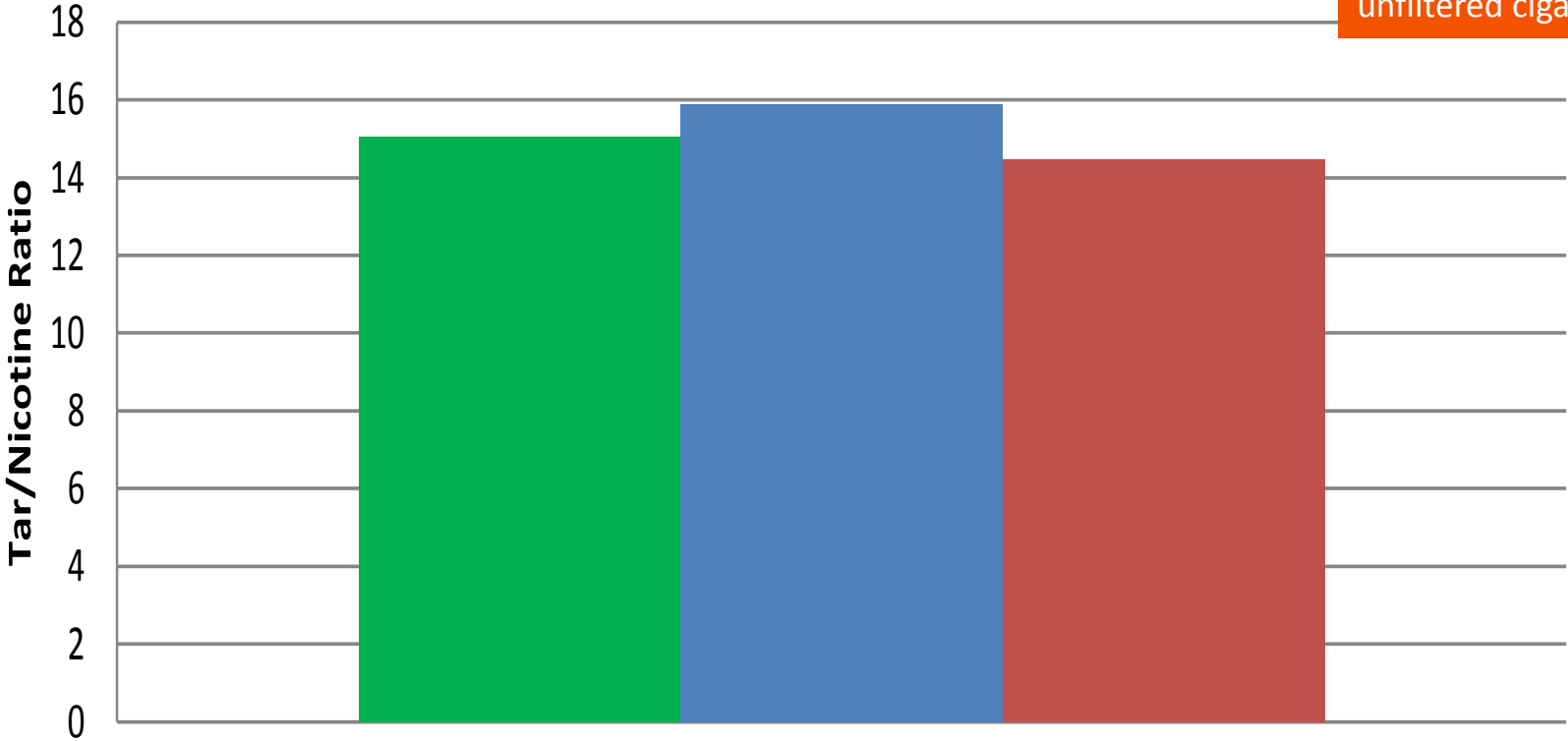
## Super Slim: Acetate vs Binder only



# Super Slim

## Super Slim: Tar/Nicotine Ratio

Binder only  
tar/nicotine ratio  
similar to an  
unfiltered cigarette



■ Super Slim Unfiltered    ■ Super Slim with acetate    ■ Super Slim binder only



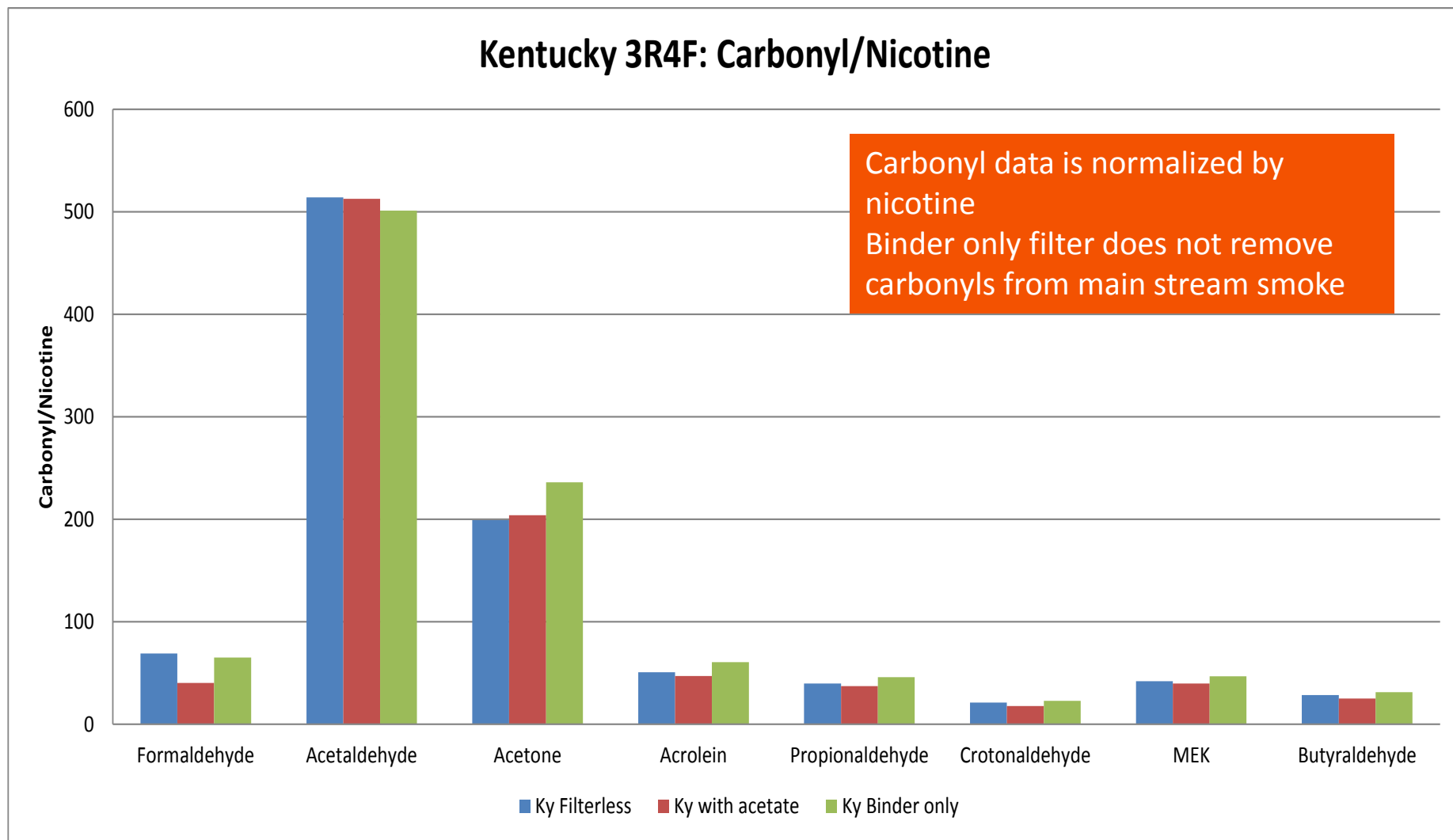
# First Conclusions

- ▶ Binder only is a low pressure drop, low efficiency filter
- ▶ Low water removal efficiency due to hydrophobic binder surface
- ▶ Binder only shows no preferred affinity to tar or nicotine
- ▶ Tar/Nicotine ratio similar to unfiltered control
- ▶ No hot collapse issues observed

# Vapor phase component filtration

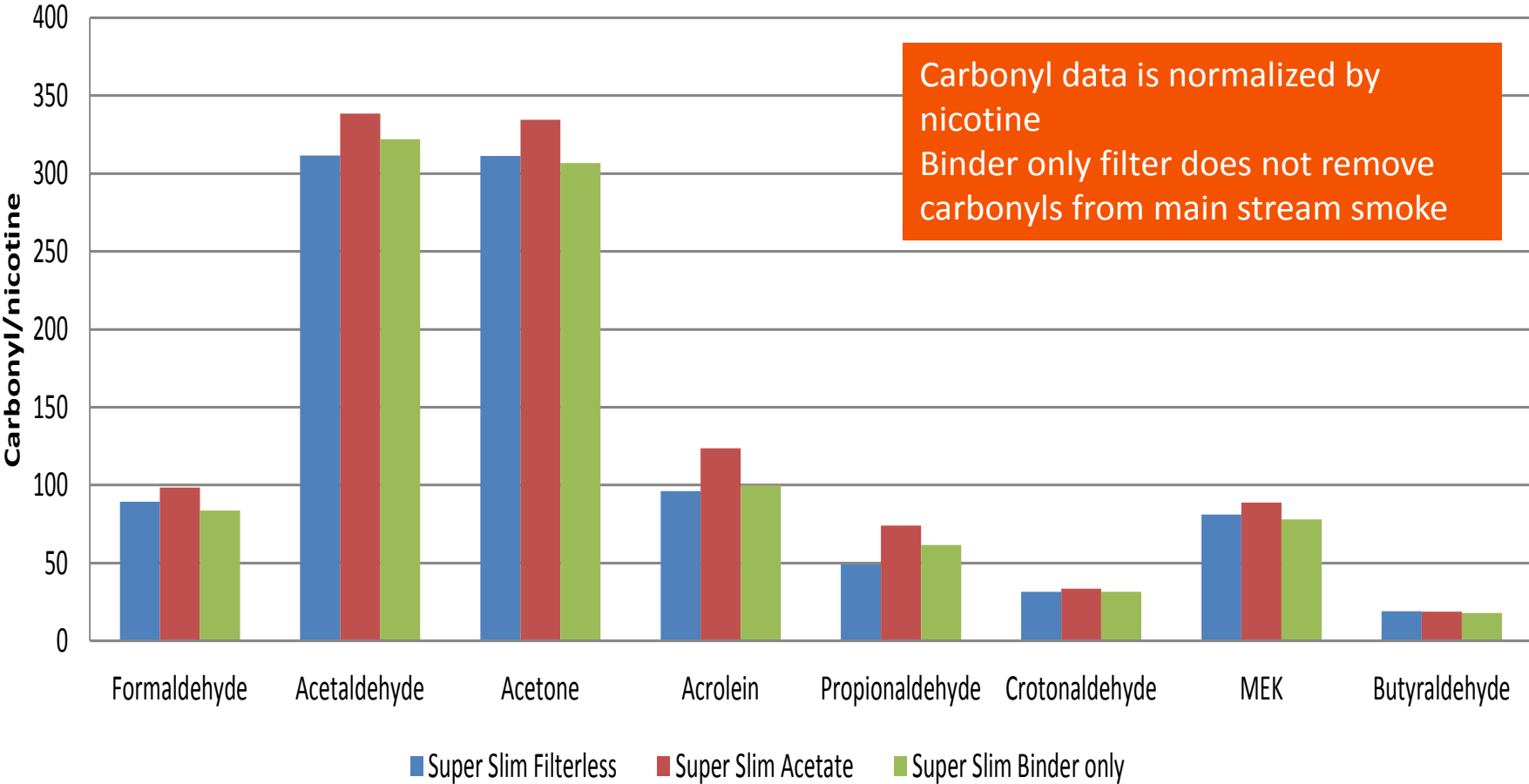
Carbonyl Results

# Kentucky 3R4F Reference Cigarette



# Super Slim

## Super Slim Carbonyl/Nicotine



# Conclusions – Binder only

- ▶ Low pressure filters
- ▶ No hot collapse issue
- ▶ Particulate Phase
  - Low removal efficiency filters
  - Similar to unfiltered cigarettes
  - No selectivity
- ▶ Vapor Phase
  - As expected no impact on carbonyl reduction
- ▶ CelFX™ Matrix Technology
  - Binder has limited role/impact in smoke filtration
  - Matrix active material has the major role in smoke filtration

# Thanks

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