Celanese

The chemistry inside innovation™

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

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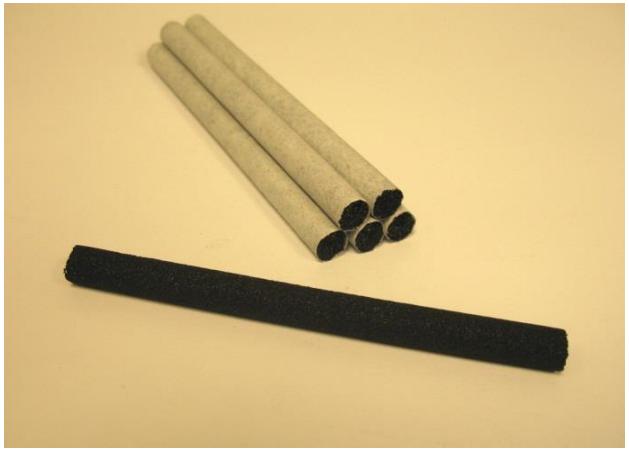
# Overview

- 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

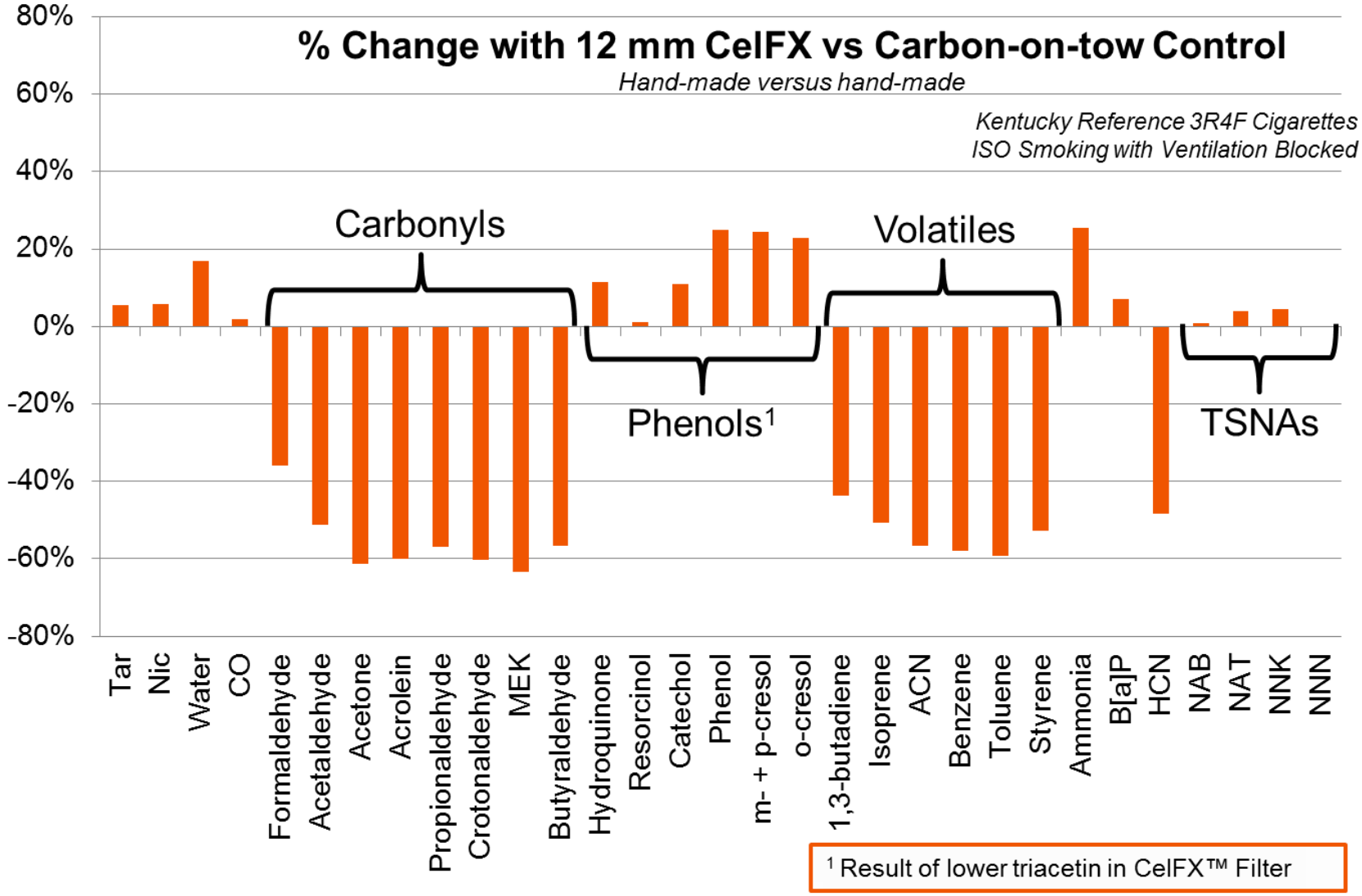
# CelFX™ Matrix Technology

***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

*All ingredients meet German Tobacco Ordinance Requirements*

Seam Glue

Binder


+


=

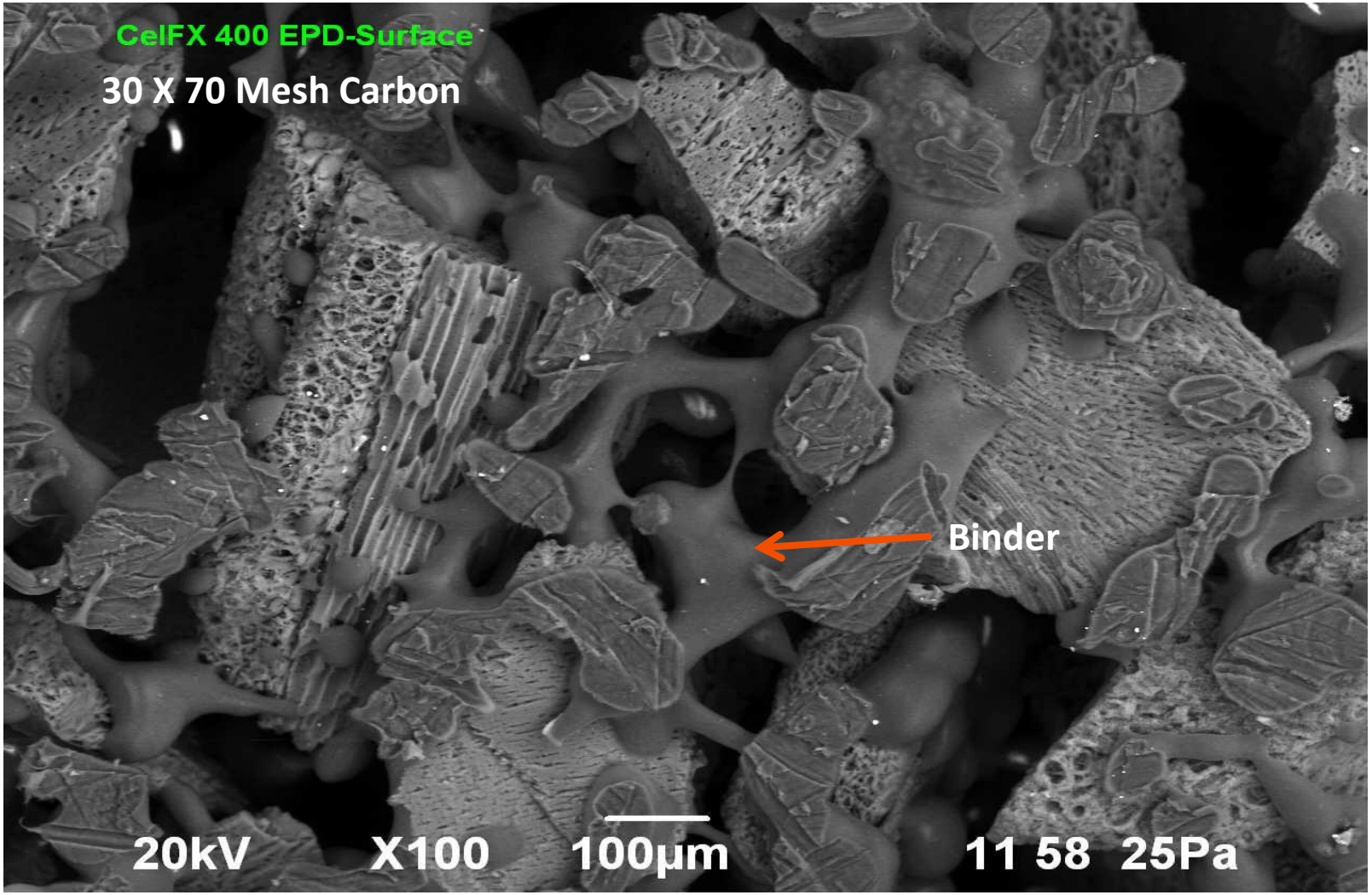
# Binder

***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

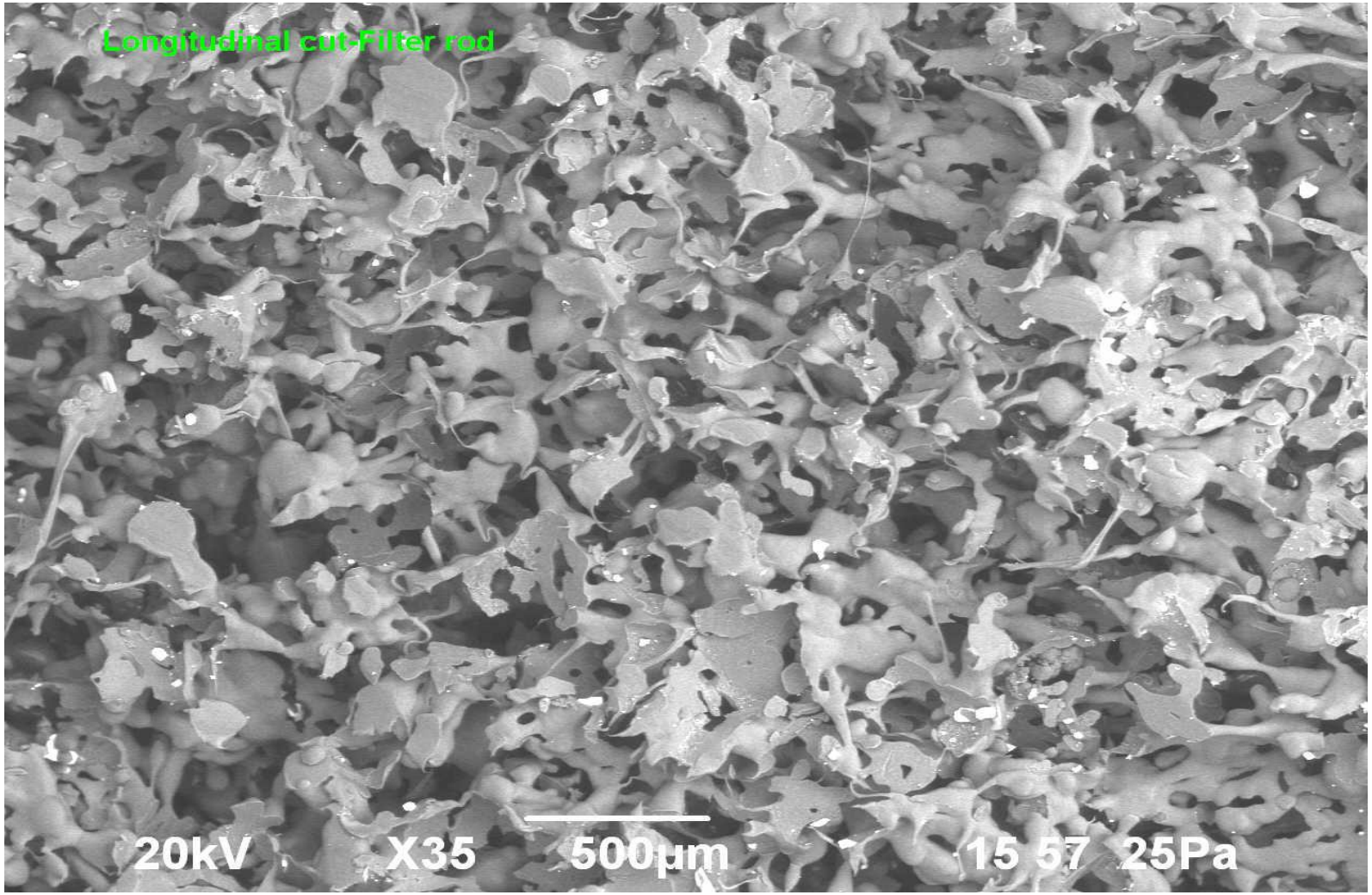
# Binder

***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

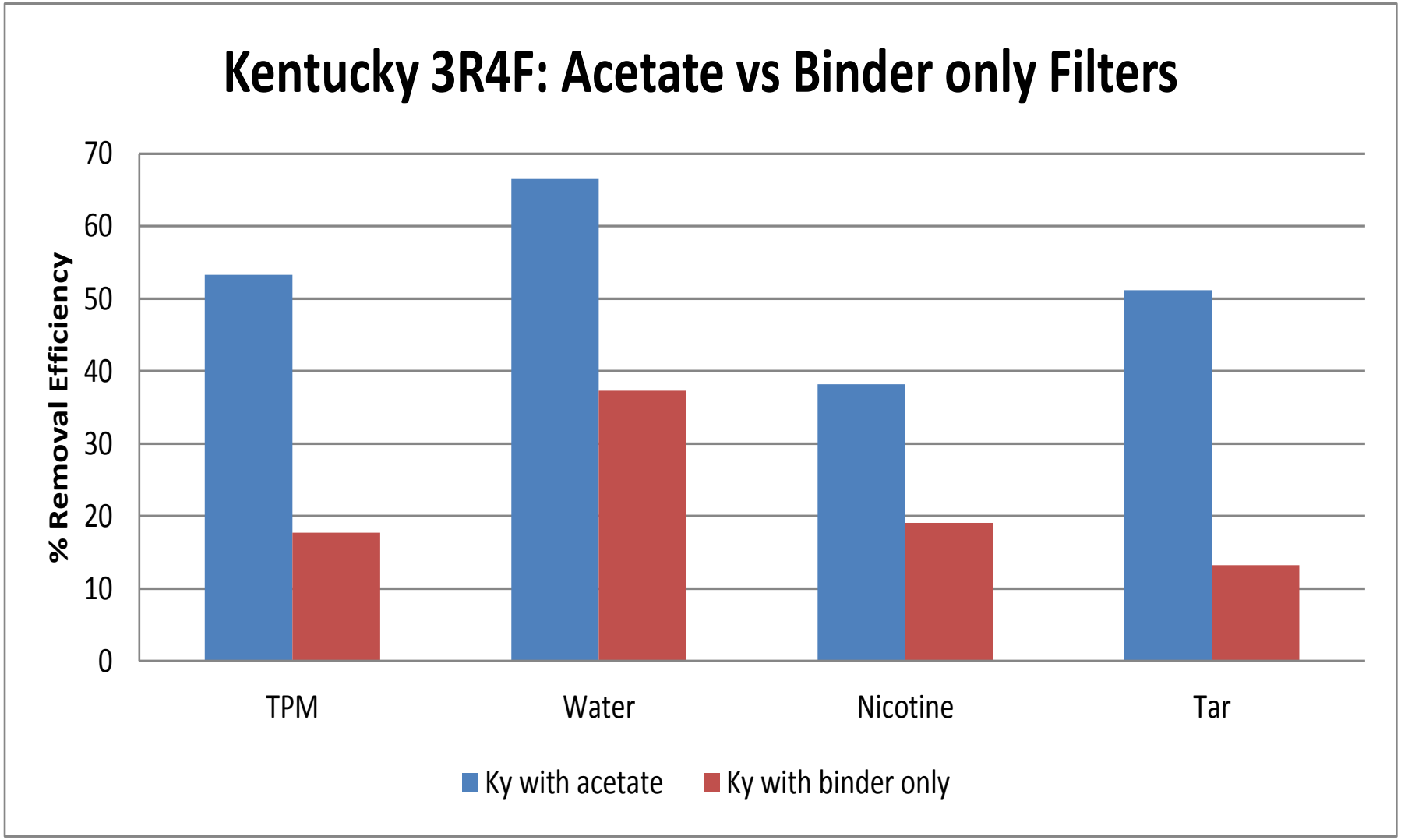
# Experimental Design

- 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

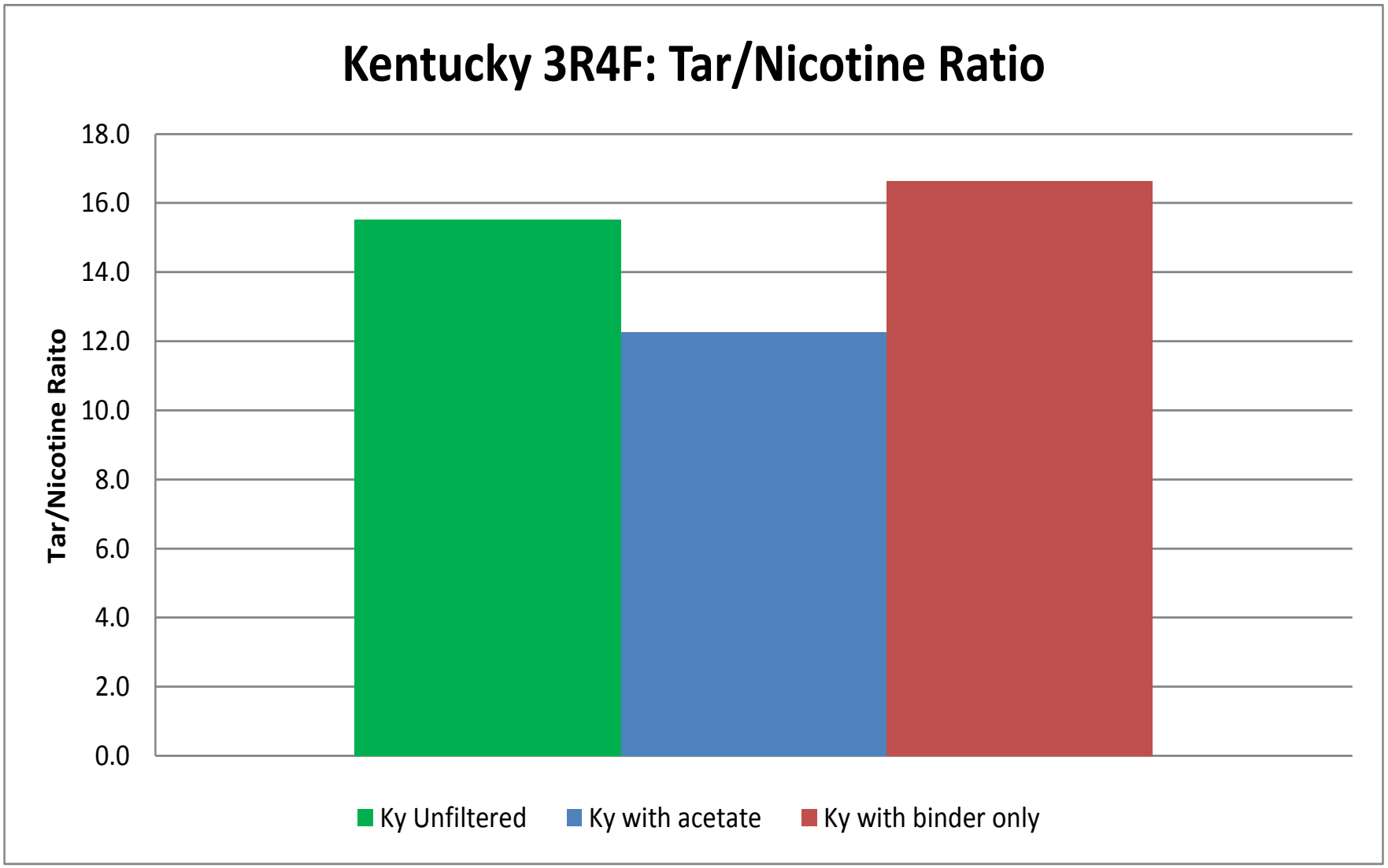
# Mainstream smoke filtration

Tar, Nicotine, Water

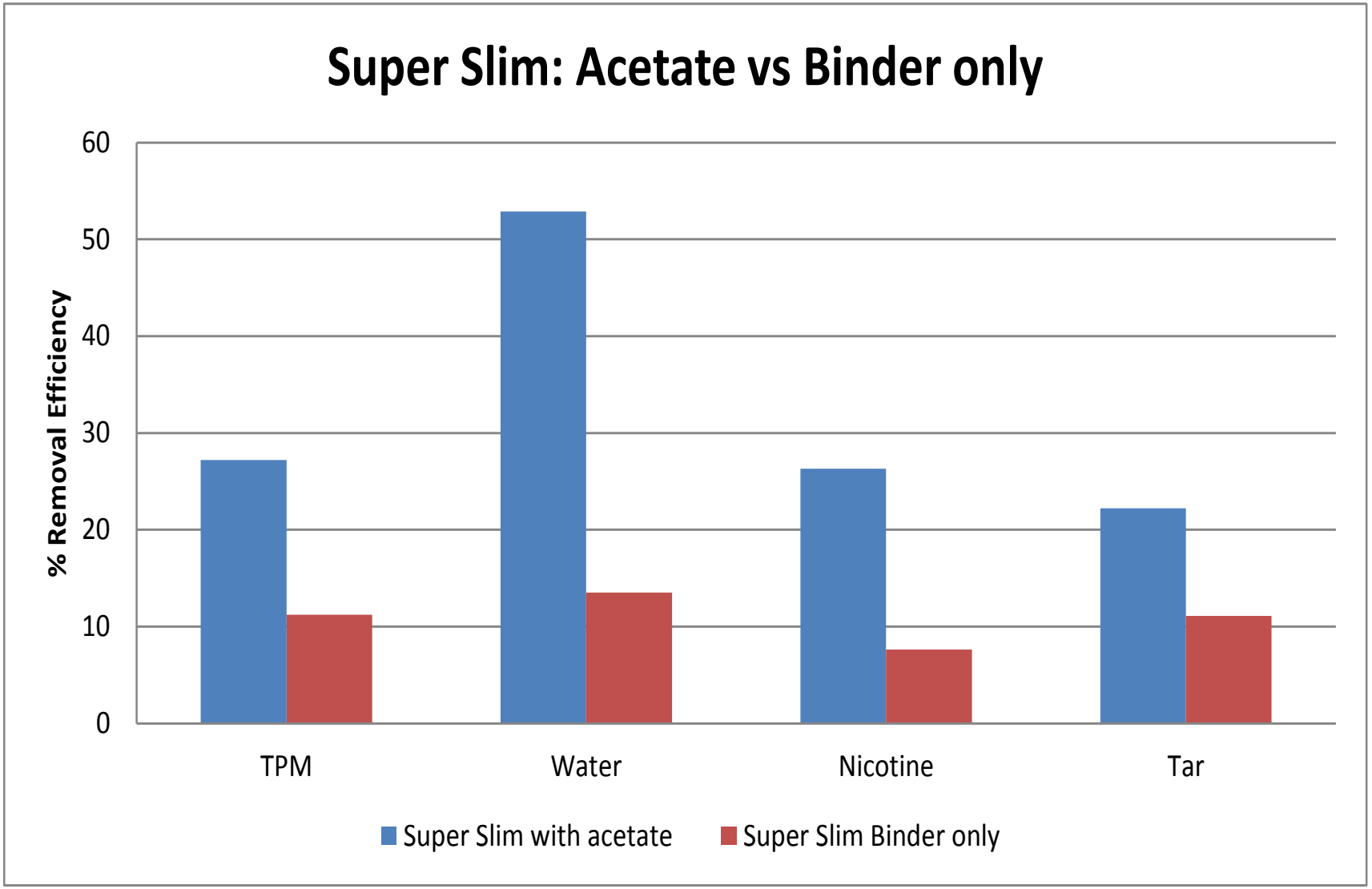
# Kentucky 3R4F



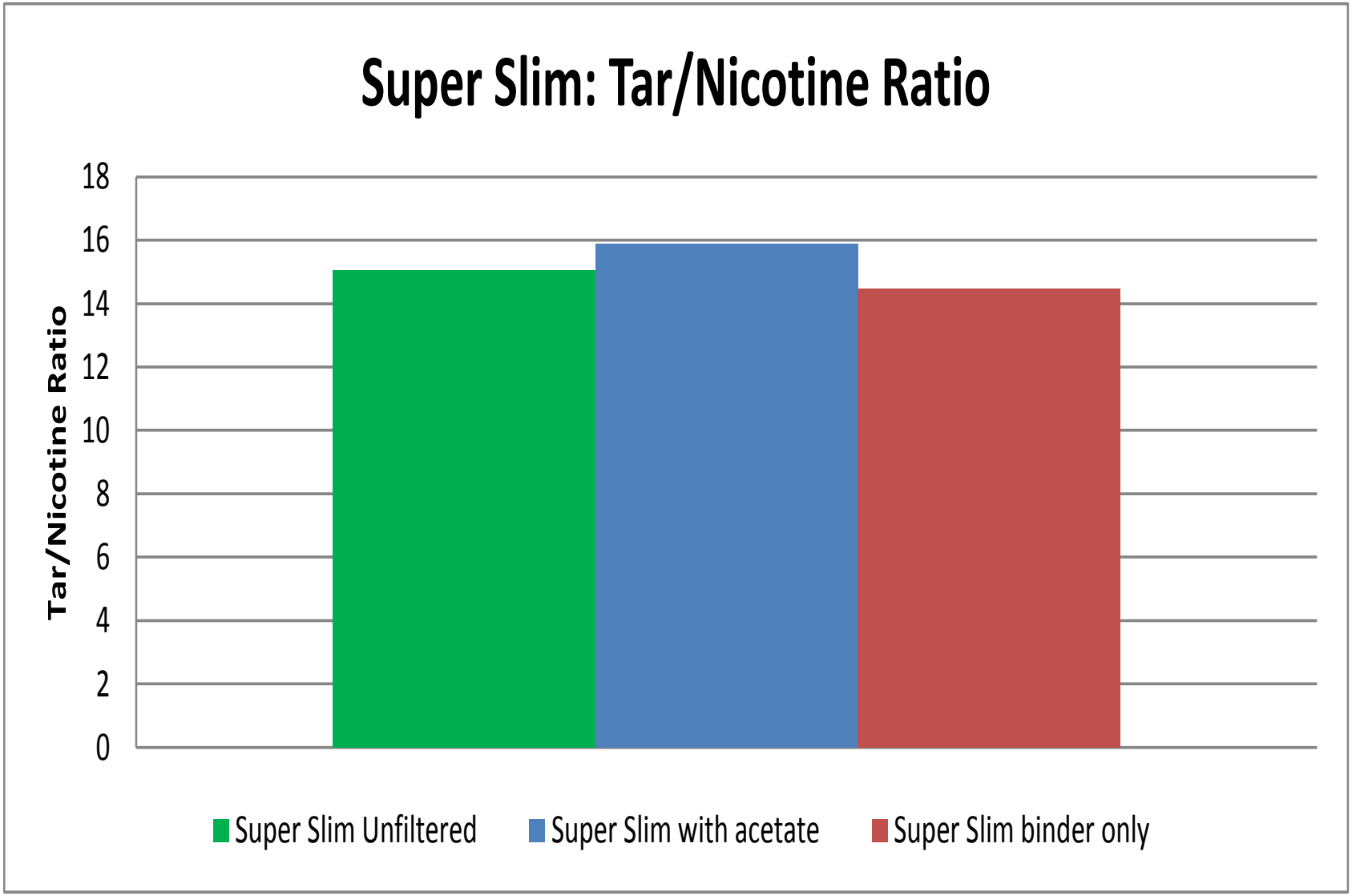
# Kentucky 3R4F



# Super Slim



# Super Slim



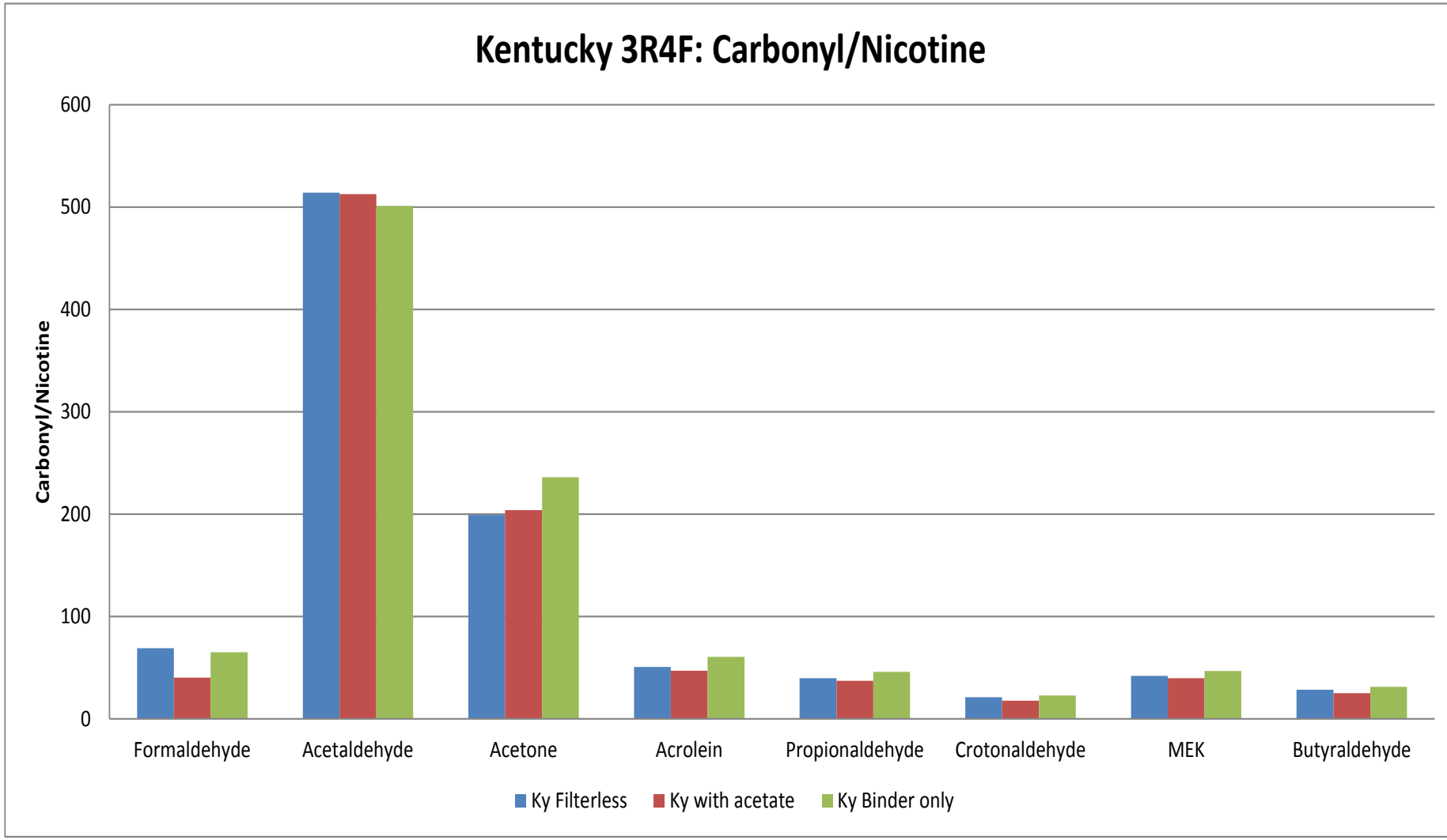
# First Conclusions

- 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

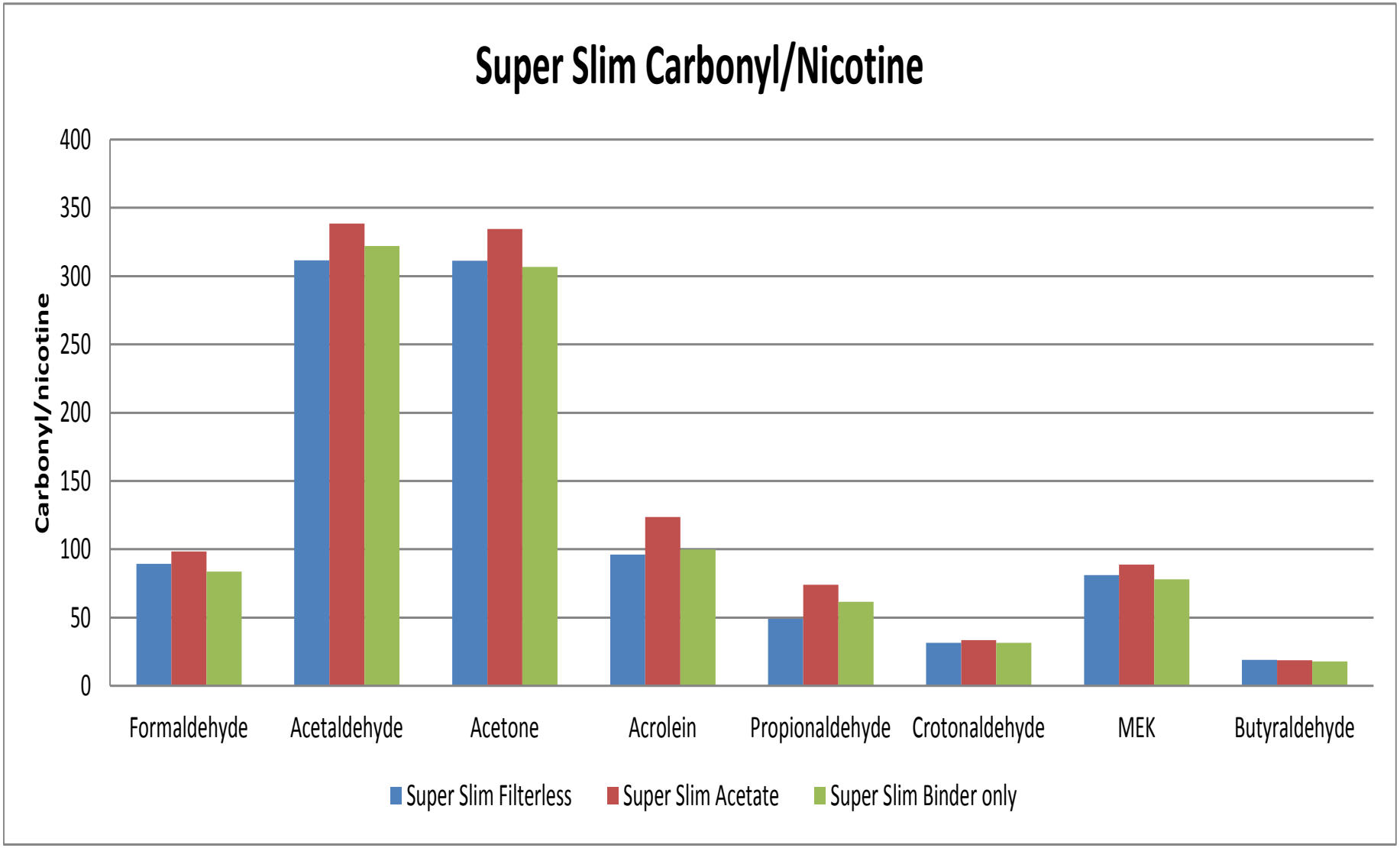
# Vapor phase component filtration

Carbonyl Results

# Kentucky 3R4F Reference



# Super Slim



# 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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