



CeIFX™ Matrix Technology Carbon Filter Performance in a Repeat Use Application

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Overview

▶ Objective

- Evaluate CelFX™ carbon filter capacity for repeated use
 - Particulate matter removal
 - Carbonyl reduction

▶ CelFX™ Matrix Technology Overview

▶ Filter Design

▶ Smoke Conditions

▶ Results

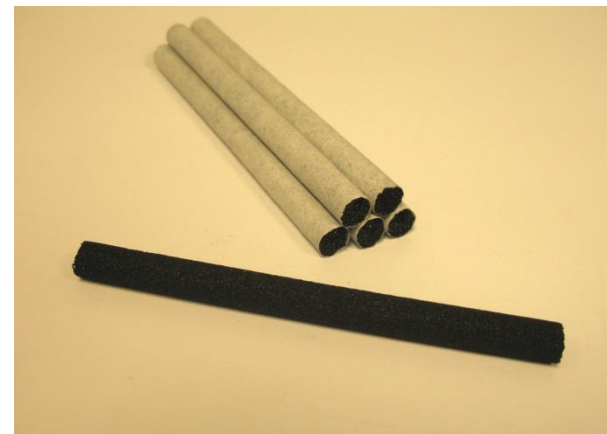
- Standard size
- Super Slim



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

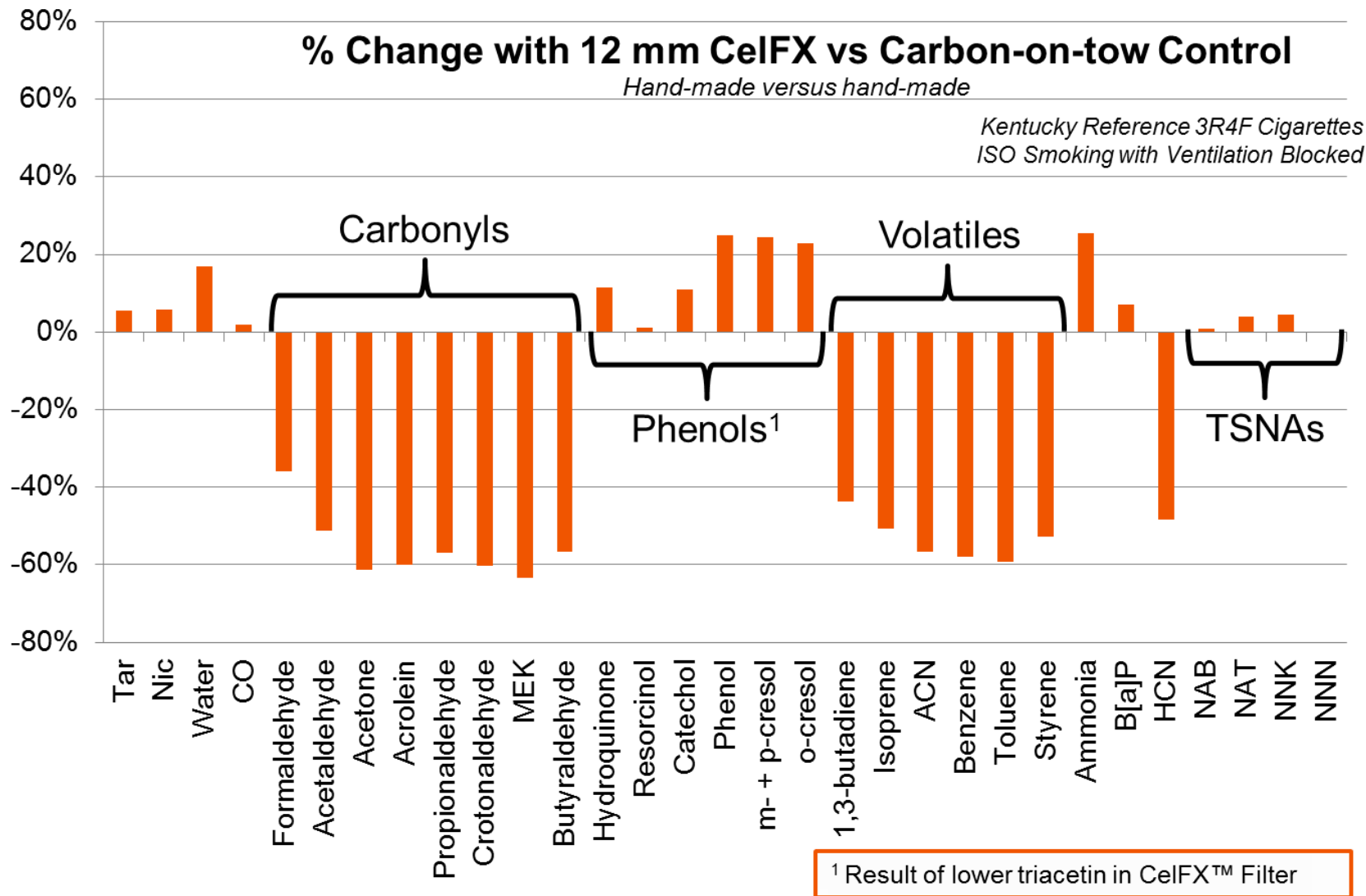
Overview

- ▶ 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



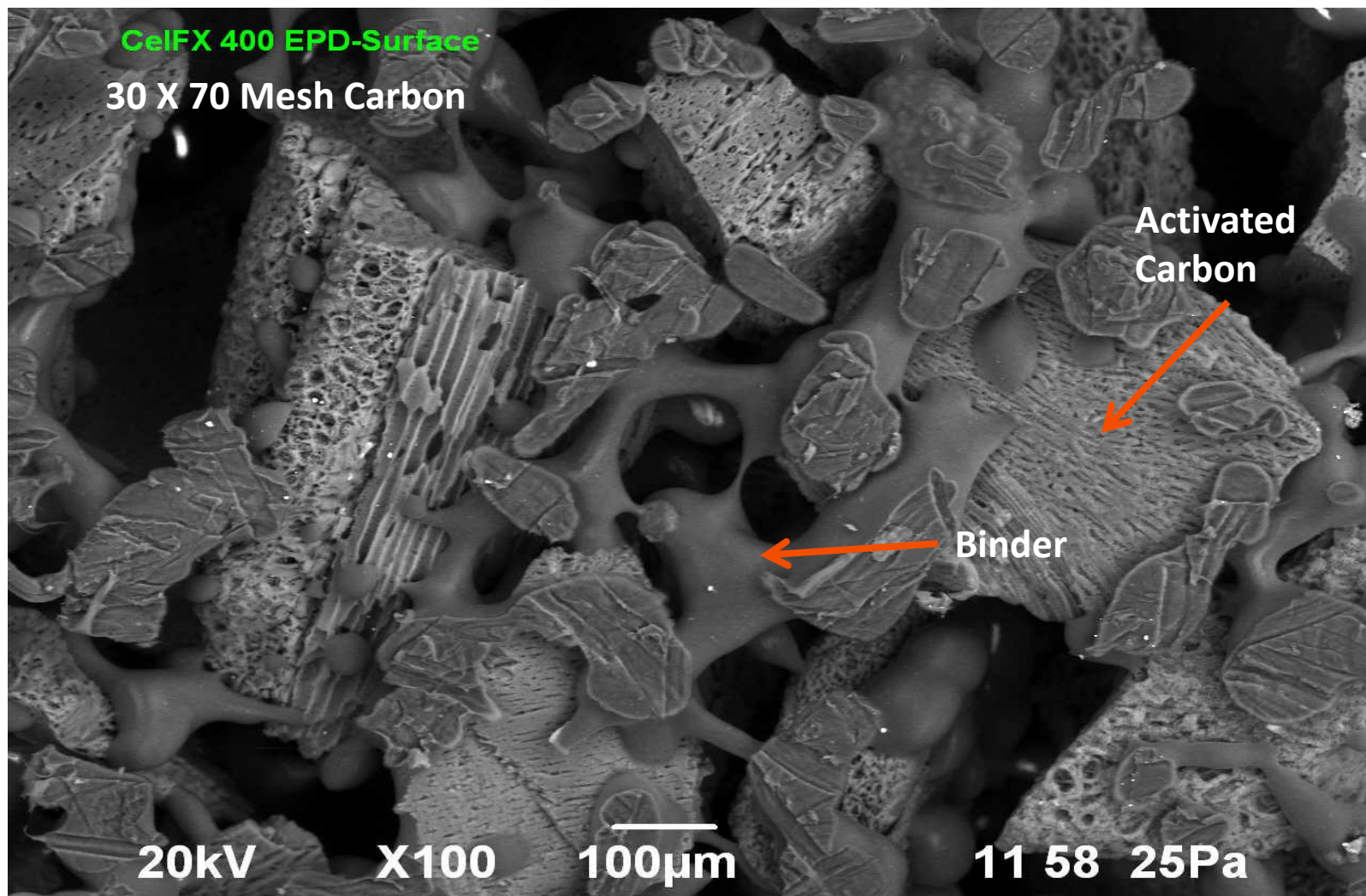
Binder



CeIFX™ Rods

*All ingredients
meet German
Tobacco Ordinance
Requirements*

Inside Look

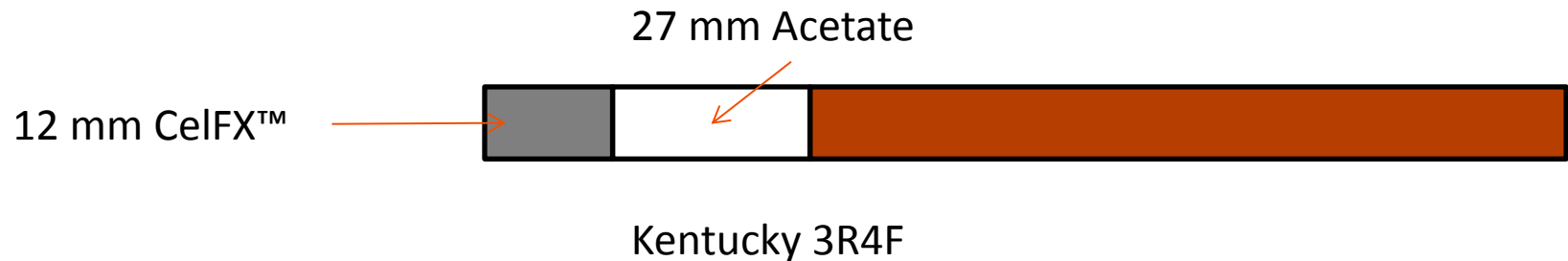


Filter Design

- ▶ 12 mm CelFX™ carbon segments prepared
 - 30x70 activated carbon, 60% activity

Carbon Loading	12 mm
Standard Size	168 mg
Super-Slim	70 mg

- ▶ Kentucky 3R4F: 27 mm acetate filter
- ▶ Commercial Super Slim: 27 mm acetate filter



Smoking Plan – Tar, Nicotine, CO

Smoke Run: ISO 3308	Segment 1	Segment 2	Segment 3	Segment 4	Smoked Cigarette/Run
Run 1	5	5	5	5	20
Run 2	5	5	5	5	20
Run 3	5	5	5	5	20
Run 4	5	5	5	5	20
Cigarettes smoked per segment	20	20	20	20	

Smoking Plan – Tar, Nicotine, CO

Smoke Run: ISO 3308	Segment 1	Segment 2	Segment 3	Segment 4	Smoked Cigarette/Run
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Run 2	5	5	5	5	20
Run 3	5	5	5	5	20
Run 4	5	5	5	5	20
Cigarettes smoked per segment	20	20	20	20	

After 5 cigarettes:
Weight
Pressure drop

After 20 cigarettes:
Tar, Nicotine, CO

Smoking Plan – Carbonyl

Smoke Run: ISO 3308	Segment 1	Segment 2	Segment 3	Segment 4
Run 1	2	2	2	2
Run 2	2	2	2	2
Run 3	2	2	2	2
Run 4	2	2	2	2
⋮	⋮	⋮	⋮	⋮
Run 9	2	2	2	2
Run 10	2	2	2	2
Cigarettes smoked per segment	20	20	20	20

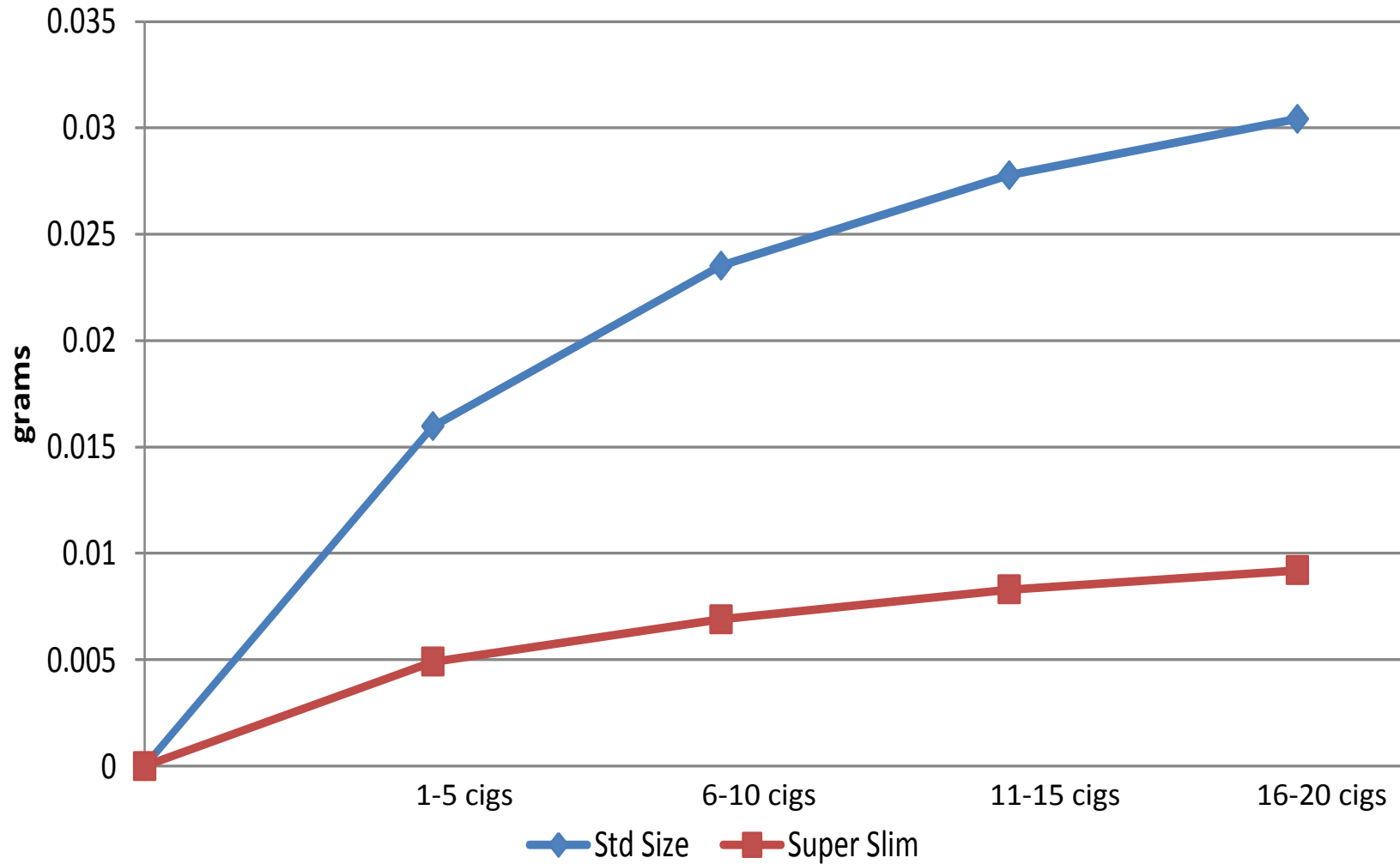
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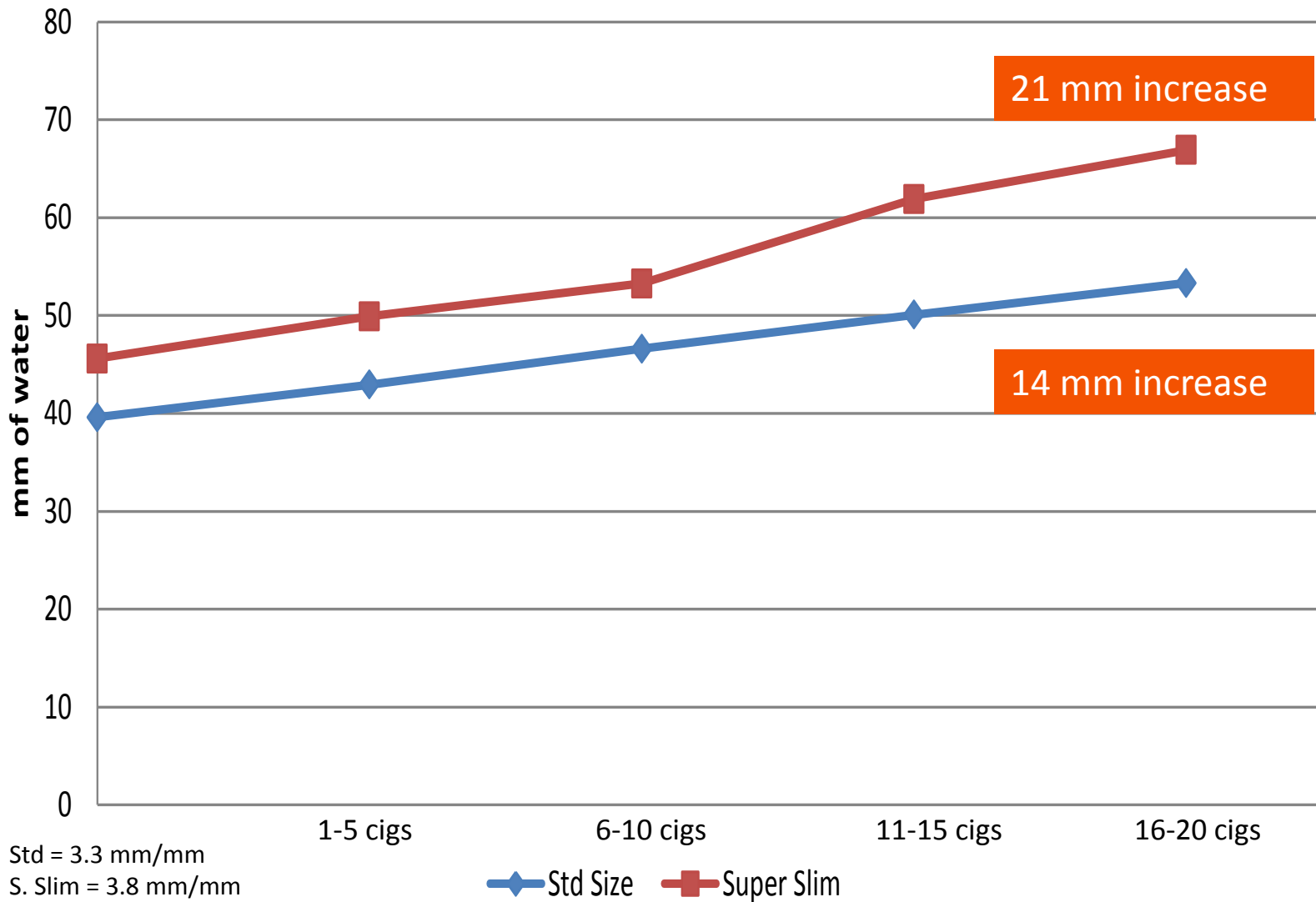
Carbonyl
Analysis

Segment physicals and particulate phase results

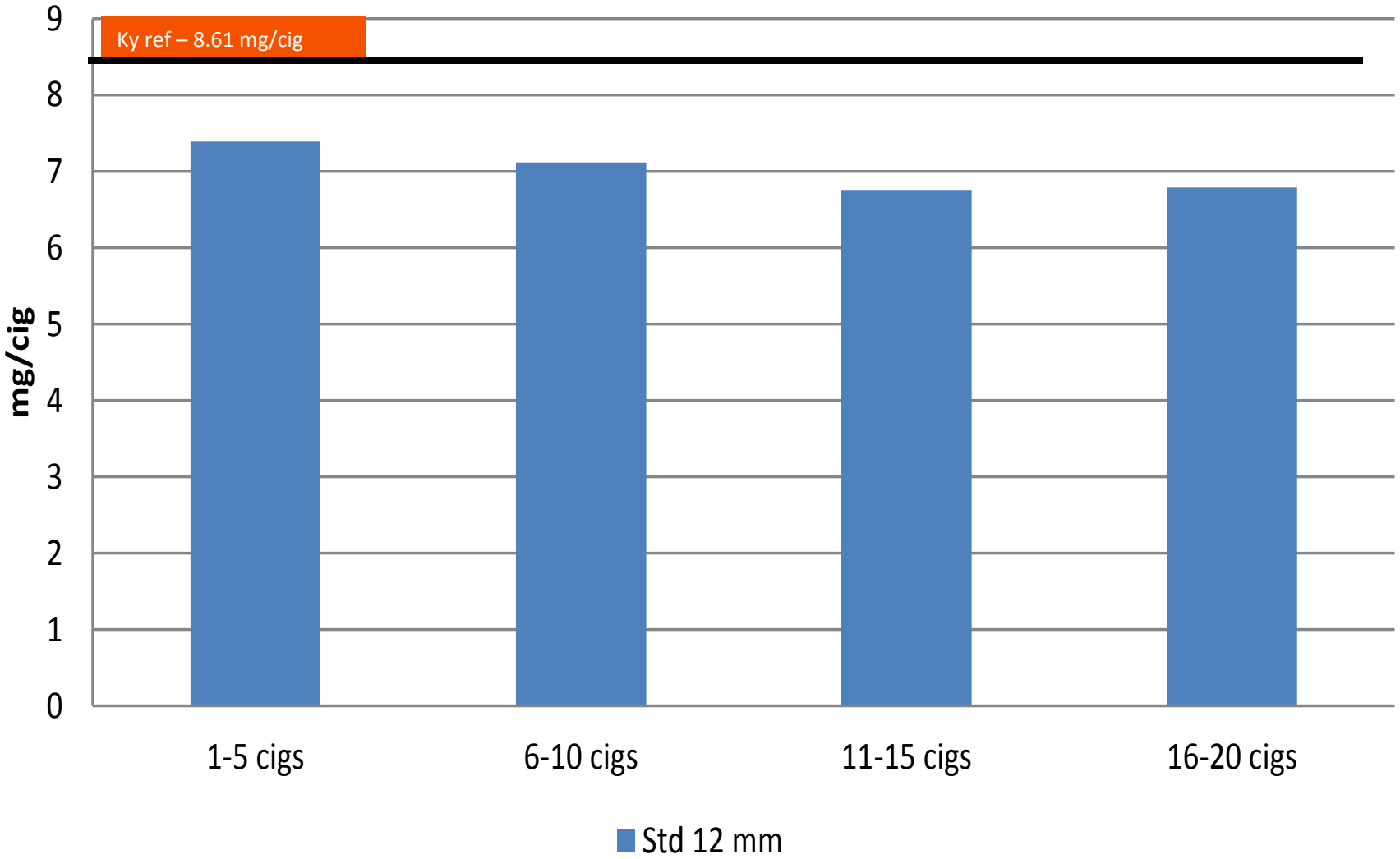
12 mm Weight Gain



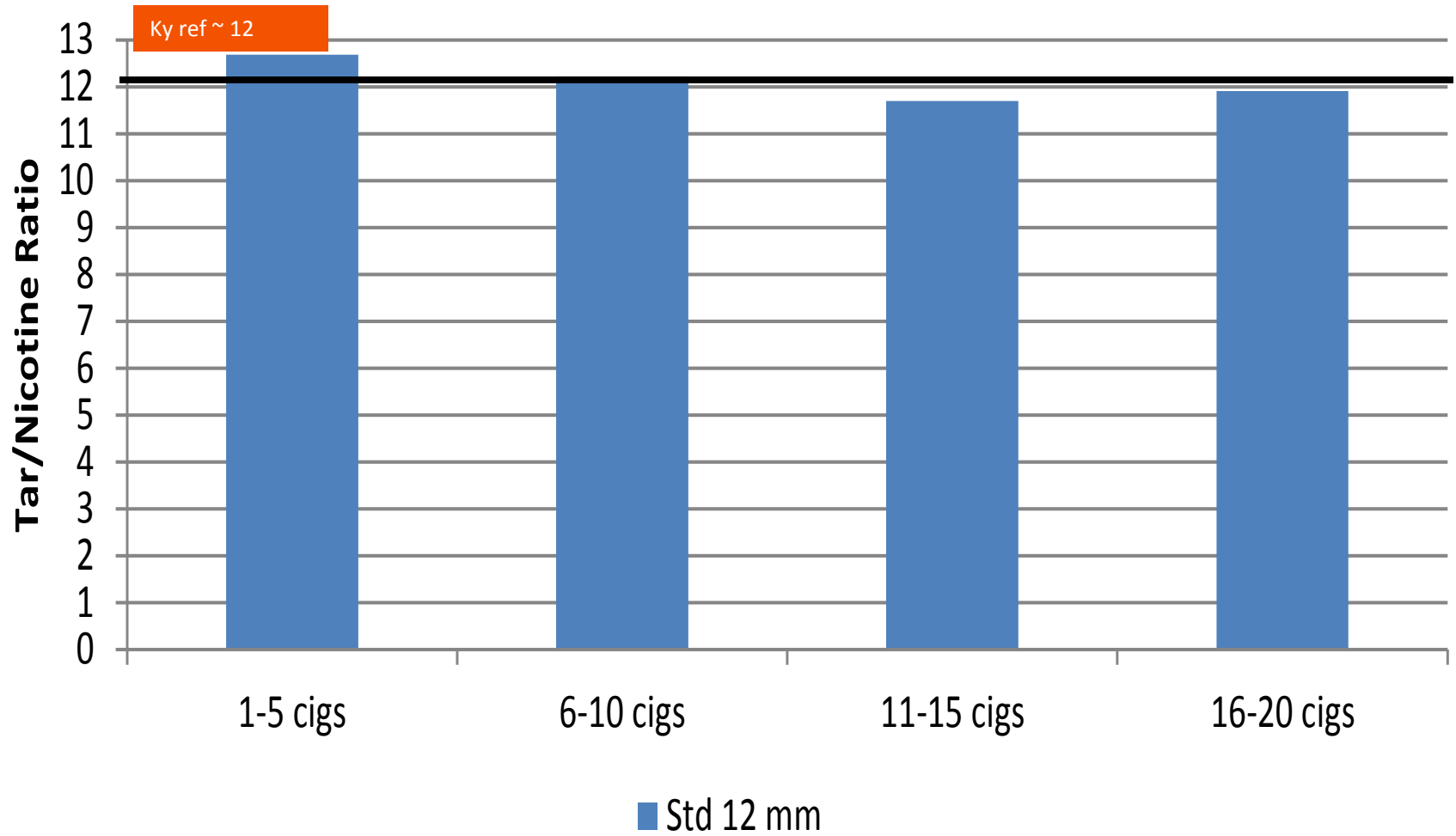
12 mm Pressure Drop



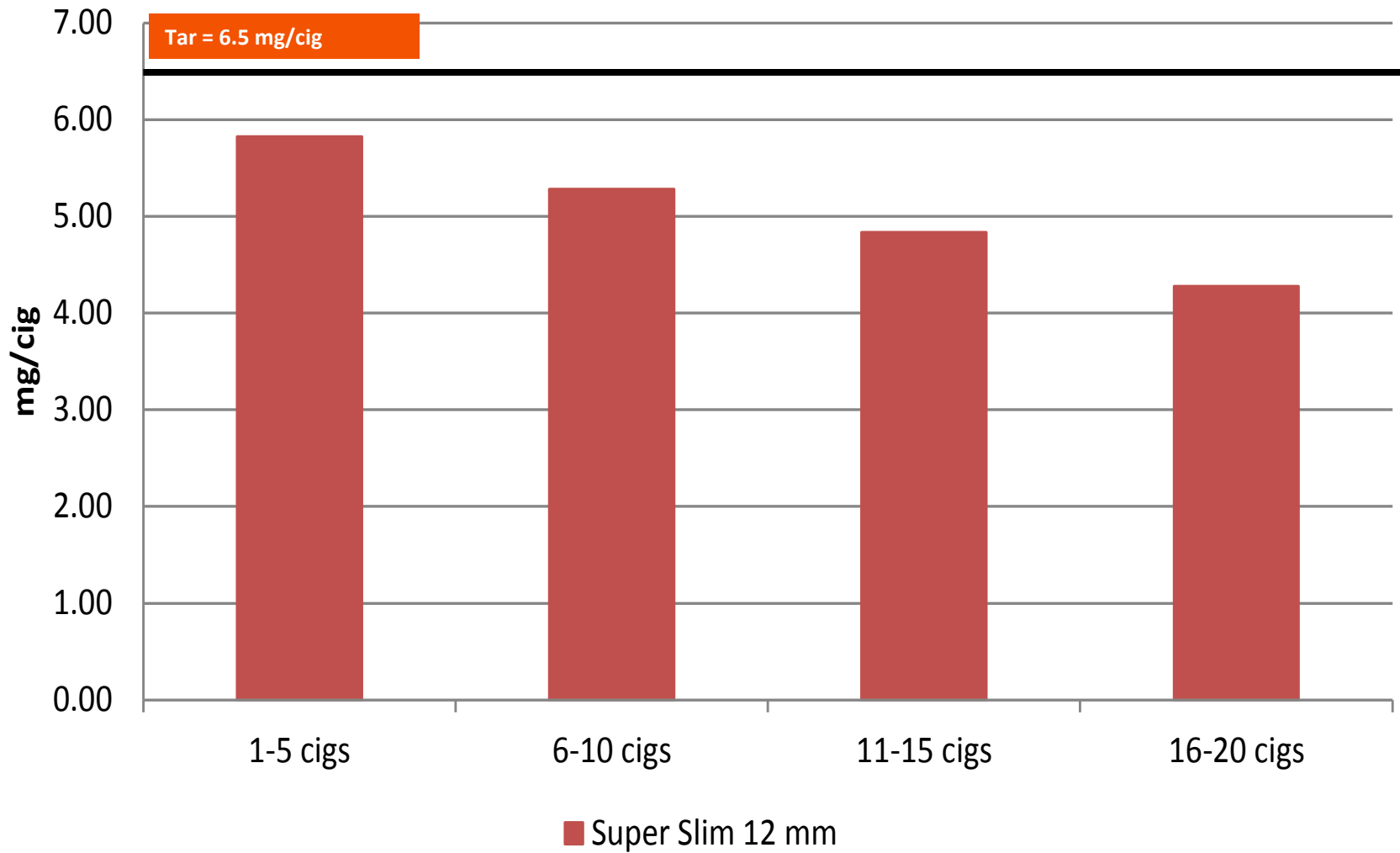
Standard Size: Tar Delivery



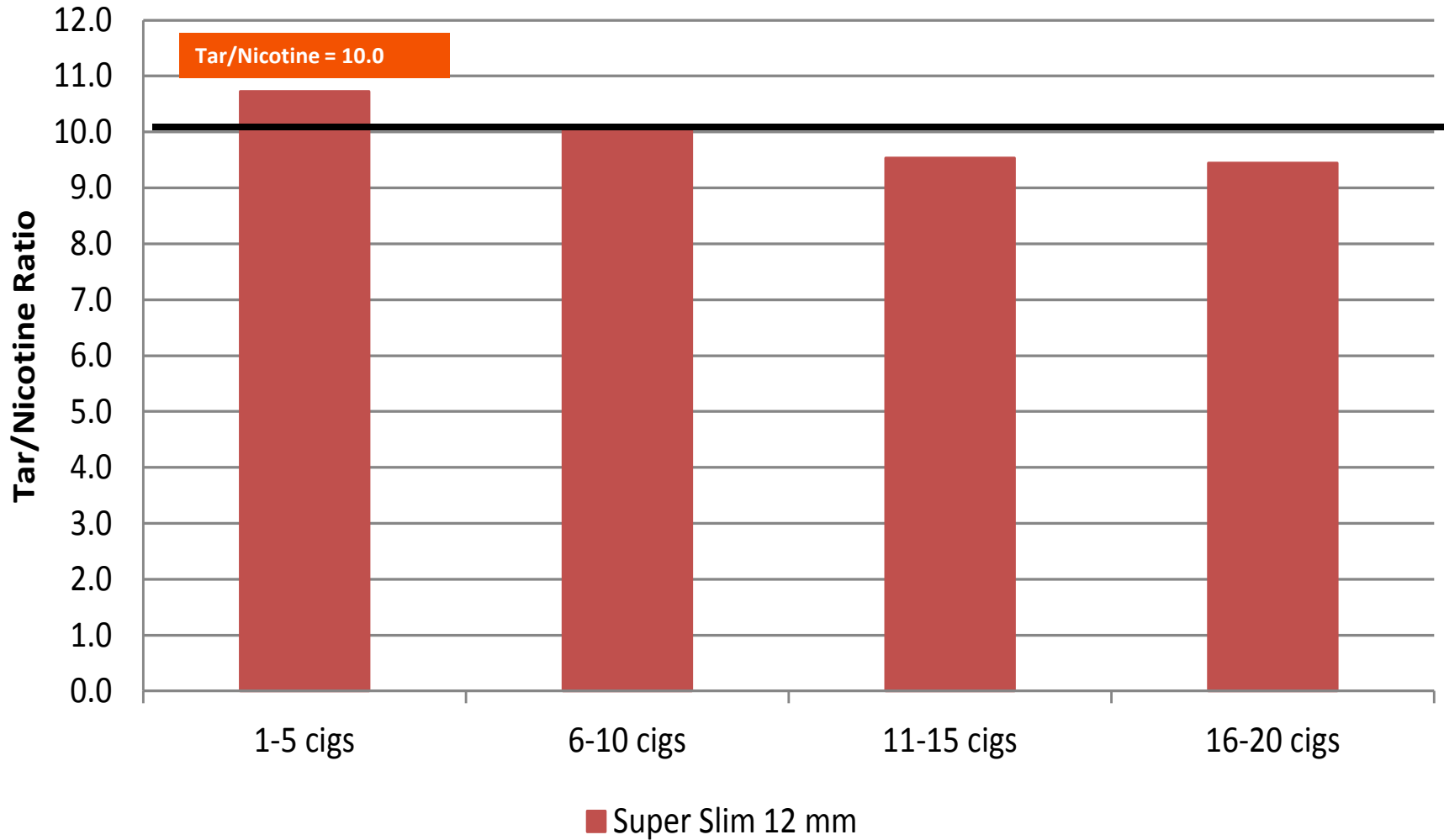
Standard Size: Tar/Nicotine Ratio



Super Slim: Tar Delivery



Super Slim: Tar/Nicotine Ratio

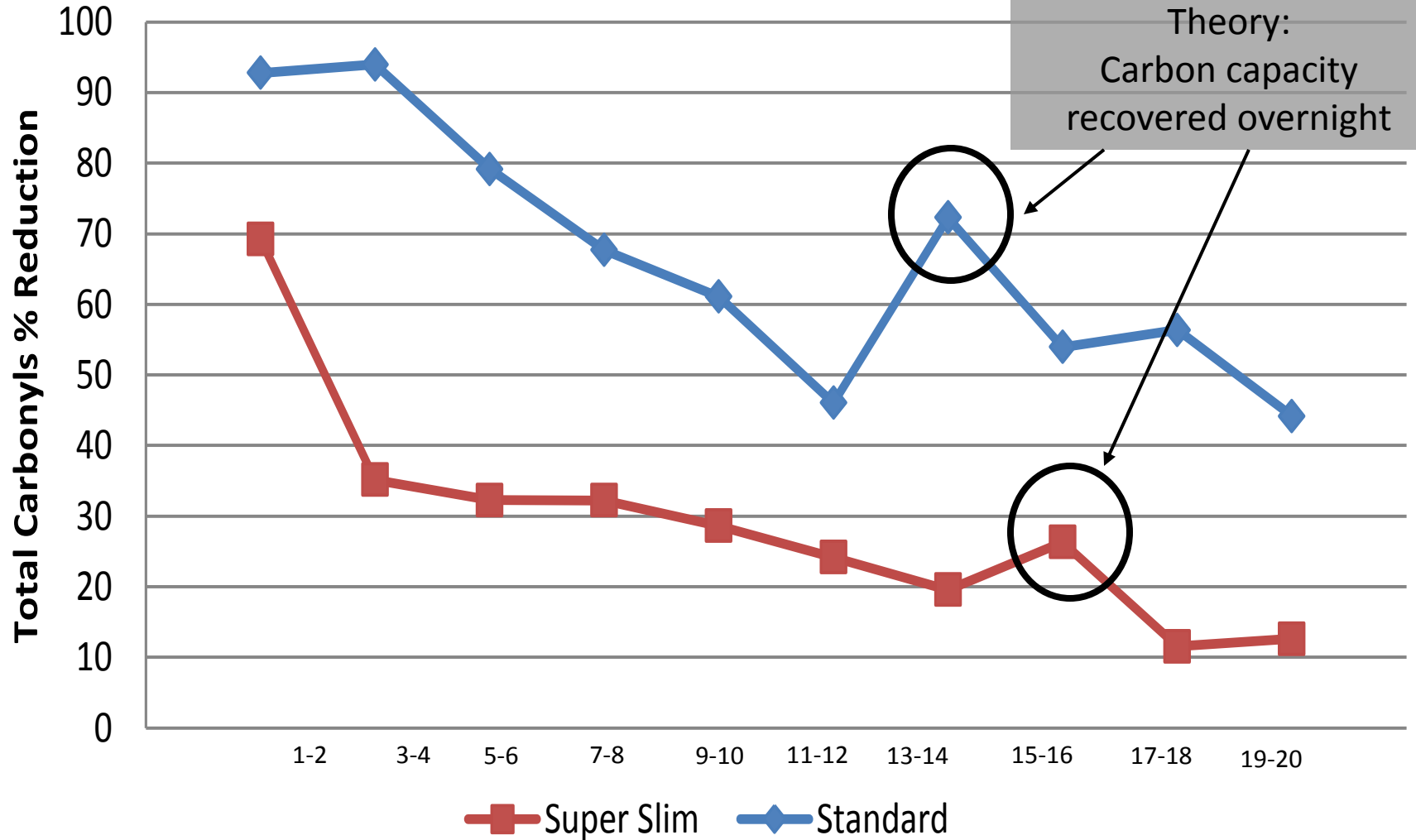


Carbonyl Analysis

(Aggregated)

$$\% \text{ Carbonyls} = [(\sum \text{ Control Carbonyls} - \sum \text{ CelFX}^{\text{TM}} \text{ Carbonyls}) / \sum \text{ Control Carbonyls}] * 100$$

Aggregated Carbonyls



12 mm segment

■ Super Slim ◆ Standard

Conclusions

- ▶ Particulate phase
 - Particulate phase removal increases with repeated use
 - Pressure drop increases only marginally with repeated use
- ▶ Total carbonyl
 - High carbon loadings equate to high carbonyl reduction
 - Carbonyl reduction >60% & >30% after 10 cigarettes
 - Carbonyl reduction decreases with use
 - Carbon appears to partially recover/re-equilibrate sitting overnight
- ▶ CelFX™ Matrix Technology has significant filtration capacity

Thanks

- ▶ Dr. Sayanti Basu
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- ▶ Melissa Aldrich Welch