

# Aditivos para cumprir com as mais restritas normas de emissões

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## Setting the Bar Through Emission and Odor Management in the Polyurethane Industry

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UTECH NA 2018 – Charlotte, NC

Day 2: September 12, 2018

12:40 P.M.



# Presentation Outline

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- Overview of emissions in the PU Industry
- Breakdown of emissions by components
- Emissions in the automotive industry
  - Overview
  - Catalysts
  - Surfactants
  - Processing Aids
- Closing remarks



# Emissions in the PU Industry

## Automotive



### Markets:

Seating, instrument panels, steering wheels, headliners, NVH

### Key influencers:

- VDA – German Association of the Automotive Industry
- GMW
- UL VIAQ – Vehicle Interior Air Quality
- OEM-specific Requirements

## Insulation



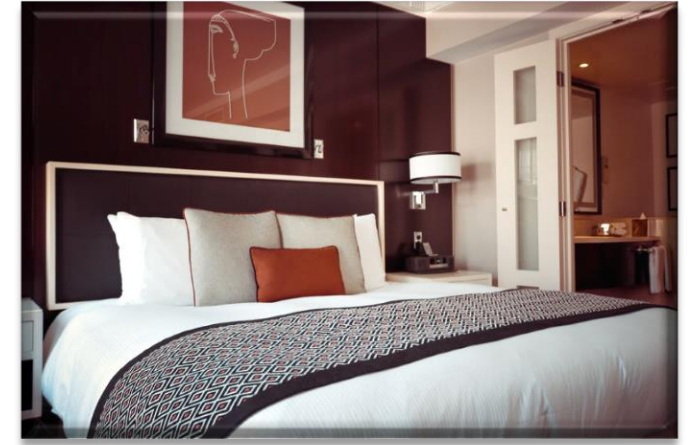
### Markets:

Spray foam

### Key influencers:

- SPFA – Spray Polyurethane Foam Alliance
- EPA (HFOs, halogenated flame retardants, etc.)
- UL GREENGUARD

## Comfort



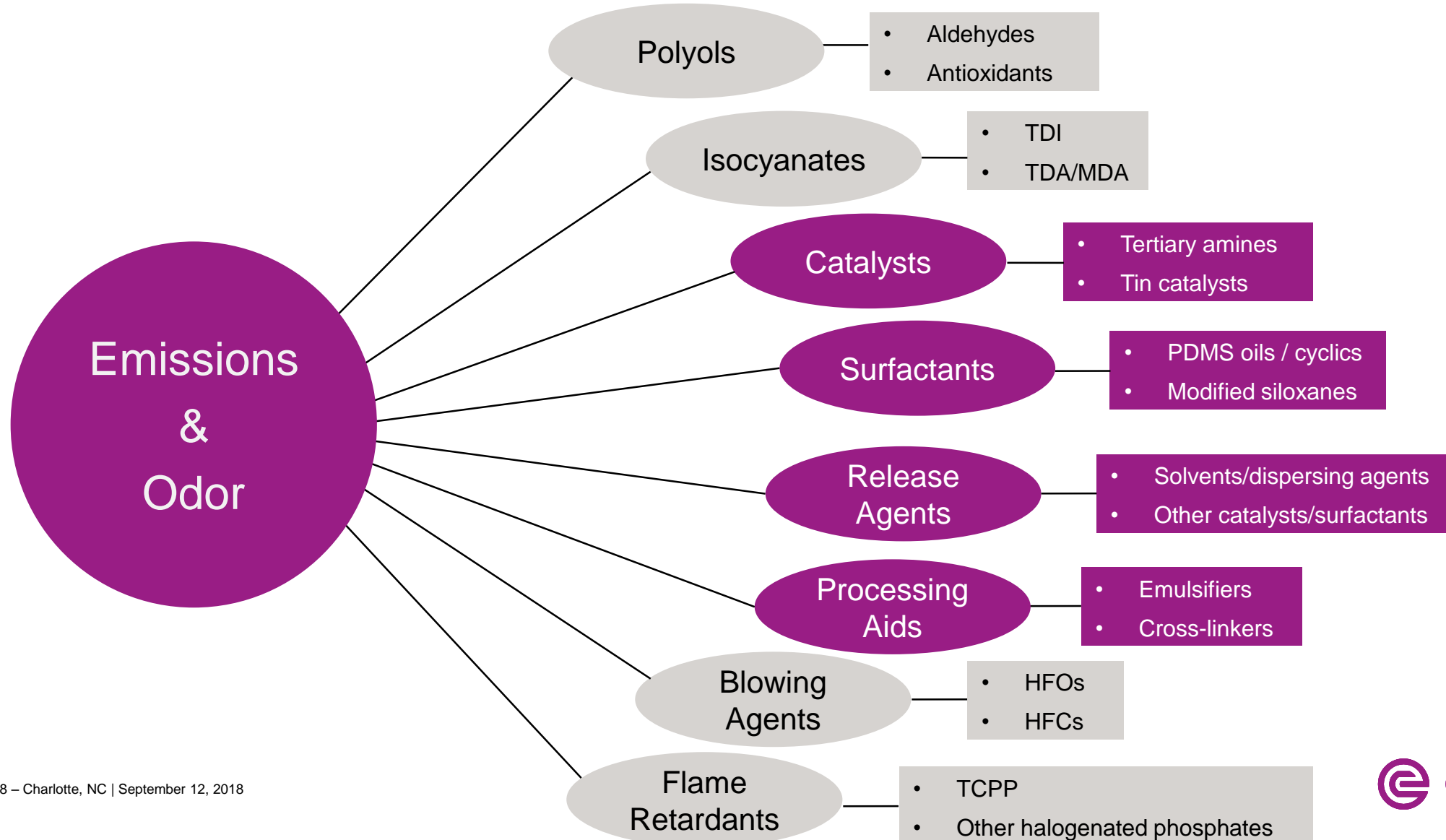
### Markets:

Mattresses, furniture, pillows, carpet backing

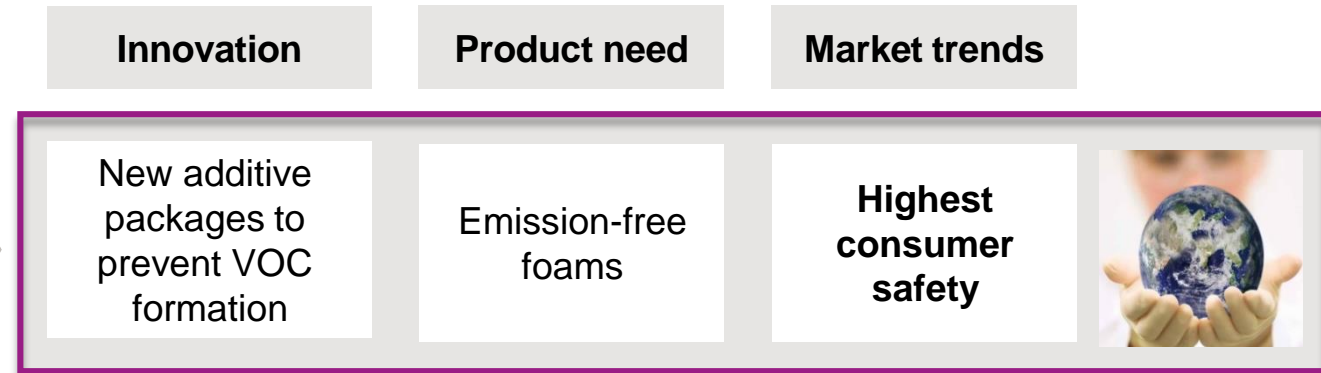
### Key influencers:

- CertiPUR-US
- State and Federal Regulations

# Emissions and Odor Sources by Component



# Our Portfolio: Meeting Market Needs through a Variety of Products





# A closer look at the automotive industry

- Overview
- Catalysts
- Surfactants
- Processing Aids



# Why are Emissions Important in the Automotive Industry?

## ▪ Health

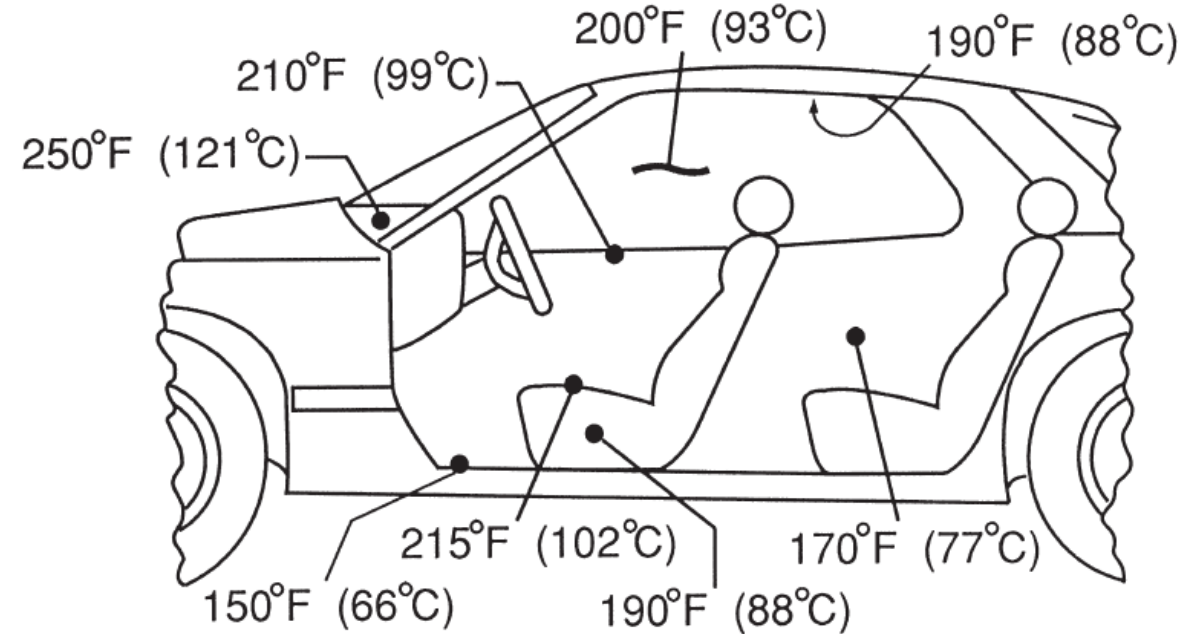
- Consumer contact with VOCs

## ▪ Safety

- Windshield fogging

## ▪ Industrial Hygiene

- Stack emissions

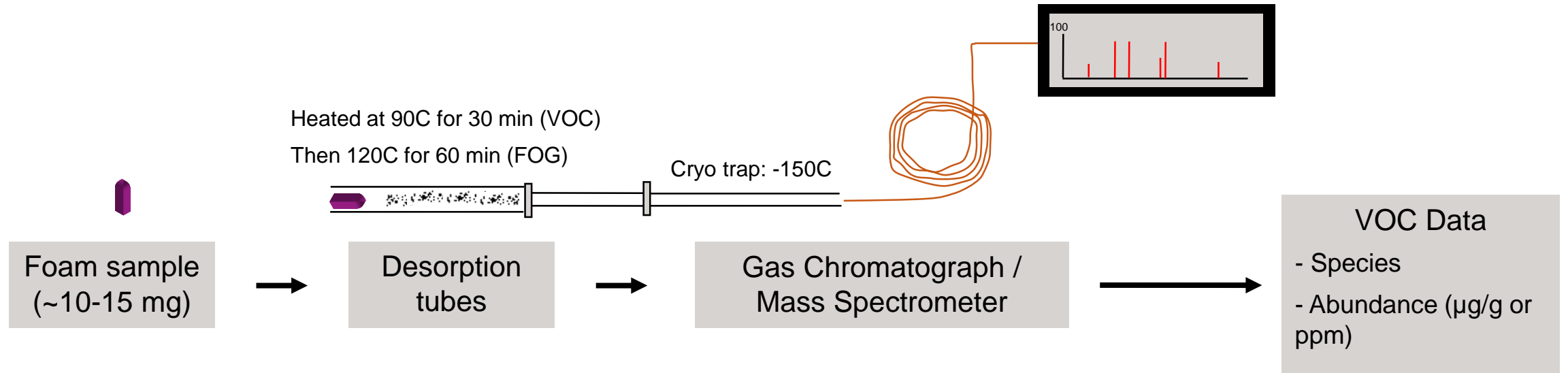


Source: R. Herrington, K. Hock, Dow Flexible PU foams, 1997

# How are Automotive Foams Tested for Emissions?

Material Test vs. Headspace Test

**Material Test General Process:**



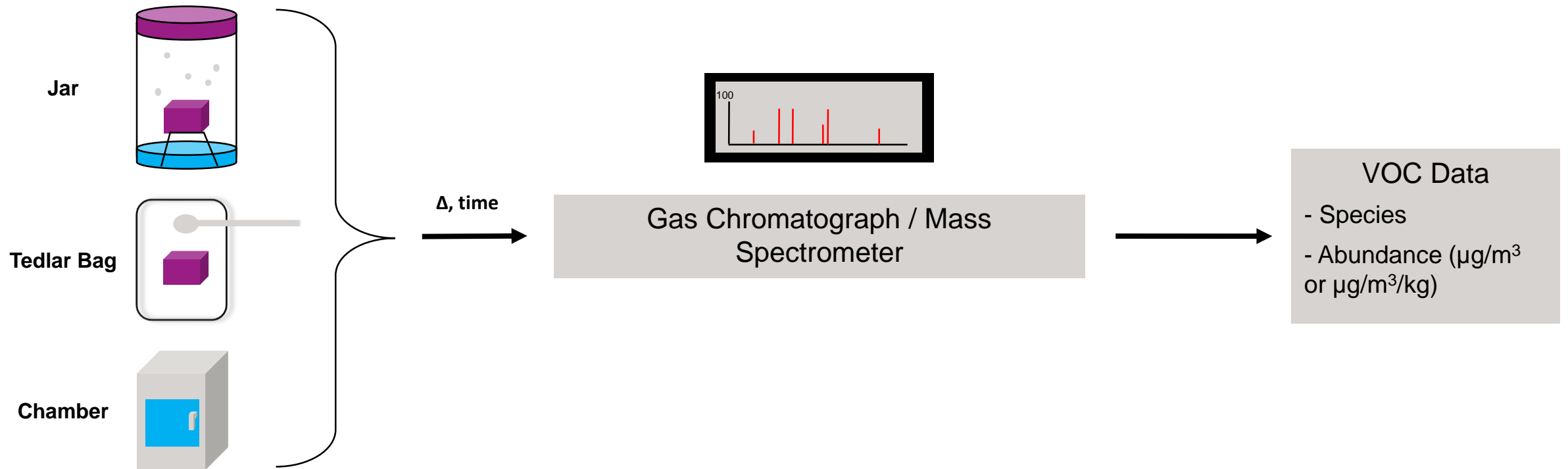
Examples: VDA 278, GMW 15634



# How are Automotive Foams Tested for Emissions?

Material Test vs. Headspace Test

## Headspace Test General Process:

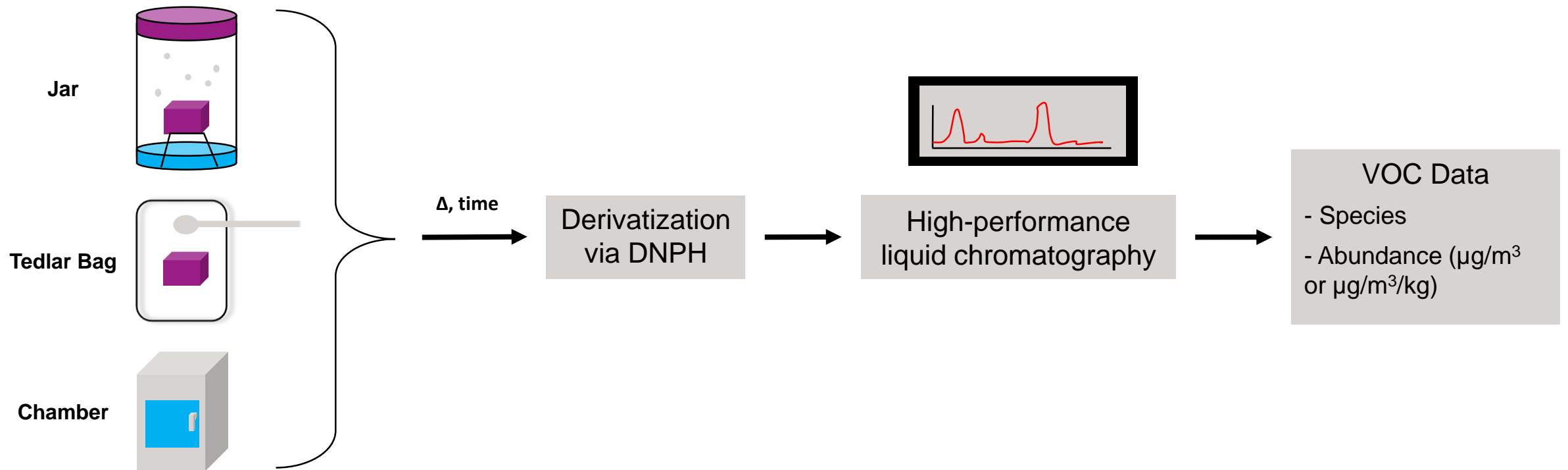


Examples: Nissan Bag NES M0402, BMW GS97014-3

# How are Automotive Foams Tested for *Aldehydes*?

Material Test vs. Headspace Test

## Typical Aldehydes Test Process:



Examples: VDA 275, GMW 15635

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# Major Contributors to Emissions – Fugitive Amine Catalysts

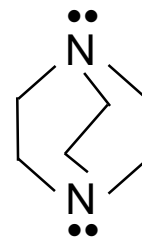
## ▪ Typical Industrial Standard Catalysts:

### Gel Catalysts

DABCO® 33LV

DABCO® 33LX

DABCO® 8154



Triethylenediamine

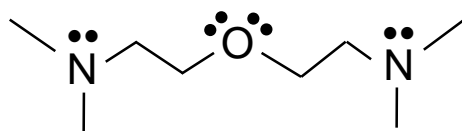
### Blow Catalysts

DABCO® BL-11

DABCO® BLX-11

DABCO® BL-19

DABCO® BL-17



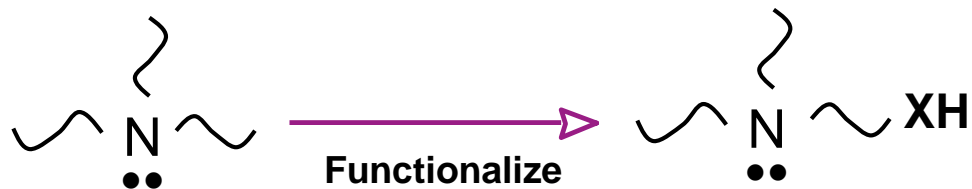
Bisdimethylamino-  
ethylether



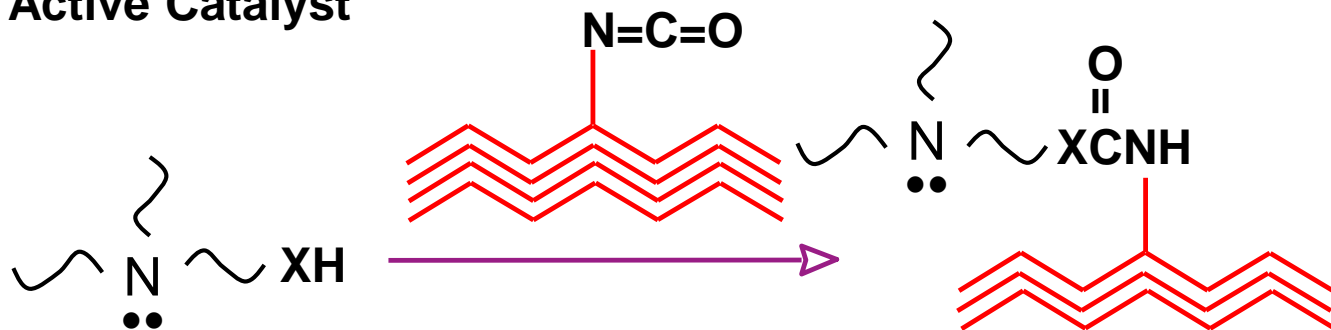
Not functional = not isocyanate reactive

# Non-emissive Technology Basics

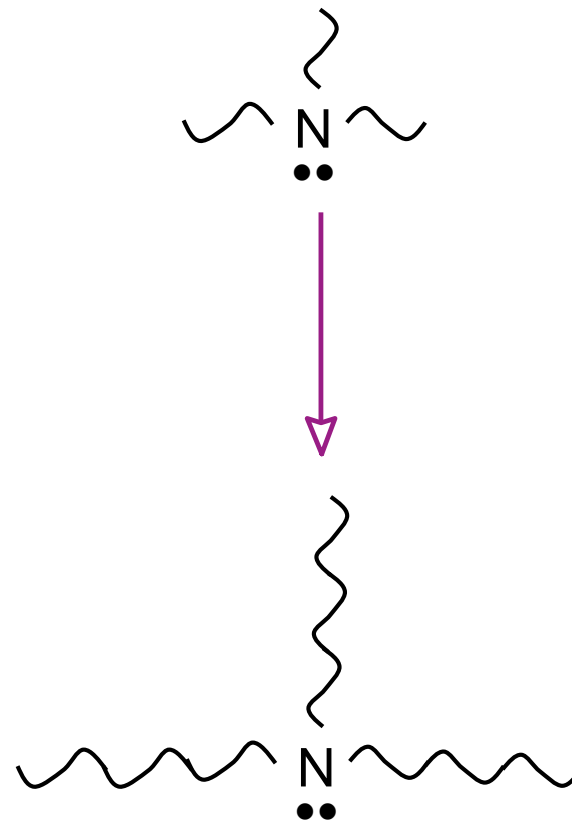
## Immobilization via functionalization



**Active Catalyst**



## Molecule augmentation



# Setting the Bar with Non-emissive Catalyst Technology

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## Gel Catalysts

DABCO® 33LV

DABCO® 33LX

DABCO® 8154



## Non-emissive Gel Catalysts

DABCO® NE 1070

DABCO® NE 1550

DABCO® NE 1091

EP-S-336

## Blow Catalysts

DABCO® BL 11

DABCO® BLX 11

DABCO® BL 19

DABCO® BL 17



## Non-emissive Blow Catalysts

DABCO® NE 300

DABCO® NE 310



# Reduction in Emissions in TDI Seating Foam

- Car seat formulation with molded density of ~40 kg/m<sup>3</sup>

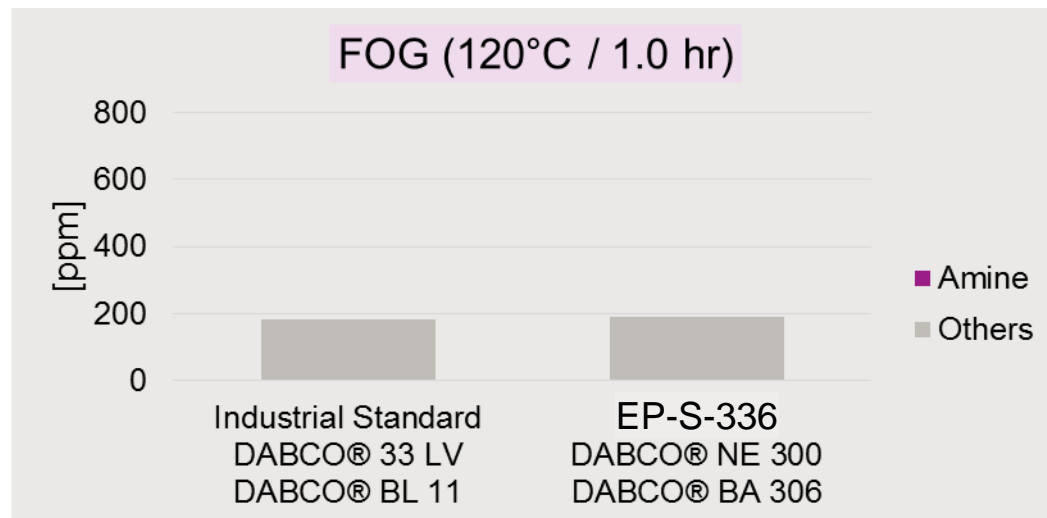
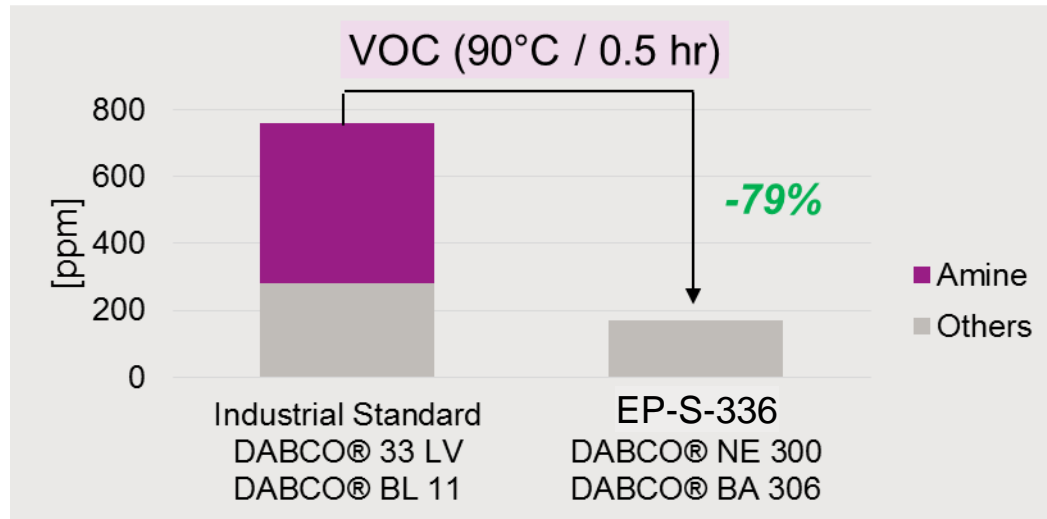
TDI-Based Formulation		
Formulation Identifier	I	II
Polyol A	70	70
Polyol B	30	30
Water	2.86	2.86
DEOA (85%)	0.94	0.94
Glycerol	0.60	0.60
TEGOSTAB® B8761 LF2	0.70	0.70
DABCO® BL-11	0.10	---
DABCO® 33LX	0.35	---
DABCO® NE 300	---	0.12
EP-S-336	---	0.70
DABCO® BA 306	---	0.50
TDI Index	100	

## DABCO® BA306

- Humid aging performance additive
- Helps meet tough humid aging/hydrolysis tests

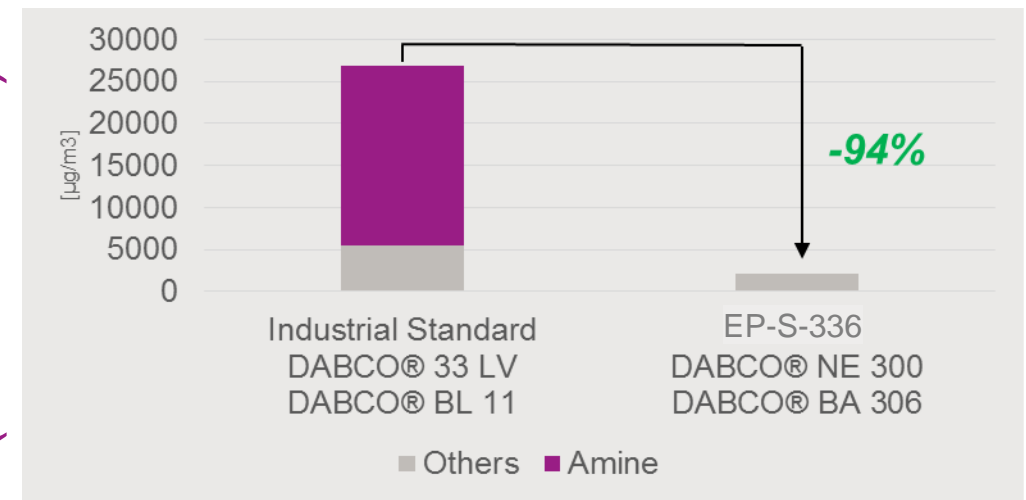
# Emissions Reduction in TDI Seating Foam

VDA 278

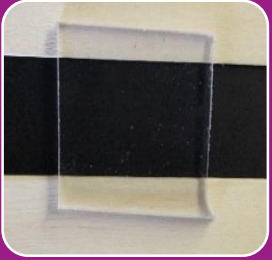


- No contribution to amine emissions detected for **EP-S-336** gel catalyst with **DABCO® NE300** blow catalyst.

Chamber Test  
(GS 97014-3)



# Polycarbonate Staining Test Results

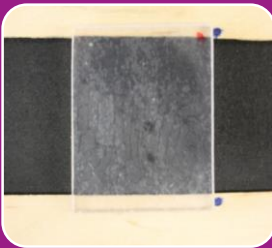


Blank



Typical Amine Catalyst

- Polycarbonate surface strongly impacted
- Complete loss of transparency



**EP-S-336**

- Even less impact on Polycarbonate surface detectable
- Polycarbonate transparency remains virtually unchanged



Polycarbonate used:  
MAKROLON® GP CLEAR 099  
6 days @ 90 °C

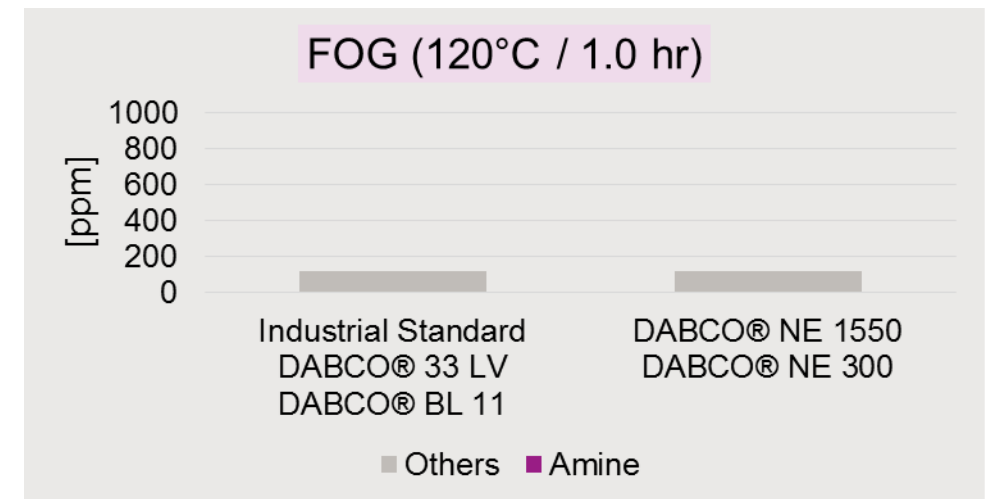
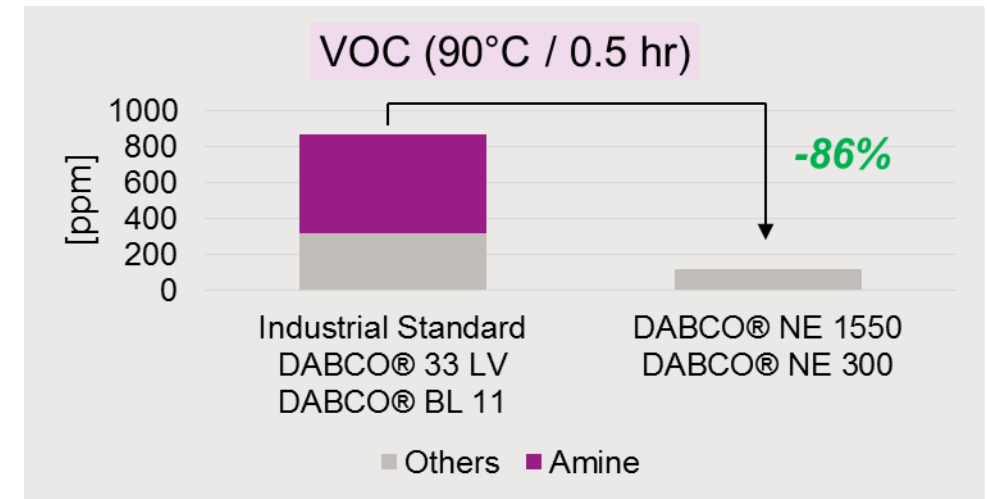
**EP-S-336** shows *excellent* performance in stringent Polycarbonate staining tests.

# Reduction in Emissions in MDI Seating Foam

- Car seat formulation with molded density of ~53 kg/m<sup>3</sup>

MDI-Based Formulation		
Formulation Identifier	I	II
Polyol A	100	100
Water	3.5	3.5
Cell opener	1.3	1.3
DEOA (100%)	0.6	0.6
TEGOSTAB® B 8734 LF2	0.80	0.80
DABCO® BL 11	0.12	---
DABCO® 33 LV	0.40	---
DABCO® NE 300	---	0.20
DABCO® NE 1550	---	0.60
MDI Index	90	

VDA 278



# Maintaining VW Specifications with MDI Foams

## Physical properties at ambient conditions

Physical Properties	Units	VW TL 52653	NE1550/NE300
Tensile Strength	[kPa]	$\geq 80$	$168.6 \pm 11.9$
Tensile Elongation	[%]	$\geq 80$	$101.3 \pm 3.1$
Comp. Set (50%)	[%]	$\leq 8$	$7.9 \pm 0.1$
CLD (40%)	[kPa]		$8.8 \pm 0.4$

## Physical properties after PV3410 humid aging (90°C / 100%RH / 200h)

Tensile Strength	[kPa]	$\geq 80$	$139 \pm 4.6$
Tensile Elongation	[%]	$\geq 80$	$147 \pm 6.3$
HACS (50% compression)	[%]	$\leq 15$	$11.3 \pm 0.6$

- DABCO® NE1550 /  
DABCO® NE300 meets  
VW TL 52653 specification



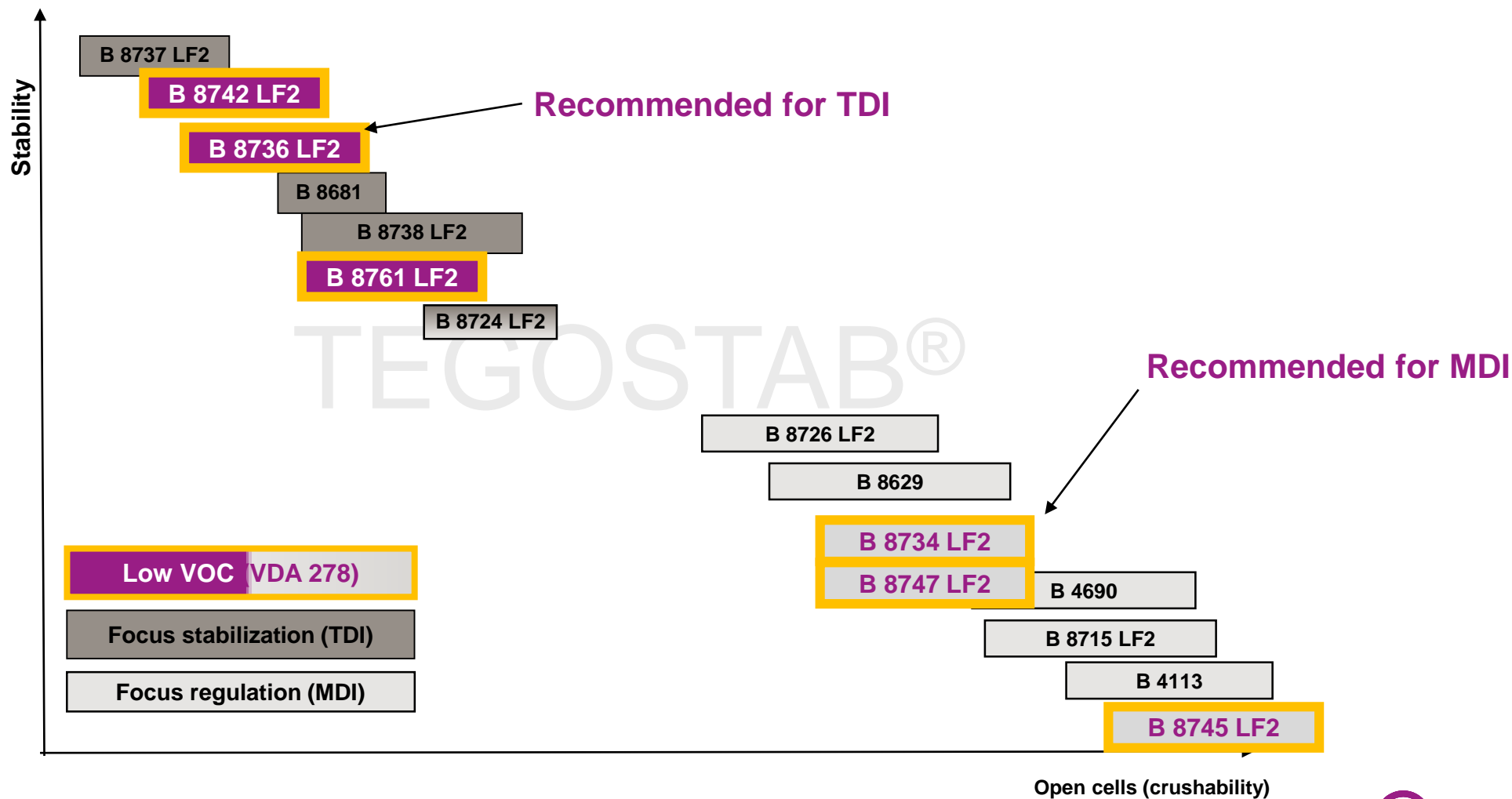
# A closer look at the automotive industry

- Overview
- Catalysts
- Surfactants
- Processing Aids

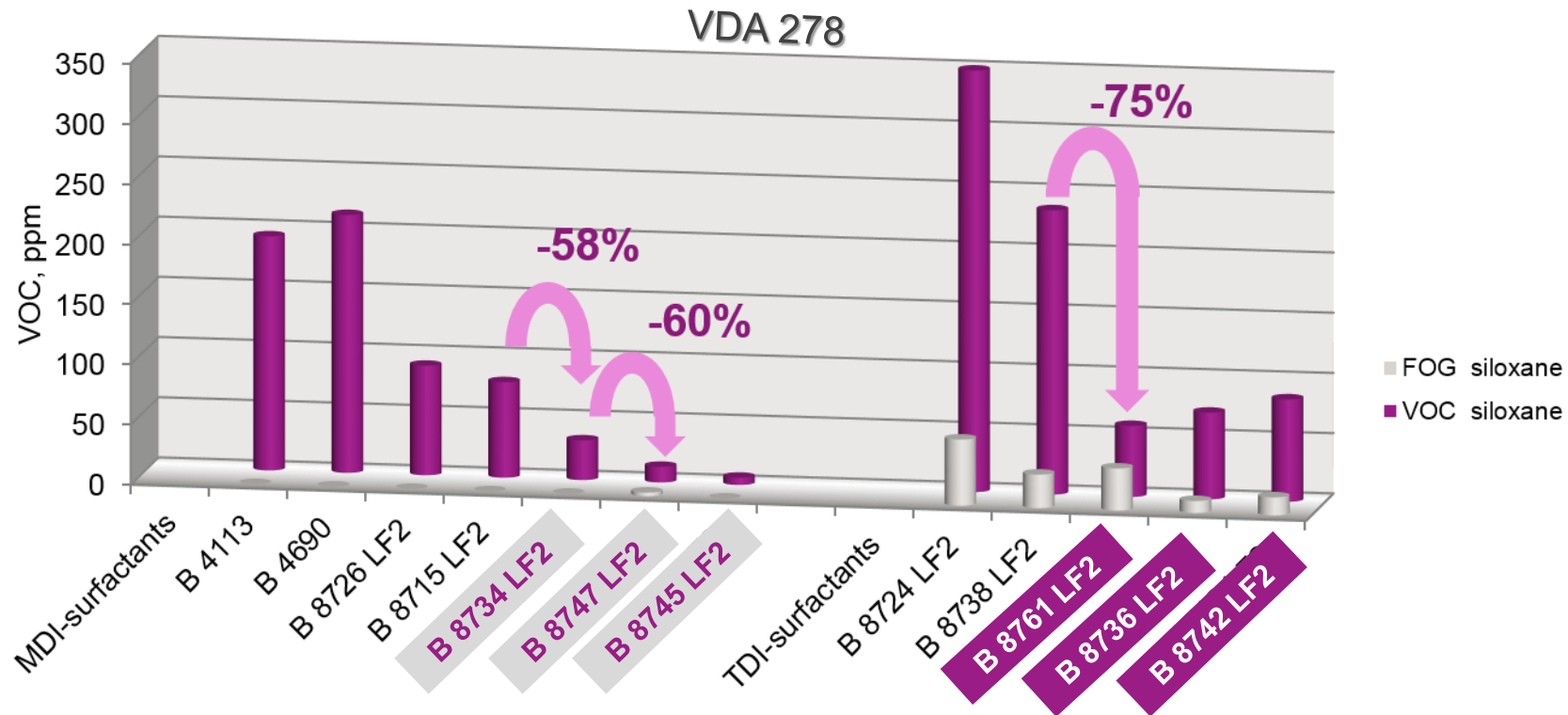




# Silicone Surfactants for Low VOC Demands



# Reducing Siloxane Emissions with TEGOSTAB® Surfactants



- All TEGOSTAB® LF2 products are phthalate-free!

*Typical emissions at 1 pphp use level, Index 95, samples taken from the foam core*

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# Non-Emissive Aldehyde Scavengers – ORTEGOL® LA 2

NESM 0402 Method #2 - Bag Test (Nissan)		
ORTEGOL® LA 2	Formaldehyde [µg/m³]	Acetaldehyde [µg/m³]
No Additive	298	58
0.2 pphp	26	<20
0.4 pphp	<20	<20

BMW GS 97014 - 1m³ Chamber Testing Results		
ORTEGOL® LA 2	Formaldehyde [µg/m³/kg]	Acetaldehyde [µg/m³/kg]
No additive	99	<20
0.2 pphp	52	<20
0.4 pphp	<20	<20

Formulation	1	2
Polyol (OH# 28)	100	100
Cell opener	1.3	0.5
Crosslinker	0.6	0.4
Water	3.5	3.5
TEGOSTAB® B 8734 LF2	1.0	1.0
DABCO® NE300	0.2	0.2
DABCO® NE1070	1.0	1.0
ORTEGOL® LA 2	-	0.4
MDI	Index varied	

- Similar foam kinetics
- Scavengers may require foam formulation optimization

# Evonik's Vision Statement for the Polyurethane Industry

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## Vision Statement:

### Polyurethane additives

- Catalysts
- Surfactants
- Release Agents
- Processing Aids

**Our vision is to be the leading additives partner to all markets in the polyurethane industry by providing additives for optimum processing and performance, while targeting the lowest emissions possible.**

# Thank you!

**Acknowledgments:**

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